GENWAL RESOURCES, INC.

CRANDALL CANYON MINE
C/015/032

2011 ANNUAL REPORT

C/015/032 Incoming
#4071
K

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 29, 2012

Re: Crandall Canyon Mines, C/015/032
2011 Annual Report

Dear Mr. Haddock:

Enclosed are two copies of the 2011 annual report.

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

Sincerely,

David Shaver
Resident Agent

RECEIVED
APR 03 2012
DIV. OF OIL, GAS & MINING

Application **for Permit Processing**
Detailed Schedule of Changes to the MRP

Title of Application:	Permit Number: 015/032
2011 annual report	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	
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Any other specific or special instructions required for insertion of this proposal into the Mining and Reclamation Plan?

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Form DOGM - C1 (Last Revised February 28, 2012) File Folder # 3

APPLICATION FOR PERMIT PROCESSING

Permit Change ☐	New Permit ☐	Renewal ☐	Transfer ☐	Exploration ☐	Bond Release ☐	Permit Number: 015/032
of Proposal 2011 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)

Signed - Name - Position - Date agent 2/27/2012

Subscribed and sworn to before me this 28th day of February 2012

Notary Public

My Commission Expires: 3-27-13

Attest: STATE OF Utah }
COUNTY OF Carbon }

LINDA KERNS
NOTARY PUBLIC • STATE of UTAH
COMMISSION # 578211
COMM. EXP. 03-27-2013

Received by Oil, Gas & Mining

RECEIVED
APR 03 2012
DIV. OF OIL, GAS & MINING

ASSIGNED TRACKING NUMBER

CHECK SHEET

Print Form | Submit by Email | Reset Form

Annual Report

This Annual Report shows information the Division has for your mine. Submit the completed document and any additional information identified in the Appendices to the Division by **March 30, 2012.** During a complete inspection an inspector will check and verify the information.

GENERAL INFORMATION

Company Name	Genwal Resources Inc.	Mine Name	Crandall Canyon Mine
Permit Number	C/015/0032	Permit expiration Date	2013-05-13
Operator Name	Genwal Resources, Inc	Phone Number	435 888-4000
Mailing Address	PO Box 910	Email	dshaver@coalsource.com
City	East Carbon		
State	UT	Zip Code	84520

		DOGM File Location or Annual Report Location
Excess Spoil Piles	☐ Required ☐ Not Required	
Refuse Piles	☐ Required ☐ Not Required	
Impoundments	☐ Required ☐ Not Required	Sediment pond certification included
Other:		

OPERATOR COMMENTS

The Crandall Mine was inactive during 2011

REVIEWER COMMENTS ☐ Met Requirements ☐ Did Not meet Requirements

COMMITMENTS AND CONDITIONS

The Permittee is responsible for ensuring annual technical commitments in the Mining and Reclamation Plan 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 additional written response is required, it should be filed as an attachment to this report.

Title: MACROINVERTEBRATE SAMPLING
Objective: To monitor macroinvertebrate populations in Crandall Creek
Frequency: Annually, during the spring and fall beginning in 2009.
Status: Spring and Fall 2011 surveys are complete. 2011 reports are due to the Division.
Reports: Submit surveys in annual report.
Citation: MRP, Volume A Text, Chapter 3, page 3-17.

Operator Comments

The Spring 2011 macroinvertebrate study is included. The fall survey has been completed and the report is still awaiting the results from the Bug Lab

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

Title: SUBSIDENCE MONITORING
Objective: To determine subsidence effects from mining. Please provide a map that shows the locations of the monitoring points to compare variations due to mining.
Frequency: Annually
Status: Ongoing.
Reports: Submit surveyed monitoring data and map to Division annually.
Citation: MRP, Volume B, Chapter 5, Section 5.25.14, page 5-25.

Operator Comments

subsidence information is included

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

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 harrass raptors, or c.) it if is prudent to insure raptor safety and/or habitat.
Status: Last survey completed in 2008. Next survey is due in 2011.
Reports: In annual report.
Citation: MRP, Volume A, Chapter 3, page 3-17.

Operator Comments

Due to the inactive status of the Crandall Mine no raptor surveys have been continued.

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

FUTURE COMMITMENTS AND CONDITIONS

The following commitments are not required for the current annual report year, but will be required by the permittee in the future as indicated by the "status" field. These commitments are included for information only, and do not currently require action. If you feel that the commitment is no longer relevant or needs to be revised, please contact the Division.

Title: RECLAMATION OF CULVERT
Objective: To reclaim part of the culverted section of the stream which provided habitat to the cutthroat trout population.
Frequency: Once during reclamation.
Status: Needs to be completed as soon as possible.
Reports: Submitted to the Division upon project completion.
Citation: MRP, Volume A, Chapter 3, page 3-16

OPERATOR COMMENTS (OPTIONAL)

REVIEWER COMMENTS

REPORTING OF OTHER TECHNICAL DATA

Please list other technical data or information that was not included in the form above, but is required under the approved plan, which must be periodically submitted to the Division.

Please list attachments:

Reviewer Comments

MAPS

Copies of mine maps, current and up-to-date through at least December 31, 2011, are to be provided to the Division as an attachment to this report in accordance with the requirements of R645-301-525.240. The map copies shall be made in accordance with 30 CFR 75.1200 as required by MSHA. Mine maps are not considered confidential.

Map Name	Map Number	Included		Confidential	
		Yes	No	Yes	No
Annual subsidence map		☐	☐	☐	☒
Mine Map		☐	☐	☐	☒
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

SEDIMENT POND CERTIFICATION

Genwal Resources, Inc.
Crandall Canyon Mine
2011 Annual Pond Certification Report

POND: Sediment Pond **LOCATION:** Crandall Canyon Mine

IMPOUNDMENTS	
(1) Stability	Slopes Stable
(2) Structural Weakness/Erosion	None Noted
(3) Potential Safety Hazards	None Noted
(4) Depth of Impounded Water	6" below "max water level" of 7773.2' allowed for iron sludge disposal
(5) Existing Storage Capacity	3.5 ac-ft
(6) Monitoring Procedures	UPDES discharge, quarterly inspection

(7) Sediment Accumulation (Elevation)	7764.2' (est, with iron sludge)
(8) Sediment Cleanout Level (Elevation)	7769.0'
(9) Principle Spillway (Elevation)	7780.81'
(10) Emergency Spillway (Elevation)	7781.81'
(11) Existing Sediment Capacity (To Cleanout)	0.29 ac-ft (est)

GENERAL	
(12) Comments/Recommendations	No discharge, sign OK, Pond cleaned and re-surveyed, December, 2009 Currently being used for temporary iron sludge storage

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 or under my direction, and include any appearances of instability, structural weakness or other hazardous conditions of the structure affecting stability.

Daniel W. Hebb
(Signature)

9/7/11
(Date)

Daniel W. Hebb
09/07/11

SUBSIDENCE INFORMATION

Shaver, Dave

From: Cody Ware [waresurveying@emerytelcom.net]
Sent: Saturday, October 22, 2011 5:37 PM
To: Shaver, Dave; Marshall, Jay
Cc: Hibbs, David
Subject: Subsidence data
Attachments: UEI - Crandall 2011 Subsidence.xls; UEI - TOWER 2011 SUBSIDENCE SURVEYS.xls

Gentlemen,

Here is the subsidence data from Crandall and Tower. There was no perceptible movement since last year's survey.

At Crandall I searched for and surveyed additional points to the South that had not been measured since 2004. Along one stretch of these points the survey shows minor upward movement (~0.4') since the 2004 survey. The points not shown on the report were destroyed by the road.

Let me know if you have any questions or need anything else.

Thanks,

Cody Ware, PLS
Ware Surveying, LLC
1344 North 1000 West
Price, UT 84501
Phone: 435-613-1266
Cell: 435-820-4335
Email: waresurveying@emerytelcom.net

UtahAmerican Energy, Inc.

Crandall Canyon Mine - Subsidence Survey

10/22/2011

YEAR			2004	2007	2008	2009	2010	2011
STATION	NORTHING (FEET)	EASTING (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)
A	413190.85	2080628.41	10440.47	10439.53	10439.43	10439.47	10439.48	10439.41
B	413095.74	2080610.92	10426.40	10425.43	10425.40	10425.41	10425.38	10425.41
C	412995.22	2080594.07	10412.27	10411.20	10411.23	10411.23	10411.16	10411.18
D	412897.30	2080578.76	10400.21	10399.21	10399.25	10399.18	10399.23	10399.24
E	412795.72	2080563.91	10385.11	10384.15	10384.18	10384.13	10384.16	10384.17
J	412296.72	2080487.65	10323.47	10323.29	10323.20	10323.15	10323.26	10323.18
N	411898.88	2080428.44	10313.15	10313.15	10313.13	10313.16	10313.16	10313.16
O	411798.12	2080415.52	10316.56	10316.49	10316.50	10316.56	10316.52	10316.56
P	411700.03	2080403.24	10321.64	10321.65	10321.65	10321.69	10321.66	10321.65
Q	411599.74	2080390.76	10326.61	---	---	---	---	10326.53
R	411550.40	2080383.83	10330.17	---	---	---	---	10330.15
S	411501.07	2080376.56	10333.65	---	---	---	---	10333.51
T	411399.27	2080366.35	10342.83	---	---	---	---	10342.74
U	411299.82	2080354.19	10349.80	---	---	---	---	10349.68
V	411247.57	2080350.11	10353.81	---	---	---	---	10353.84
W	411198.08	2080343.54	10358.03	---	---	---	---	10357.94
X	411147.67	2080337.97	10360.97	---	---	---	---	10360.78
Y	411097.90	2080332.61	10365.90	---	---	---	---	10365.78
Z	411044.53	2080331.80	10371.01	---	---	---	---	10370.93
AA	410994.37	2080331.13	10376.37	---	---	---	---	10376.27
EE	410741.97	2080325.86	10430.72	---	---	---	---	10430.86
GG	410619.62	2080334.65	10435.38	---	---	---	---	10435.09
HH	410508.23	2080321.51	10435.17	---	---	---	---	10435.63
II	410458.36	2080312.15	10433.84	---	---	---	---	10434.29
JJ	410409.35	2080302.79	10433.25	---	---	---	---	10433.73
KK	410359.98	2080292.88	10432.40	---	---	---	---	10432.87
LL	410265.30	2080265.04	10428.65	---	---	---	---	10428.57
NN	409769.08	2080125.54	10347.00	---	---	---	---	10346.66
OO	409498.68	2080210.27	10284.52	---	---	---	---	10284.27
PP	409291.54	2080286.75	10262.98	---	---	---	---	10263.41

WARE SURVEYING & ENGINEERING

G.P.S. & CONVENTIONAL SURVEYING - AUTOCAD MAPPING - CIVIL ENGINEERING

Phone: 435-613-1266

Email: waresurveying@emerytelcom.net

1344 North 1000 West

Price, Utah 84501

Olympus Aerial Surveys, Inc.
Job No 211030
Photography Dated October 20, 2011
For
UTAH AMERICAN ENERGY
CRANDALL CANYON SUBSIDENCE STUDY

			2003/2007/2009	2011	2011	
POINT	EASTING	NORTHING	ELEVATION	DIFFERENCE	ELEVATION	POINT
101	2075558.238	407296.622	8876.39	-1.92	8874.469	101
102	2075571.465	408179.127	8892.40	-1.37	8891.029	102
103	2075578.997	408784.976	8888.45	-1.00	8887.449	103
104	2075579.333	407874.899	8891.78	-1.58	8890.198	104
105	2075580.158	408490.497	8886.68	-1.09	8885.594	105
106	2075584.099	407579.859	8887.79	0.75	8888.535	106
107	2075586.078	418626.301	9200.92	-1.53	9199.387	107
108	2075589.924	409081.631	8889.69	-1.09	8888.599	108
109	2075591.674	409392.750	8892.04	-1.27	8890.773	109
110	2075596.374	409675.980	8896.29	0.24	8896.528	110
111	2075602.098	414772.964	9087.43	0.52	9087.952	111
112	2075602.211	411777.074	8947.64	-0.28	8947.357	112
113	2075602.655	415732.602	9182.08	-1.70	9180.382	113
114	2075603.148	410302.698	8906.97	-2.26	8904.711	114
115	2075604.359	410889.582	8921.77	-0.50	8921.271	115
116	2075605.536	409968.624	8900.24	-1.41	8898.829	116
117	2075608.931	413586.436	9040.25	-0.67	9039.577	117
118	2075610.583	414195.043	9064.20	-0.21	9063.993	118
119	2075611.545	413292.485	9018.93	1.21	9020.135	119
120	2075611.700	415061.373	9134.73	0.42	9135.149	120
121	2075613.550	411501.717	8936.79	-0.05	8936.744	121
122	2075614.250	412976.268	8999.48	-0.42	8999.057	122
123	2075615.021	413902.429	9054.14	0.43	9054.567	123
124	2075615.076	411181.655	8928.24	-0.77	8927.473	124
125	2075617.063	414458.204	9074.59	-0.32	9074.271	125
126	2075620.148	410574.465	8914.50	-1.61	8912.895	126
127	2075620.503	415393.849	9159.64	0.32	9159.958	127
128	2075623.045	416861.260	9211.69	-0.93	9210.756	128
129	2075623.955	412393.829	8973.96	-1.73	8972.228	129
130	2075627.162	412688.260	8987.69	-1.79	8985.899	130
131	2075627.238	412092.665	8962.62	-1.96	8960.656	131
132	2075634.137	416269.565	9226.64	-22.69	9203.948	132
133	2075636.346	417167.610	9211.23	-0.30	9210.935	133
134	2075637.108	415992.834	9187.36	-0.30	9187.059	134
135	2075663.742	417472.573	9215.66	-0.37	9215.290	135
136	2075677.553	417785.304	9258.87	0.11	9258.975	136
137	2075734.834	418090.100	9276.82	-1.35	9275.469	137
138	2075857.818	407000.991	8877.38	-1.63	8875.748	138
139	2075861.849	407297.283	8898.60	-2.26	8896.336	139
140	2075869.383	407593.316	8912.78	-1.04	8911.744	140
141	2075879.730	408201.675	8907.95	0.21	8908.164	141
142	2075880.579	408499.528	8908.48	-1.40	8907.077	142
143	2075883.995	407920.020	8911.31	-1.10	8910.210	143
144	2075884.063	408798.754	8907.68	-0.92	8906.757	144

145	2075885.406	409081.868	8905.47	0.52	8905.990	145
146	2075893.830	409396.582	8907.28	1.01	8908.292	146
147	2075896.091	410302.768	8922.96	0.68	8923.637	147
148	2075897.230	409710.735	8909.23	-0.87	8908.356	148
149	2075898.176	412098.850	8977.59	-1.33	8976.256	149
150	2075898.281	410002.259	8916.45	0.67	8917.115	150
151	2075902.609	410607.540	8930.50	-1.05	8929.455	151
152	2075904.932	412441.995	8992.88	-0.58	8992.304	152
153	2075906.072	410887.885	8933.91	-0.17	8933.739	153
154	2075906.537	411800.967	8963.81	-0.85	8962.958	154
155	2075910.837	418399.827	9247.97	-0.54	9247.427	155
156	2075911.693	411495.359	8949.50	-1.06	8948.444	156
157	2075912.006	413905.206	9072.85	-0.87	9071.980	157
158	2075912.428	411193.224	8938.56	-0.99	8937.575	158
159	2075915.948	413323.991	9032.79	-0.09	9032.703	159
160	2075933.340	413606.072	9053.21	0.70	9053.913	160
161	2075938.729	414507.997	9100.73	-0.08	9100.651	161
162	2075939.680	414222.310	9089.24	0.48	9089.719	162
163	2075942.065	415713.505	9152.47	-0.69	9151.776	163
164	2075942.534	413029.330	9019.81	-0.07	9019.742	164
165	2075945.266	414807.484	9108.55	0.22	9108.768	165
166	2075947.425	415134.430	9121.01	0.52	9121.533	166
167	2075954.765	412717.969	9008.47	-0.51	9007.959	167
168	2075955.869	417208.168	9195.05	-1.40	9193.646	168
169	2075956.113	417810.485	9206.92	-1.59	9205.326	169
170	2075956.728	416910.527	9185.21	-0.84	9184.375	170
171	2075957.722	415984.402	9161.26	-0.71	9160.548	171
172	2075958.399	418668.301	9254.23	-0.20	9254.026	172
173	2075968.471	417509.313	9201.39	-1.48	9199.915	173
174	2075973.226	416323.895	9171.02	0.66	9171.676	174
175	2075981.539	415451.954	9137.06	-0.34	9136.720	175
176	2075983.887	416621.690	9176.89	-1.68	9175.211	176
177	2076067.139	418133.417	9219.17	-1.90	9217.270	177
178	2076123.601	407301.758	8917.16	-1.39	8915.772	178
179	2076143.864	406996.867	8898.33	-1.55	8896.783	179
180	2076166.639	409403.072	8922.70	-0.53	8922.166	180
181	2076171.627	408780.167	8933.11	-1.10	8932.012	181
182	2076172.344	407544.094	8940.15	-1.36	8938.790	182
183	2076174.313	409683.486	8926.20	-0.90	8925.299	183
184	2076176.336	408177.474	8934.57	-0.32	8934.250	184
185	2076176.580	408478.025	8935.02	-1.60	8933.419	185
186	2076177.726	407868.195	8939.45	-1.49	8937.958	186
187	2076181.962	410281.182	8942.41	0.15	8942.562	187
188	2076185.412	412091.495	8994.20	-0.49	8993.711	188
189	2076190.457	411783.904	8980.12	-0.92	8979.197	189
190	2076194.002	409075.426	8929.39	0.07	8929.455	190
191	2076198.263	410570.224	8951.54	1.12	8952.664	191
192	2076201.427	409990.000	8937.67	-0.67	8936.999	192
193	2076201.878	410885.555	8953.53	-1.25	8952.280	193
194	2076204.946	413244.617	9040.41	-0.11	9040.297	194
195	2076205.167	411490.288	8968.24	-0.62	8967.625	195
196	2076205.965	412448.066	9012.06	-2.17	9009.887	196
197	2076206.827	411186.757	8957.52	-2.04	8955.477	197
198	2076226.082	413551.360	9061.49	-0.38	9061.113	198
199	2076228.595	412705.758	9022.65	-0.16	9022.491	199

200	2076229.897	414462.602	9117.75	-0.21	9117.540	200
201	2076235.431	414188.758	9110.15	-1.97	9108.179	201
202	2076236.310	412970.285	9031.86	-0.07	9031.787	202
203	2076237.532	414780.117	9124.09	-0.27	9123.824	203
204	2076238.604	413882.576	9085.82	-1.01	9084.810	204
205	2076247.454	416232.280	9187.40	-2.31	9185.095	205
206	2076249.132	416577.279	9199.99	-1.28	9198.711	206
207	2076252.094	415078.387	9136.00	-0.66	9135.345	207
208	2076252.842	417146.065	9213.97	-1.58	9212.387	208
209	2076252.914	417442.718	9221.15	-0.91	9220.240	209
210	2076253.992	416855.517	9207.89	-2.11	9205.781	210
211	2076257.427	415677.187	9167.00	-1.74	9165.261	211
212	2076259.402	418651.115	9281.93	-0.72	9281.214	212
213	2076260.496	417768.501	9223.26	-0.65	9222.615	213
214	2076260.998	415927.983	9175.92	-2.15	9173.771	214
215	2076263.282	415352.524	9150.23	-1.07	9149.157	215
216	2076272.090	418064.967	9222.04	-1.21	9220.833	216
217	2076282.160	418386.545	9232.09	-1.16	9230.930	217
218	2076463.615	407329.270	8950.17	-0.77	8949.403	218
219	2076470.880	407602.300	8969.39	-0.87	8968.520	219
220	2076474.709	407901.090	8966.96	-1.19	8965.771	220
221	2076480.924	408194.773	8962.57	-2.36	8960.208	221
222	2076482.280	408825.347	8960.76	0.47	8961.231	222
223	2076482.719	408480.438	8963.90	-0.24	8963.661	223
224	2076483.271	409103.248	8951.63	0.46	8952.088	224
225	2076489.002	410030.646	8968.69	0.85	8969.543	225
226	2076494.160	410319.213	8978.34	0.54	8978.878	226
227	2076495.764	409760.219	8954.69	-0.62	8954.070	227
228	2076498.271	410594.890	8984.15	0.42	8984.568	228
229	2076500.874	409412.088	8945.83	0.31	8946.142	229
230	2076506.936	411202.998	8984.68	-2.16	8982.522	230
231	2076509.185	411805.286	9007.54	-0.34	9007.202	231
232	2076509.593	412088.479	9023.98	-0.73	9023.250	232
233	2076513.539	410908.687	8984.68	0.34	8985.016	233
234	2076517.462	411500.781	8991.59	1.16	8992.752	234
235	2076520.030	412410.506	9042.98	-2.92	9040.065	235
236	2076529.695	412721.677	9050.56	1.39	9051.949	236
237	2076535.592	413306.264	9063.76	1.28	9065.041	237
238	2076536.725	413611.807	9082.48	NR 2011		238
239	2076538.137	413015.348	9055.08	-0.644	9054.436	239
240	2076542.870	414219.807	9139.30	0.89	9140.189	240
241	2076544.257	413921.331	9107.87	-0.02	9107.852	241
242	2076545.436	414498.907	9151.12	0.92	9152.038	242
243	2076546.203	416316.603	9222.55	-1.52	9221.033	243
244	2076548.572	416010.171	9211.27	-0.45	9210.821	244
245	2076549.921	406994.200	8930.45	-0.04	8930.414	245
246	2076551.183	416619.617	9229.39	-1.03	9228.365	246
247	2076552.515	416931.417	9238.56	-1.82	9236.744	247
248	2076558.852	415721.939	9199.27	-2.46	9196.813	248
249	2076561.909	414800.217	9161.34	-0.14	9161.202	249
250	2076562.963	415424.214	9177.35	-0.37	9176.978	250
251	2076565.805	417207.541	9247.81	-1.24	9246.569	251
252	2076566.314	418682.255	9250.13	-1.38	9248.747	252
253	2076573.688	417513.288	9256.76	0.30	9257.062	253
254	2076573.869	417827.190	9252.83	-0.59	9252.244	254

255	2076576.768	415103.258	9163.50	-0.53	9162.970	255
256	2076593.689	418139.566	9255.20	-2.16	9253.036	256
257	2076765.871	412407.014	9070.63	0.64	9071.266	257
258	2076771.863	410863.171	9031.75	-6.52	9025.232	258
259	2076773.378	407893.498	9009.75	-1.21	9008.544	259
260	2076775.162	407285.345	8985.03	-1.10	8983.929	260
261	2076775.449	408179.572	8992.26	0.43	8992.688	261
262	2076776.200	407575.592	9006.34	-0.74	9005.603	262
263	2076777.777	408473.482	8999.88	0.54	9000.424	263
264	2076781.101	408777.571	9001.91	0.69	9002.598	264
265	2076781.233	409079.505	8986.27	-0.17	8986.103	265
266	2076781.441	406992.169	8964.30	0.13	8964.428	266
267	2076785.696	409364.225	8973.20	-0.27	8972.932	267
268	2076791.695	409666.324	8981.89	0.50	8982.394	268
269	2076792.809	412095.926	9061.94	0.57	9062.507	269
270	2076795.633	409976.226	8997.35	1.60	8998.954	270
271	2076798.479	410273.776	9015.96	1.34	9017.304	271
272	2076799.839	410577.745	9031.46	0.61	9032.073	272
273	2076800.273	412651.421	9082.28	1.29	9083.566	273
274	2076803.418	411174.105	9020.89	-0.07	9020.820	274
275	2076806.850	411481.645	9017.77	3.88	9021.651	275
276	2076809.108	411774.505	9038.02	1.02	9039.042	276
277	2076821.416	412967.083	9078.82	0.16	9078.984	277
278	2076834.173	413256.739	9090.52	1.43	9091.945	278
279	2076837.820	414473.521	9185.42	-2.03	9183.393	279
280	2076839.313	413569.478	9109.60	-0.70	9108.899	280
281	2076840.829	414182.792	9154.23	0.16	9154.394	281
282	2076841.418	413881.868	9128.14	-2.42	9125.723	282
283	2076842.537	414758.913	9192.64	0.05	9192.689	283
284	2076844.513	415085.053	9192.52	-0.36	9192.165	284
285	2076852.418	415394.268	9201.34	-0.53	9200.806	285
286	2076853.449	415679.774	9224.32	-1.06	9223.259	286
287	2076854.166	416880.661	9272.51	-1.66	9270.848	287
288	2076854.226	417147.026	9282.78	-1.70	9281.082	288
289	2076858.943	416576.961	9271.33	-1.14	9270.194	289
290	2076864.493	418678.780	9287.13	-1.03	9286.097	290
291	2076865.160	418360.328	9284.68	-1.29	9283.391	291
292	2076865.909	416254.004	9266.26	0.53	9266.790	292
293	2076866.518	415980.209	9247.85	-0.24	9247.610	293
294	2076868.848	417769.759	9294.94	-3.23	9291.706	294
295	2076869.605	417463.849	9294.18	-1.75	9292.432	295
296	2076875.548	418066.460	9290.68	-2.01	9288.670	296
297	2077070.936	407582.190	9049.93	1.20	9051.126	297
298	2077072.484	407898.206	9049.77	0.08	9049.847	298
299	2077075.424	408205.126	9038.11	0.68	9038.786	299
300	2077082.042	406998.004	9053.28	NR 2011		300
301	2077082.369	408795.259	9049.73	-2.57	9047.162	301
302	2077084.788	408502.932	9048.89	-1.41	9047.482	302
303	2077086.185	409110.490	9025.30	-0.84	9024.464	303
304	2077087.389	407302.913	9045.86	NR 2011		304
305	2077094.475	409697.869	9039.97	-0.67	9039.298	305
306	2077096.245	409395.856	9039.08	-1.38	9037.699	306
307	2077099.747	410568.705	9090.47	0.23	9090.703	307
308	2077103.405	409991.461	9051.71	0.38	9052.085	308
309	2077104.545	410893.804	9068.86	1.77	9070.627	309

310	2077105.104	410296.037	9064.34	-0.11	9064.233	310
311	2077110.506	413616.441	9149.54	0.60	9150.139	311
312	2077111.236	411488.520	9064.07	1.44	9065.512	312
313	2077111.711	411791.953	9077.10	-0.53	9076.573	313
314	2077112.676	412069.697	9103.01	0.74	9103.746	314
315	2077113.972	411187.475	9073.77	0.44	9074.207	315
316	2077115.636	412718.694	9120.38	1.42	9121.795	316
317	2077116.398	413312.806	9133.89	1.32	9135.214	317
318	2077118.535	412445.617	9131.19	-2.00	9129.192	318
319	2077125.387	413009.395	9115.64	1.84	9117.475	319
320	2077135.638	414778.248	9241.11	-1.03	9240.082	320
321	2077141.396	418675.217	9326.15	-0.59	9325.558	321
322	2077144.869	413921.949	9166.32	-0.60	9165.719	322
323	2077145.358	414490.603	9220.28	0.43	9220.706	323
324	2077148.953	416050.491	9284.30	1.28	9285.577	324
325	2077149.057	418104.603	9337.27	-1.09	9336.183	325
326	2077149.713	416310.230	9312.20	-0.90	9311.303	326
327	2077151.862	416617.820	9322.82	-0.91	9321.908	327
328	2077153.409	415115.610	9236.64	0.63	9237.267	328
329	2077154.311	417495.828	9339.49	-0.61	9338.885	329
330	2077158.281	417851.766	9336.43	-0.91	9335.523	330
331	2077161.746	415737.397	9262.09	-0.01	9262.077	331
332	2077162.608	418398.411	9328.98	-2.30	9326.680	332
333	2077164.701	415408.855	9232.59	-1.02	9231.572	333
334	2077165.219	416914.972	9321.75	-1.68	9320.075	334
335	2077174.046	417227.008	9331.50	-0.14	9331.362	335
336	2077181.606	414208.077	9198.46	0.71	9199.169	336
337	2077327.144	408584.183	9118.50	-9.06	9109.436	337
338	2077341.919	409427.893	9123.69	-2.11	9121.584	338
339	2077369.243	412440.405	9181.64	0.43	9182.068	339
340	2077372.040	407304.093	9212.03	NR 2011		340
341	2077375.260	408191.709	9231.11	NR 2011		341
342	2077377.800	407936.184	9202.25	-1.13	9201.121	342
343	2077378.502	407034.029	9236.93	NR 2011		343
344	2077380.015	413587.030	9208.46	6.69	9215.142	344
345	2077394.763	409983.859	9134.71	0.24	9134.947	345
346	2077395.978	412645.274	9172.70	1.73	9174.425	346
347	2077397.366	409679.669	9140.26	-1.03	9139.230	347
348	2077399.707	411496.044	9152.86	-0.71	9152.146	348
349	2077402.652	411205.346	9155.77	-2.47	9153.296	349
350	2077402.965	412950.462	9185.55	0.20	9185.750	350
351	2077405.646	410882.927	9153.38	-1.36	9152.018	351
352	2077405.827	410221.835	9146.48	-1.88	9144.601	352
353	2077406.135	415651.618	9332.15	-1.21	9330.941	353
354	2077407.691	413278.777	9199.36	0.79	9200.151	354
355	2077409.167	407548.934	9190.99	NR 2011		355
356	2077410.252	410542.455	9154.74	-2.21	9152.529	356
357	2077413.404	415030.801	9277.00	-0.52	9276.478	357
358	2077421.588	415362.935	9314.11	1.19	9315.296	358
359	2077424.785	414470.169	9256.17	0.67	9256.840	359
360	2077426.097	416858.967	9368.46	-1.12	9367.337	360
361	2077426.868	414154.724	9238.09	0.88	9238.969	361
362	2077428.813	414723.692	9287.51	-1.41	9286.101	362
363	2077428.858	418082.652	9390.74	-1.44	9389.304	363
364	2077431.268	417772.752	9389.25	-2.00	9387.255	364

365	2077433.431	413924.580	9236.96	8.56	9245.515	365
366	2077433.603	417178.339	9378.32	-1.95	9376.367	366
367	2077433.749	408830.537	9223.80	-6.50	9217.297	367
368	2077433.974	411773.423	9178.68	0.89	9179.574	368
369	2077439.776	416550.490	9377.44	1.68	9379.120	369
370	2077441.113	412095.887	9179.68	0.21	9179.894	370
371	2077448.081	415970.215	9352.21	-0.78	9351.430	371
372	2077450.407	417472.218	9388.52	3.68	9392.204	372
373	2077459.348	418342.719	9389.59	1.96	9391.548	373
374	2077467.012	418649.456	9388.60	-0.88	9387.720	374
375	2077473.441	416249.283	9356.83	0.76	9357.583	375
376	2077486.811	409078.793	9251.42	0.72	9252.142	376
377	2077617.220	416811.723	9420.82	-0.59	9420.229	377
378	2077653.954	407389.895	9348.26	-2.18	9346.085	378
379	2077655.214	417753.204	9443.98	-0.17	9443.808	379
380	2077662.949	408527.324	9280.97	NR 2011		380
381	2077667.836	417044.337	9453.80	-2.40	9451.397	381
382	2077677.808	412398.030	9240.19	0.57	9240.762	382
384	2077705.279	409419.764	9352.05	-0.84	9351.212	384
385	2077706.029	408239.791	9388.73	0.11	9388.839	385
386	2077707.058	413860.681	9389.09	-0.22	9388.874	386
387	2077713.671	417429.568	9486.07	NR 2011		387
388	2077714.351	409715.921	9340.91	-1.59	9339.320	388
389	2077722.152	410325.622	9359.75	1.53	9361.282	389
390	2077722.785	410015.663	9340.43	-2.07	9338.361	390
391	2077722.335	412131.521	9356.95	-2.25	9354.696	391
392	2077723.462	413633.072	9390.62	4.15	9394.765	392
393	2077723.663	407928.653	9315.77	-1.72	9314.051	393
394	2077726.902	418152.914	9462.44	-0.28	9462.156	394
395	2077732.966	416598.184	9478.95	-0.66	9478.292	395
396	2077733.047	413372.927	9416.26	0.50	9416.760	396
397	2077736.450	412772.912	9392.31	-2.00	9390.314	397
398	2077736.578	410900.265	9373.43	-1.34	9372.087	398
399	2077736.685	411737.335	9374.03	1.03	9375.060	399
400	2077746.821	413109.696	9410.24	-0.22	9410.017	400
401	2077751.745	415324.085	9538.11	-0.77	9537.338	401
402	2077752.566	415932.907	9540.71	-0.49	9540.218	402
403	2077752.693	415632.986	9533.45	-1.61	9531.839	403
404	2077755.497	409050.595	9388.89	2.00	9390.885	404
405	2077758.768	408804.221	9287.39	0.37	9287.755	405
406	2077758.773	416238.547	9546.56	0.79	9547.353	406
407	2077761.250	411521.427	9389.72	0.91	9390.629	407
408	2077762.691	418677.222	9467.25	-1.40	9465.852	408
409	2077763.913	418088.944	9476.19	-2.68	9473.506	409
410	2077766.600	418385.690	9471.69	0.89	9472.583	410
411	2077767.387	411199.842	9391.99	-2.74	9389.254	411
412	2077769.532	410619.303	9288.57	-1.45	9287.116	412
413	2077774.996	407709.917	9210.22	NR 2011		413
414	2077784.328	414966.591	9438.28	-4.17	9434.107	414
416	2077977.570	417956.009	9564.72	NR 2011		416
417	2077991.702	415647.014	9651.53	0.49	9652.024	417
418	2077993.098	415373.835	9653.41	0.84	9654.250	418
419	2078009.322	416581.861	9558.67	-0.12	9558.547	419
420	2078009.957	411739.624	9527.35	0.58	9527.932	420
421	2078014.165	412604.064	9412.59	1.26	9413.847	421

422	2078015.585	410894.682	9502.72	-0.75	9501.974	422
423	2078021.702	411169.941	9524.67	1.03	9525.695	423
424	2078022.117	411423.848	9491.19	-2.65	9488.548	424
425	2078027.614	415977.361	9677.71	-0.74	9676.965	425
426	2078030.955	407686.494	9257.74	-3.16	9254.572	426
427	2078032.505	410611.536	9388.00	1.38	9389.382	427
428	2078034.658	408649.050	9309.12	NR 2011		428
429	2078038.452	409739.749	9485.93	-1.99	9483.944	429
430	2078042.377	410247.077	9492.03	5.47	9497.499	430
431	2078043.741	410015.211	9495.39	0.70	9496.092	431
432	2078045.520	408922.564	9409.45	0.33	9409.778	432
433	2078054.818	413840.001	9605.95	0.09	9606.038	433
434	2078055.142	414117.045	9624.98	-1.20	9623.778	434
435	2078057.519	408181.298	9502.93	-0.83	9502.102	435
436	2078059.763	409456.376	9551.43	-2.34	9549.095	436
437	2078063.062	413527.239	9566.96	-2.82	9564.144	437
438	2078065.623	413261.367	9594.05	-0.58	9593.470	438
439	2078083.292	412039.022	9560.52	-0.88	9559.645	439
440	2078093.765	409201.227	9571.71	-8.93	9562.778	440
441	2078110.326	417007.273	9679.84	14.47	9694.303	441
442	2078111.788	415056.226	9509.25	0.53	9509.779	442
443	2078121.857	412942.249	9596.56	0.45	9597.005	443
444	2078133.011	414433.546	9627.51	NR 2011		444
445	2078247.352	417736.019	9672.14	-3.11	9669.029	445
447	2078257.796	413864.903	9701.26	0.74	9702.003	447
448	2078267.822	414937.082	9464.01	-0.58	9463.433	448
449	2078292.610	408799.342	9420.07	2.37	9422.437	449
450	2078301.331	416532.685	9615.91	1.29	9617.199	450
451	2078311.547	409059.426	9554.78	0.20	9554.978	451
452	2078353.533	410857.308	9609.30	-0.30	9609.004	452
453	2078354.224	411137.838	9698.83	0.84	9699.666	453
454	2078364.331	413654.280	9727.04	1.77	9728.809	454
455	2078366.027	410275.851	9584.64	-3.00	9581.639	455
456	2078375.574	409395.539	9664.23	2.00	9666.227	456
457	2078383.019	410621.898	9500.49	-3.25	9497.243	457
458	2078394.824	417907.170	9770.90	2.19	9773.094	458
459	2078404.264	415701.062	9837.85	NR 2011		459
460	2078413.346	412631.116	9543.59	1.70	9545.291	460
461	2078423.908	408199.568	9577.25	2.02	9579.273	461
462	2078424.906	414154.702	9818.06	0.69	9818.752	462
463	2078426.111	415432.012	9744.31	0.67	9744.978	463
464	2078441.123	409650.144	9663.63	-0.09	9663.542	464
465	2078443.435	411709.163	9745.61	0.63	9746.244	465
466	2078456.871	417037.658	9882.24	-6.14	9876.103	466
467	2078456.885	407653.147	9384.26	-6.74	9377.522	467
468	2078457.420	413347.459	9770.04	NR 2011		468
469	2078466.935	411362.218	9709.92	-1.56	9708.361	469
470	2078468.237	413127.991	9775.58	-6.64	9768.937	470
471	2078470.900	410029.721	9675.59	0.04	9675.626	471
472	2078473.904	416770.068	9770.86	0.30	9771.162	472
473	2078474.252	416091.219	9804.42	NR 2011		473
474	2078520.643	417321.463	9885.63	5.78	9891.413	474
476	2078574.858	411906.212	9757.66	-1.51	9756.154	476
477	2078583.147	412356.375	9579.76	-3.30	9576.460	477
478	2078599.885	413888.700	9853.79	-0.08	9853.708	478

479	2078617.669	415075.189	9607.31	-1.44	9605.875	479
480	2078624.884	410291.579	9670.49	NR 2011		480
481	2078632.011	417777.743	9840.61	-3.97	9836.642	481
482	2078654.261	408803.055	9570.71	-0.77	9569.939	482
483	2078662.668	412976.862	9760.98	-0.62	9760.361	483
484	2078669.874	407939.206	9575.58	0.47	9576.045	484
485	2078670.293	409073.205	9649.18	1.19	9650.371	485
486	2078672.957	410885.248	9712.56	1.11	9713.668	486
487	2078679.036	413604.746	9845.62	1.48	9847.096	487
488	2078683.998	410559.020	9632.29	NR 2011		488
489	2078685.652	416548.919	9749.30	0.52	9749.822	489
490	2078686.464	416183.369	9830.79	0.53	9831.320	490
491	2078693.533	415733.365	9945.82	-0.21	9945.614	491
492	2078702.149	413353.352	9849.17	-3.06	9846.114	492
493	2078703.928	411118.440	9817.22	0.60	9817.820	493
494	2078718.302	416863.261	9876.30	-2.17	9874.132	494
495	2078738.455	409903.137	9805.45	-1.66	9803.786	495
496	2078791.597	417158.140	10045.50	-0.86	10044.640	496
497	2078796.984	409506.035	9870.68	0.88	9871.559	497
498	2078808.760	408483.181	9639.72	-4.95	9634.770	498
499	2078809.579	408214.750	9723.87	0.73	9724.601	499
500	2078860.561	411458.313	9911.78	-0.26	9911.519	500
501	2078862.614	412389.103	9654.45	2.29	9656.747	501
502	2078864.060	414684.834	9683.21	NR 2011		502
503	2078875.866	410193.285	9802.20	2.87	9805.065	503
504	2078876.903	407628.913	9567.12	1.89	9569.012	504
505	2078894.259	412729.500	9718.03	-1.20	9716.833	505
506	2078901.193	413948.220	10035.98	0.49	10036.473	506
507	2078902.630	410875.949	9785.92	-3.62	9782.304	507
508	2078905.403	413666.146	9983.32	0.79	9984.105	508
509	2078906.840	411721.610	9970.37	-1.69	9968.679	509
510	2078908.558	416612.253	9863.73	0.84	9864.574	510
511	2078912.617	413087.455	9834.42	1.29	9835.706	511
512	2078928.744	417892.060	10015.04	-0.62	10014.417	512
513	2078943.842	415858.289	10065.30	0.89	10066.192	513
515	2078960.541	407880.213	9666.99	1.00	9667.985	515
516	2078962.331	415478.680	9859.72	0.08	9859.796	516
517	2078999.972	410571.191	9788.40	-2.13	9786.268	517
518	2079007.439	416828.813	9968.72	-0.20	9968.525	518
519	2079007.633	417212.526	10139.86	0.73	10140.589	519
520	2079008.594	409085.598	9772.56	-0.49	9772.074	520
521	2079019.184	415010.411	9678.98	3.22	9682.202	521
522	2079024.978	408739.251	9712.95	NR 2011		522
523	2079036.729	417604.373	10023.16	-1.61	10021.544	523
524	2079047.226	408204.857	9833.19	-1.40	9831.791	524
525	2079050.768	413383.901	10038.70	-2.75	10035.950	525
526	2079165.119	411683.115	10089.68	0.99	10090.669	526
527	2079170.521	407570.344	9683.23	-1.55	9681.676	527
528	2079183.351	412745.496	9808.64	-2.88	9805.758	528
529	2079197.243	410291.942	9952.22	22.50	9974.717	529
530	2079203.057	410910.553	9976.32	-91.57	9884.753	530
532	2079211.499	415388.869	9883.57	NR 2011		532
533	2079214.744	409641.740	10035.85	-0.14	10035.709	533
534	2079230.262	415688.640	10022.37	4.82	10027.188	534
535	2079231.145	416895.453	10084.98	-0.75	10084.231	535

536	2079231.992	411202.534	10100.02	-0.15	10099.874	536
537	2079233.930	410018.925	10038.84	-1.80	10037.042	537
538	2079235.425	415115.330	9777.78	-0.93	9776.850	538
539	2079237.432	413635.948	10142.19	-0.98	10141.208	539
540	2079242.727	417757.912	10162.03	-1.79	10160.236	540
541	2079243.157	415903.618	10131.07	-0.67	10130.405	541
542	2079245.082	413832.474	10175.17	-1.14	10174.030	542
543	2079247.960	412359.203	9874.94	-6.79	9868.155	543
544	2079249.768	414265.925	9976.66	-1.83	9974.831	544
545	2079258.108	417275.659	10264.87	-1.73	10263.145	545
546	2079264.704	413083.054	9992.21	2.75	9994.958	546
547	2079286.252	407859.478	9792.44	-4.45	9787.987	547
549	2079296.109	410572.769	0.00	NR 2011		549
550	2079305.439	412087.051	0.00	NR 2011		550
551	2079309.524	413404.059	10158.47	-0.72	10157.751	551
552	2079315.179	417516.922	10215.53	-2.56	10212.972	552
553	2079319.514	408782.708	9966.68	-98.59	9868.092	553
554	2079327.312	414853.045	9943.81	NR 2011		554
555	2079328.045	408262.240	9936.82	-1.14	9935.684	555
556	2079328.690	416588.351	10031.59	-1.06	10030.526	556
557	2079348.162	409093.074	9918.97	-1.06	9917.913	557
558	2079353.155	416285.939	10048.96	NR 2011		558
559	2079417.198	408517.305	9930.79	-0.56	9930.226	559
561	2079513.802	415354.372	9974.87	0.62	9975.489	561
562	2079514.358	415671.206	10134.21	-0.07	10134.138	562
563	2079515.313	415000.281	9893.66	NR 2011		563
564	2079539.154	414604.806	9898.73	-15.39	9883.339	564
565	2079544.886	413267.894	10176.82	-1.90	10174.918	565
566	2079547.534	416894.454	10231.16	-1.17	10229.988	566
567	2079552.675	417277.174	10364.85	-1.72	10363.130	567
568	2079555.568	413537.332	10277.81	-0.97	10276.836	568
569	2079559.334	413812.992	10259.86	-1.58	10258.287	569
570	2079565.599	415950.746	10260.44	-0.39	10260.047	570
571	2079574.596	407854.713	9940.85	-1.03	9939.823	571
572	2079584.483	407612.050	9886.68	-1.71	9884.974	572
573	2079593.755	417669.223	10331.33	-3.00	10328.334	573
574	2079617.468	412775.821	10074.55	-4.21	10070.336	574
575	2079627.019	409536.688	10139.71	-0.36	10139.351	575
576	2079627.728	410672.430	10151.83	-1.18	10150.648	576
577	2079635.053	416232.892	10214.35	0.31	10214.662	577
578	2079637.739	410090.080	10194.03	-1.24	10192.791	578
579	2079640.580	411663.374	10203.92	-0.72	10203.199	579
580	2079641.980	412229.726	10102.69	-1.29	10101.398	580
581	2079646.996	411333.375	10263.44	-0.14	10263.303	581
582	2079648.732	408911.030	10032.37	0.04	10032.409	582
583	2079655.237	409261.767	10080.63	-1.00	10079.628	583
584	2079655.497	416601.362	10199.10	-1.57	10197.528	584
585	2079665.946	409842.086	10221.30	-0.52	10220.780	585
586	2079669.657	408622.731	10041.99	-0.06	10041.929	586
587	2079689.014	411996.840	10158.02	-1.66	10156.360	587
588	2079692.386	408028.867	10008.46	-0.38	10008.080	588
589	2079695.443	411068.280	10228.43	0.28	10228.713	589
590	2079695.531	412473.143	10096.03	-5.10	10090.926	590
591	2079706.441	410446.607	10163.25	4.41	10167.658	591
592	2079754.447	408298.391	10102.23	0.31	10102.540	592

595	2079835.076	414339.802	10136.82	0.83	10137.656	595
596	2079838.583	417448.923	10442.25	-1.48	10440.772	596
597	2079839.206	415984.906	10343.45	-1.71	10341.739	597
598	2079843.279	413273.770	10288.08	0.66	10288.741	598
599	2079845.115	417136.729	10429.02	-0.21	10428.812	599
600	2079850.556	415628.098	10203.15	0.02	10203.168	600
601	2079851.817	416833.319	10347.42	-1.37	10346.047	601
602	2079852.530	413534.749	10384.98	-1.13	10383.851	602
603	2079854.253	415374.458	10132.87	-2.25	10130.619	603
604	2079855.925	417727.546	10432.58	-0.84	10431.736	604
605	2079865.446	414735.680	9998.99	NR 2011		605
606	2079865.599	411663.608	10274.57	-0.67	10273.902	606
607	2079870.858	416264.634	10316.93	0.21	10317.139	607
608	2079875.569	415049.469	10111.55	-5.56	10105.986	608
609	2079904.992	413883.352	10333.65	-1.23	10332.415	609
610	2079921.059	408638.789	10139.19	-1.43	10137.765	610
611	2079934.149	416600.727	10331.37	-0.65	10330.721	611
612	2079939.244	409220.153	10181.22	-0.87	10180.351	612
614	2079953.127	410434.492	10287.82	-0.08	10287.738	614
615	2079963.134	408938.296	10152.88	0.05	10152.933	615
616	2079963.254	410132.981	10318.01	-2.22	10315.791	616
617	2079963.619	410725.586	10319.80	-0.14	10319.662	617
618	2079966.973	409534.925	10241.05	-0.60	10240.455	618
620	2079967.209	408064.802	10127.01	-1.24	10125.769	620
623	2079975.682	412788.577	10236.45	-2.47	10233.983	623
624	2079978.879	414160.443	10257.14	-0.60	10256.544	624
625	2079979.879	412165.562	10241.44	-0.73	10240.709	625
626	2079980.933	411305.126	10376.80	0.36	10377.163	626
627	2079982.695	411956.538	10268.58	0.94	10269.523	627
628	2079985.960	412537.992	10239.45	-1.42	10238.028	628
629	2079986.217	411030.844	10344.34	0.39	10344.732	629
630	2080015.532	409863.611	10354.85	0.16	10355.013	630
631	2080019.402	417136.529	10506.45	-0.59	10505.862	631
632	2080019.441	413112.649	10304.51	-2.25	10302.257	632
633	2080039.931	417499.171	10506.41	-0.88	10505.533	633
634	2080092.467	415364.712	10238.81	1.88	10240.692	634
635	2080104.500	416032.369	10433.50	-0.20	10433.297	635
636	2080124.478	416853.177	10464.64	-0.73	10463.915	636
637	2080136.305	415707.277	10335.10	2.48	10337.578	637
638	2080141.550	416562.245	10432.46	-0.15	10432.310	638
639	2080146.772	416256.511	10436.98	0.17	10437.145	639
640	2080161.223	415051.851	10223.18	1.89	10225.071	640
641	2080173.603	414738.443	10188.68	5.42	10194.091	641
642	2080200.853	411028.016	10395.72	0.33	10396.045	642
643	2080210.609	411334.784	10367.52	1.11	10368.627	643
644	2080213.252	414272.881	10317.44	-0.68	10316.761	644
645	2080215.586	410462.454	10409.27	1.82	10411.087	645
646	2080219.509	408606.565	10255.18	1.21	10256.385	646
647	2080224.983	408261.473	10292.78	0.23	10293.006	647
648	2080225.739	409220.467	10256.11	0.47	10256.575	648
649	2080235.795	414514.522	10241.51	-1.31	10240.199	649
651	2080254.400	408917.813	10236.27	2.85	10239.122	651
653	2080255.204	411634.738	10344.57	1.62	10346.191	653
654	2080259.962	410723.491	10439.31	0.59	10439.901	654
656	2080265.171	411936.302	10336.51	0.86	10337.369	656

657	2080265.352	410143.268	10390.21	1.36	10391.571	657
658	2080266.221	409837.923	10296.52	1.56	10298.083	658
659	2080271.569	409534.868	10273.98	-0.01	10273.966	659
660	2080281.706	414057.157	10385.84	1.20	10387.041	660
663	2080319.782	412220.425	10330.41	1.25	10331.657	663
664	2080322.001	412857.898	10376.13	0.63	10376.764	664
665	2080353.923	412532.165	10357.67	0.81	10358.478	665
666	2080367.658	413122.559	10447.92	-0.12	10447.800	666
667	2080399.856	417794.036	10607.25	0.44	10607.687	667
668	2080437.131	415032.685	10329.48	0.60	10330.080	668
669	2080439.271	417111.724	10638.00	1.62	10639.624	669
670	2080441.541	416829.196	10585.57	-0.10	10585.466	670
671	2080466.689	415906.014	10530.71	-2.06	10528.654	671
672	2080470.012	417432.992	10622.84	1.21	10624.050	672
673	2080477.355	416504.448	10581.37	0.15	10581.520	673
674	2080478.757	416249.518	10585.75	-0.51	10585.236	674
675	2080491.687	415347.701	10422.60	-1.32	10421.277	675
676	2080499.109	414518.836	10352.73	0.18	10352.904	676
678	2080506.543	408312.079	10281.24	-0.55	10280.693	678
679	2080521.968	414722.959	10356.46	0.42	10356.883	679
680	2080523.335	415659.194	10509.50	-0.15	10509.349	680
681	2080539.207	409837.768	10185.15	0.53	10185.682	681
682	2080550.136	408946.215	10108.68	1.79	10110.474	682
683	2080552.671	410436.037	10361.45	0.20	10361.646	683
684	2080553.641	408633.932	10158.34	-0.90	10157.439	684
685	2080553.849	410134.667	10249.97	0.96	10250.927	685
686	2080555.098	413443.178	10497.82	-0.43	10497.394	686
687	2080555.179	411634.695	10304.98	1.45	10306.429	687
688	2080555.200	411334.756	10322.36	2.09	10324.454	688
689	2080555.316	409532.545	10169.50	-0.38	10169.117	689
690	2080555.328	411034.657	10340.60	1.31	10341.907	690
691	2080555.358	412234.783	10312.51	1.15	10313.664	691
692	2080555.420	411934.680	10294.95	1.32	10296.274	692
693	2080556.224	413138.704	10443.84	-0.15	10443.689	693
695	2080575.530	410694.975	10382.69	-0.23	10382.463	695
696	2080579.683	409239.127	10118.12	1.81	10119.930	696
697	2080585.268	412526.293	10347.04	0.19	10347.231	697
700	2080640.287	412848.814	10389.99	-0.47	10389.524	700
701	2080750.467	413860.350	10557.41	0.23	10557.644	701
702	2080761.872	417129.373	10652.60	-0.75	10651.847	702
703	2080762.638	415343.103	10525.44	0.88	10526.319	703
704	2080770.087	417439.095	10617.93	-0.52	10617.413	704
705	2080770.212	417735.270	10594.43	-0.54	10593.887	705
706	2080774.145	415634.735	10582.83	2.36	10585.187	706
707	2080774.574	413577.296	10501.13	-0.97	10500.157	707
708	2080776.143	413016.266	10400.92	-0.58	10400.344	708
709	2080776.394	416284.630	10690.05	0.99	10691.035	709
710	2080781.772	416850.224	10669.26	0.60	10669.855	710
711	2080782.507	415047.417	10484.93	2.35	10487.281	711
712	2080785.706	416532.375	10683.96	1.12	10685.082	712
714	2080801.410	414733.192	10486.93	2.06	10488.992	714
715	2080823.581	415872.922	10666.63	0.32	10666.945	715
716	2080826.735	414147.403	10540.25	3.52	10543.765	716
717	2080828.099	414449.386	10501.91	-2.20	10499.713	717
718	2080837.384	413346.675	10446.92	0.39	10447.307	718

719	2080841.762	409247.766	9989.15	-1.42	9987.728	719
720	2080842.646	408338.218	10095.91	-0.48	10095.432	720
721	2080843.828	408933.106	9989.37	1.06	9990.425	721
722	2080843.842	408045.594	10157.70	0.69	10158.391	722
723	2080844.969	410130.644	10146.92	1.63	10148.554	723
725	2080852.016	409830.770	10083.44	-0.70	10082.738	725
726	2080852.352	411038.435	10288.28	0.57	10288.849	726
727	2080854.862	409520.568	10043.64	0.16	10043.801	727
728	2080855.119	411934.888	10232.48	0.14	10232.617	728
729	2080855.249	411334.551	10261.84	-0.09	10261.748	729
730	2080855.454	411634.600	10238.33	0.76	10239.090	730
731	2080856.082	412239.890	10254.69	0.20	10254.894	731
732	2080856.807	410426.817	10243.79	0.76	10244.548	732
733	2080856.922	412553.103	10303.34	0.87	10304.214	733
734	2080867.497	408545.571	10062.96	2.07	10065.031	734
735	2080872.072	410711.139	10322.62	-0.32	10322.296	735
737	2081041.903	414394.005	10579.62	0.82	10580.435	737
738	2081061.943	415670.606	10668.55	2.44	10670.990	738
739	2081061.995	417150.462	10623.48	-0.55	10622.933	739
740	2081067.022	416847.819	10661.39	0.84	10662.225	740
741	2081069.293	413867.525	10469.06	0.74	10469.802	741
742	2081069.429	417450.194	10582.76	-0.44	10582.321	742
743	2081072.774	413535.131	10418.65	0.28	10418.925	743
744	2081072.926	416227.300	10735.40	0.69	10736.090	744
745	2081073.108	416536.563	10700.55	0.48	10701.032	745
746	2081076.806	413247.379	10381.42	0.08	10381.499	746
747	2081083.629	415022.303	10587.46	-0.99	10586.469	747
748	2081083.818	417748.086	10556.77	-0.41	10556.364	748
749	2081086.028	412940.754	10327.53	0.89	10328.419	749
750	2081096.222	414136.882	10500.17	0.32	10500.486	750
753	2081123.805	408631.458	9941.93	0.74	9942.666	753
754	2081124.883	415316.386	10623.69	-0.19	10623.501	754
755	2081125.104	408083.547	10028.88	-0.60	10028.283	755
756	2081138.518	409283.972	9849.25	0.85	9850.099	756
757	2081138.817	411340.272	10185.75	0.95	10186.698	757
758	2081141.636	415912.080	10735.83	-0.17	10735.663	758
759	2081144.995	408905.563	9867.97	0.92	9868.885	759
760	2081147.161	408361.687	9958.41	0.00	9958.406	760
761	2081150.467	410694.870	10297.42	1.39	10298.813	761
762	2081155.398	412234.899	10186.95	1.208	10188.158	762
763	2081155.410	412534.840	10240.35	0.36	10240.709	763
764	2081156.998	411632.783	10150.10	0.80	10150.902	764
765	2081161.401	411950.948	10149.50	1.02	10150.521	765
766	2081162.144	409537.105	9879.58	2.16	9881.737	766
767	2081164.690	414688.581	10643.45	0.79	10644.236	767
768	2081165.396	410134.993	10057.34	1.25	10058.589	768
769	2081174.914	409850.680	9973.01	1.49	9974.495	769
770	2081189.998	411052.799	10217.54	1.15	10218.685	770
771	2081192.312	410450.222	10169.91	0.51	10170.418	771
773	2081328.319	416261.483	10711.98	0.83	10712.806	773
774	2081341.670	408216.045	9916.65	-0.51	9916.136	774
775	2081345.535	416823.136	10630.07	1.31	10631.377	775
776	2081346.262	412960.194	10246.08	1.08	10247.155	776
777	2081351.413	416538.985	10674.53	-0.10	10674.427	777
778	2081351.705	413550.500	10260.45	0.95	10261.395	778

779	2081358.267	414480.299	10478.35	0.76	10479.109	779
780	2081370.683	417143.561	10580.27	0.38	10580.645	780
781	2081371.815	417735.952	10508.89	-0.40	10508.491	781
782	2081373.295	417438.175	10538.90	0.15	10539.048	782
783	2081374.156	414102.320	10343.18	1.03	10344.205	783
784	2081396.878	418094.089	10485.18	0.84	10486.016	784
786	2081405.862	415654.987	10710.48	1.44	10711.918	786
787	2081408.943	414744.305	10558.05	0.61	10558.663	787
788	2081411.124	413265.974	10208.73	2.31	10211.044	788
789	2081412.484	415057.130	10661.54	-0.96	10660.581	789
790	2081428.814	408587.463	9787.91	2.24	9790.154	790
791	2081430.480	415924.433	10719.17	1.07	10720.239	791
792	2081434.540	413837.270	10269.85	0.52	10270.373	792
793	2081436.578	411677.059	10052.70	2.62	10055.320	793
794	2081441.803	411018.782	10176.36	0.12	10176.480	794
795	2081444.503	410489.549	10142.83	0.52	10143.350	795
796	2081444.630	409828.096	9884.48	-0.90	9883.578	796
797	2081445.958	410759.429	10220.80	0.77	10221.573	797
798	2081446.881	411342.259	10095.65	0.92	10096.574	798
799	2081448.253	415282.706	10706.99	1.21	10708.202	799
800	2081453.066	411929.692	10047.19	2.04	10049.228	800
801	2081453.344	410106.467	9995.33	0.97	9996.296	801
802	2081463.721	409178.158	9699.60	0.97	9700.569	802
803	2081464.827	412496.761	10152.68	0.48	10153.163	803
804	2081469.440	409549.846	9757.80	2.40	9760.197	804
805	2081487.957	412214.209	10090.30	-0.45	10089.847	805
806	2081490.263	408976.881	9693.58	6.07	9699.649	806
808	2081605.976	412874.146	10100.07	-0.35	10099.721	808
809	2081616.867	412996.566	10085.91	-0.63	10085.283	809
810	2081621.850	417179.770	10539.93	0.24	10540.165	810
811	2081636.492	413599.234	10125.54	1.05	10126.590	811
812	2081646.479	413930.458	10192.36	0.17	10192.529	812
813	2081648.975	415034.571	10606.04	-0.32	10605.725	813
814	2081659.309	417729.572	10450.58	-0.41	10450.169	814
815	2081665.150	416559.845	10639.57	0.00	10639.566	815
816	2081668.515	414445.928	10357.60	1.67	10359.268	816
817	2081669.259	418040.308	10439.26	1.09	10440.345	817
818	2081669.337	417447.254	10486.96	0.60	10487.561	818
819	2081672.526	414777.174	10481.34	0.04	10481.378	819
820	2081680.718	415591.353	10713.22	-0.74	10712.477	820
821	2081695.052	413302.088	10036.83	1.39	10038.222	821
822	2081698.835	414171.779	10253.26	1.26	10254.521	822
823	2081702.972	416830.341	10587.21	1.28	10588.492	823
824	2081711.113	410142.954	9966.72	2.32	9969.036	824
825	2081712.113	408639.669	9685.11	0.45	9685.559	825
827	2081725.866	411028.717	10117.18	1.80	10118.978	827
828	2081727.813	410455.064	10070.49	0.82	10071.314	828
829	2081729.480	411656.158	9942.04	1.13	9943.174	829
830	2081730.850	408134.356	9895.83	2.60	9898.429	830
831	2081733.724	408350.115	9807.42	0.70	9808.115	831
833	2081740.616	409560.826	9689.08	1.27	9690.351	833
834	2081742.314	415340.075	10687.98	-0.63	10687.351	834
835	2081749.172	412499.276	10050.34	0.15	10050.489	835
836	2081749.806	409848.031	9822.58	1.08	9823.664	836
837	2081751.171	409212.244	9604.60	0.36	9604.955	837

838	2081755.377	411926.293	9924.07	0.00	9924.070	838
840	2081767.477	410763.037	10151.78	-0.02	10151.759	840
841	2081772.641	411322.306	10027.50	1.35	10028.854	841
842	2081772.826	416221.798	10676.77	0.58	10677.354	842
843	2081775.296	412211.296	9981.36	1.10	9982.460	843
845	2081781.870	415904.332	10703.40	-0.56	10702.841	845
846	2081793.841	408909.224	9611.18	-1.40	9609.779	846
847	2081933.795	417434.982	10442.25	-0.98	10441.270	847
848	2081943.003	414449.366	10277.65	1.14	10278.792	848
849	2081959.010	415928.614	10676.13	0.71	10676.844	849
850	2081959.192	416577.681	10603.83	1.19	10605.018	850
851	2081971.391	413857.065	10017.11	-0.43	10016.681	851
852	2081971.581	415601.737	10686.17	0.72	10686.891	852
853	2081972.705	417767.246	10378.39	-1.44	10376.948	853
854	2081974.321	414727.363	10384.80	0.55	10385.347	854
855	2081979.883	415052.532	10535.16	0.58	10535.741	855
856	2081981.115	417143.739	10496.36	0.33	10496.693	856
857	2081982.460	413250.561	9876.39	3.02	9879.409	857
858	2081985.967	415356.996	10645.62	0.70	10646.324	858
859	2081989.876	413603.291	9925.16	1.87	9927.030	859
860	2081997.337	414130.780	10115.36	-0.48	10114.882	860
861	2082001.022	416156.043	10659.61	1.97	10661.584	861
862	2082004.406	418136.119	10376.08	-0.44	10375.640	862
863	2082009.019	410456.252	10020.08	1.57	10021.651	863
864	2082009.314	408700.843	9635.26	-3.33	9631.929	864
867	2082036.445	409818.553	9731.29	0.00	9731.288	867
868	2082036.503	411088.377	10039.82	1.22	10041.040	868
869	2082041.721	409590.867	9621.68	-0.13	9621.553	869
870	2082042.295	409248.218	9535.62	0.60	9536.221	870
872	2082045.725	412487.917	9837.86	0.91	9838.770	872
873	2082053.260	411954.664	9763.68	0.20	9763.878	873
876	2082055.575	416883.406	10541.75	1.77	10543.519	876
878	2082075.278	412913.598	9799.78	0.54	9800.315	878
879	2082077.259	410745.304	10108.23	0.15	10108.379	879
880	2082081.122	412163.248	9751.21	0.67	9751.883	880
881	2082095.387	411683.597	9816.63	NR 2011		881
883	2082127.601	408010.187	9933.88	0.05	9933.928	883
884	2082153.225	410116.121	9850.22	1.08	9851.300	884
885	2082158.071	408385.379	9775.07	0.28	9775.346	885
886	2082174.483	415865.057	10647.87	1.60	10649.465	886
887	2082232.217	414137.827	10048.51	1.28	10049.792	887
888	2082239.976	417797.002	10297.12	3.73	10300.848	888
889	2082243.816	417476.075	10374.33	4.52	10378.846	889
890	2082253.573	418085.889	10317.02	-1.32	10315.702	890
892	2082256.882	413493.534	9788.93	2.65	9791.577	892
893	2082264.478	413278.644	9754.43	-0.13	9754.299	893
894	2082265.691	415610.061	10628.96	1.84	10630.801	894
895	2082270.233	415346.610	10590.30	0.36	10590.661	895
896	2082282.646	416862.005	10521.71	1.15	10522.856	896
897	2082288.585	411006.291	10022.70	1.37	10024.065	897
898	2082289.020	415081.665	10488.17	0.44	10488.606	898
899	2082297.359	414459.206	10185.51	-1.35	10184.161	899
900	2082298.474	414747.546	10321.79	0.70	10322.485	900
901	2082298.832	413908.902	9927.69	0.71	9928.395	901
902	2082298.919	411927.849	9682.15	0.30	9682.449	902

904	2082308.021	408603.390	9649.75	NR 2011		904
905	2082311.682	412908.739	9727.50	-0.17	9727.329	905
906	2082319.955	416486.804	10566.20	1.26	10567.464	906
907	2082320.058	412435.034	9726.29	14.56	9740.850	907
908	2082320.320	418391.415	10356.46	-1.17	10355.290	908
909	2082327.375	409603.450	9592.28	-0.64	9591.638	909
910	2082337.906	416272.090	10549.62	1.46	10551.083	910
911	2082337.918	411723.428	9714.06	NR 2011		911
912	2082345.135	411312.384	9894.71	-1.76	9892.951	912
913	2082357.145	412198.942	9729.86	0.21	9730.068	913
914	2082363.783	410775.914	10057.49	0.40	10057.887	914
916	2082365.172	409258.721	9453.31	0.38	9453.689	916
917	2082375.501	410160.017	9820.78	0.16	9820.944	917
918	2082383.317	410496.856	9983.91	0.11	9984.018	918
920	2082396.724	408925.413	9498.78	-0.94	9497.843	920
921	2082396.992	407968.514	9873.51	0.61	9874.115	921
923	2082413.209	417162.667	10433.25	-0.62	10432.633	923
926	2082439.619	409841.570	9637.48	0.49	9637.974	926
927	2082442.422	408338.567	9772.48	-0.99	9771.495	927
928	2082492.683	417931.262	10235.46	1.00	10236.461	928
929	2082498.036	418101.110	10267.68	-1.38	10266.299	929
930	2082510.345	413899.904	9931.67	2.25	9933.921	930
932	2082548.296	417344.620	10363.05	0.48	10363.534	932
933	2082552.314	415352.745	10548.08	0.75	10548.833	933
934	2082562.451	414466.200	10200.61	2.05	10202.660	934
935	2082571.033	416817.816	10470.80	-0.06	10470.736	935
936	2082572.522	412942.159	9604.41	0.12	9604.526	936
937	2082572.757	415946.115	10389.46	0.24	10389.695	937
938	2082574.039	414724.782	10329.66	1.33	10330.990	938
939	2082577.866	415672.060	10449.44	1.74	10451.179	939
940	2082579.334	416586.674	10417.33	0.69	10418.021	940
941	2082579.357	416232.292	10383.12	0.45	10383.573	941
942	2082595.271	413169.679	9588.76	2.38	9591.140	942
943	2082604.399	408448.703	10409.61	-0.206	10409.404	943
944	2082605.045	417149.612	10409.95	NR 2011		944
945	2082616.166	413586.804	9805.17	0.69	9805.856	945
946	2082616.914	410140.692	9742.97	-0.26	9742.711	946
947	2082617.472	414135.034	10062.39	2.33	10064.717	947
948	2082622.576	409839.400	9608.38	-0.25	9608.131	948
949	2082629.936	415059.245	10476.36	2.616	10478.976	949
950	2082631.898	407772.892	9729.92	-7.84	9722.078	950
951	2082640.394	411601.928	9817.79	NR 2011		951
952	2082643.688	411316.630	9820.61	-2.62	9817.992	952
953	2082647.467	411029.440	9950.92	-1.11	9949.812	953
954	2082651.718	408006.574	9710.23	-0.02	9710.206	954
955	2082654.399	412746.181	9555.72	-3.36	9552.356	955
957	2082658.481	410468.588	9890.77	1.15	9891.924	957
958	2082659.411	408885.966	9465.11	-1.86	9463.251	958
959	2082672.454	409531.175	9478.10	0.94	9479.039	959
960	2082683.487	410761.221	9994.80	-0.32	9994.479	960
961	2082691.519	418226.750	10250.31	0.15	10250.464	961
963	2082695.565	409196.316	9345.57	-2.20	9343.368	963
966	2082713.420	412504.683	9532.78	0.62	9533.395	966
968	2082720.018	412050.577	9515.51	-1.78	9513.726	968
971	2082785.241	418027.332	10200.61	-0.27	10200.341	971

972	2082814.539	412937.111	9540.30	-0.29	9540.013	972
973	2082820.349	408605.559	9548.87	1.53	9550.404	973
974	2082826.476	414975.310	10442.39	2.97	10445.355	974
975	2082833.033	416227.440	10223.04	0.96	10224.004	975
976	2082847.348	413290.620	9745.80	1.78	9747.581	976
977	2082861.898	414491.186	10272.59	2.34	10274.932	977
978	2082869.439	415324.243	10443.68	1.77	10445.454	978
979	2082876.684	413840.316	10000.66	4.96	10005.615	979
980	2082888.592	412735.856	9482.78	0.85	9483.625	980
981	2082888.772	417139.247	10364.65	0.59	10365.236	981
982	2082901.560	415921.687	10194.71	0.47	10195.181	982
983	2082904.086	417546.023	10245.22	0.01	10245.229	983
984	2082909.213	414167.222	10161.46	2.15	10163.611	984
985	2082909.566	416840.000	10327.31	0.74	10328.045	985
986	2082911.342	409264.063	9310.46	0.88	9311.343	986
987	2082923.695	408493.325	9552.69	6.12	9558.811	987
988	2082927.029	410740.147	9974.96	0.20	9975.162	988
989	2082927.255	409497.331	9419.86	2.06	9421.921	989
990	2082927.399	410125.566	9647.85	0.14	9647.986	990
991	2082929.582	416630.626	10244.12	0.83	10244.951	991
992	2082930.551	412591.403	9439.98	-1.39	9438.587	992
993	2082938.442	408156.655	9529.14	1.88	9531.022	993
994	2082938.597	412126.838	9436.80	0.11	9436.906	994
995	2082944.666	410437.537	9860.52	0.09	9860.605	995
996	2082951.618	408898.164	9406.47	1.20	9407.673	996
997	2082956.980	411596.725	10252.59	NR 2011		997
998	2082959.469	415615.709	10254.86	0.18	10255.044	998
999	2082964.353	411029.795	9894.67	-0.44	9894.234	999
1000	2082984.086	409809.377	9557.04	2.99	9560.030	1000
1002	2083009.774	418249.531	10197.66	0.19	10197.854	1002
1003	2083009.806	414742.666	10332.29	2.14	10334.431	1003
1004	2083023.143	413411.749	9847.52	2.08	9849.603	1004
1005	2083039.326	411292.796	9761.85	NR 2011		1005
1008	2083118.855	416273.909	10077.13	2.25	10079.376	1008
1009	2083126.334	417994.830	10120.98	0.25	10121.231	1009
1011	2083134.952	409888.367	9576.31	-2.16	9574.149	1011
1013	2083136.874	415028.959	10327.27	1.30	10328.574	1013
1015	2083148.094	414158.605	10171.45	1.43	10172.877	1015
1016	2083161.013	415965.411	10064.70	1.70	10066.404	1016
1017	2083165.544	415688.182	10131.54	0.52	10132.058	1017
1018	2083169.990	412898.372	9646.54	0.59	9647.131	1018
1019	2083175.803	417559.492	10202.50	0.20	10202.696	1019
1022	2083191.038	417084.357	10327.59	0.81	10328.396	1022
1023	2083195.153	414499.319	10232.93	2.39	10235.321	1023
1024	2083196.633	410713.631	9956.38	1.97	9958.347	1024
1025	2083205.691	418452.023	10209.98	0.31	10210.287	1025
1026	2083210.065	409545.190	9400.87	-0.06	9400.806	1026
1027	2083211.077	412317.435	9350.89	-0.62	9350.267	1027
1028	2083220.509	409259.435	9265.85	1.85	9267.702	1028
1029	2083223.566	408888.490	9331.21	-0.16	9331.046	1029
1030	2083238.133	408447.397	9406.83	0.91	9407.737	1030
1031	2083240.687	415381.134	10257.82	1.82	10259.644	1031
1032	2083267.394	411408.047	9665.78	-2.01	9663.773	1032
1033	2083290.655	411795.507	9504.96	NR 2011		1033
1034	2083298.156	412557.376	9485.95	1.88	9487.827	1034

1035	2083299.905	410202.947	9709.90	1.56	9711.457	1035
1036	2083306.370	413856.798	10114.26	1.78	10116.042	1036
1037	2083322.323	418182.473	10124.68	-0.44	10124.241	1037
1038	2083325.250	410737.225	9944.70	1.84	9946.539	1038
1039	2083346.104	411094.410	9790.56	-0.81	9789.753	1039
1040	2083374.575	416695.640	10087.62	0.46	10088.079	1040
1041	2083377.450	408131.259	9371.26	-8.83	9362.428	1041
1043	2083406.210	413346.636	9833.11	1.82	9834.927	1043
1044	2083413.909	415048.975	10249.42	1.69	10251.106	1044
1045	2083421.929	416001.105	9957.21	1.15	9958.360	1045
1046	2083427.939	416397.639	9984.88	0.98	9985.859	1046
1047	2083429.956	417859.630	10074.30	2.24	10076.539	1047
1048	2083434.433	417088.436	10294.13	0.11	10294.239	1048
1049	2083462.230	415685.959	10030.94	1.45	10032.386	1049
1050	2083484.647	411330.464	9629.98	-2.27	9627.706	1050
1051	2083492.930	414802.379	10179.22	1.17	10180.389	1051
1052	2083494.395	417511.437	10174.70	1.56	10176.261	1052
1053	2083496.954	409980.006	9595.27	-3.34	9591.927	1053
1054	2083503.074	409614.121	9437.77	1.67	9439.441	1054
1056	2083504.688	408871.787	9263.32	-1.72	9261.606	1056
1057	2083505.053	410515.421	9762.92	1.80	9764.724	1057
1058	2083506.547	411862.204	9413.49	-5.79	9407.705	1058
1060	2083512.582	412238.427	9276.28	-0.27	9276.013	1060
1064	2083528.852	409270.939	9261.22	1.67	9262.889	1064
1065	2083529.130	412627.586	9528.49	0.70	9529.192	1065
1066	2083531.981	414551.463	10113.66	2.32	10115.976	1066
1069	2083551.830	413917.513	10040.21	1.67	10041.883	1069
1070	2083555.674	414386.353	10073.31	1.52	10074.826	1070
1071	2083558.214	407710.410	9658.17	2.36	9660.532	1071
1072	2083573.955	410140.768	9601.32	2.16	9603.479	1072
1075	2083630.115	418459.299	10019.80	-0.58	10019.218	1075
1076	2083633.692	418187.191	9990.47	0.87	9991.343	1076
1077	2083643.536	415429.420	10098.72	1.90	10100.621	1077
1078	2083699.046	417138.428	10259.37	0.65	10260.017	1078
1079	2083700.683	415139.157	10163.05	0.89	10163.942	1079
1080	2083708.936	416844.277	10104.78	1.90	10106.677	1080
1081	2083717.821	416277.534	9875.28	1.61	9876.888	1081
1082	2083745.390	411576.379	9426.17	10.55	9436.714	1082
1083	2083751.124	417844.029	10025.07	2.20	10027.267	1083
1084	2083754.764	415971.286	9860.70	1.10	9861.798	1084
1085	2083785.542	410142.417	9548.87	2.56	9551.431	1085
1086	2083787.537	418111.713	9955.31	0.31	9955.616	1086
1087	2083788.186	415751.726	9904.06	0.69	9904.751	1087
1088	2083789.657	412164.511	9152.31	0.10	9152.408	1088
1089	2083792.086	413902.088	9911.57	-0.23	9911.336	1089
1090	2083796.592	409783.991	9449.09	0.30	9449.389	1090
1091	2083799.915	413494.538	9877.19	5.85	9883.043	1091
1092	2083807.478	417501.199	10138.91	2.02	10140.926	1092
1093	2083831.829	409491.678	9287.69	3.18	9290.870	1093
1094	2083835.456	414167.622	9929.51	0.89	9930.397	1094
1097	2083848.864	414811.330	10088.65	2.52	10091.174	1097
1099	2083861.769	408381.432	9324.86	NR 2011		1099
1100	2083870.199	414505.957	9980.40	1.79	9982.186	1100
1101	2083879.997	408975.239	9075.50	NR 2011		1101
1102	2083886.992	408070.466	9501.40	NR 2011		1102

1103	2083891.549	407767.406	9659.79	2.15	9661.944	1103
1105	2083900.711	416481.667	9919.48	0.92	9920.403	1105
1106	2083911.176	408654.091	9207.27	NR 2011		1106
1107	2083912.602	410708.307	9649.62	1.25	9650.874	1107
1108	2083925.493	409250.353	9162.01	-1.84	9160.173	1108
1109	2083929.727	417153.032	10231.34	1.59	10232.927	1109
1110	2083937.026	412588.622	9416.86	2.57	9419.427	1110
1113	2083967.806	418458.663	9950.75	0.94	9951.690	1113
1114	2083996.763	413243.400	9747.90	-0.04	9747.863	1114
1115	2084009.237	413624.356	9777.09	1.09	9778.175	1115
1116	2084012.198	415062.472	10119.29	2.63	10121.916	1116
1117	2084019.824	410968.131	9541.93	2.22	9544.147	1117
1118	2084020.067	415433.249	9954.91	0.60	9955.514	1118
1119	2084029.412	413004.470	9643.09	0.40	9643.491	1119
1120	2084030.209	418057.638	9853.24	0.89	9854.127	1120
1121	2084055.731	411691.288	9185.13	NR 2011		1121
1122	2084061.140	417617.853	10040.05	0.17	10040.223	1122
1123	2084106.922	416894.324	10109.06	0.76	10109.821	1123
1124	2084107.025	415797.893	9763.43	0.48	9763.912	1124
1125	2084129.660	416102.377	9730.84	1.24	9732.078	1125
1126	2084137.169	412236.299	9237.56	1.17	9238.726	1126
1127	2084146.966	414061.314	9768.12	0.82	9768.942	1127
1128	2084150.490	410345.623	9547.33	1.34	9548.671	1128
1129	2084153.409	411995.563	9002.97	-0.42	9002.553	1129
1130	2084155.858	410097.338	9419.38	3.70	9423.076	1130
1131	2084161.262	414307.508	9817.27	0.52	9817.786	1131
1132	2084168.097	414720.708	9988.65	2.09	9990.740	1132
1133	2084174.150	409726.709	9219.82	1.29	9221.110	1133
1134	2084179.366	411342.879	9354.90	22.58	9377.478	1134
1135	2084189.389	417193.250	10199.48	0.66	10200.144	1135
1136	2084207.279	416588.720	9927.96	1.38	9929.338	1136
1140	2084267.899	413329.465	9648.36	3.31	9651.665	1140
1141	2084277.031	410564.348	9585.97	2.11	9588.076	1141
1143	2084290.575	408538.022	9311.45	NR 2011		1143
1144	2084291.986	408230.380	9492.77	2.38	9495.147	1144
1145	2084295.297	412632.842	9460.86	2.15	9463.009	1145
1146	2084301.586	409479.567	9154.02	2.78	9156.804	1146
1147	2084305.008	407783.205	9719.48	-0.48	9718.998	1147
1148	2084307.367	408833.854	9129.20	NR 2011		1148
1149	2084310.672	415131.070	10016.31	1.28	10017.594	1149
1150	2084326.167	411140.238	9320.04	1.92	9321.964	1150
1151	2084343.662	417888.585	9867.79	0.67	9868.457	1151
1152	2084359.420	415443.433	9837.39	1.31	9838.700	1152
1153	2084360.343	413899.500	9670.38	-0.05	9670.329	1153
1154	2084370.300	414262.633	9792.39	2.10	9794.489	1154
1157	2084385.272	418084.074	9776.37	1.98	9778.354	1157
1158	2084387.420	418463.144	9825.93	-1.84	9824.093	1158
1159	2084390.968	417267.173	10145.97	0.45	10146.423	1159
1160	2084393.708	409214.066	8980.60	-0.19	8980.412	1160
1161	2084396.693	408042.007	9558.81	NR 2011		1161
1162	2084408.087	417656.246	9948.93	1.52	9950.447	1162
1163	2084409.220	414528.611	9892.45	1.60	9894.046	1163
1164	2084409.338	416002.247	9666.12	1.56	9667.681	1164
1165	2084421.149	413063.412	9585.44	2.26	9587.699	1165
1166	2084425.543	414947.276	10051.67	2.01	10053.681	1166

1167	2084425.716	413615.470	9577.08	7.61	9584.687	1167
1169	2084474.189	415665.096	9721.85	3.54	9725.393	1169
1170	2084480.327	416685.710	9886.66	1.48	9888.139	1170
1171	2084481.361	416245.738	9709.24	3.21	9712.455	1171
1172	2084566.412	416859.644	9926.14	2.21	9928.345	1172
1173	2084575.995	411895.477	8899.70	4.92	8904.619	1173
1174	2084583.568	411473.208	9069.54	NR 2011		1174
1175	2084589.584	412293.019	9196.15	0.16	9196.305	1175
1176	2084600.723	415340.678	9812.93	2.11	9815.039	1176
1177	2084610.238	410134.772	9407.08	2.13	9409.214	1177
1178	2084611.929	414785.520	10016.63	1.51	10018.140	1178
1179	2084621.454	412617.179	9396.12	0.77	9396.891	1179
1180	2084630.831	414189.755	9752.88	3.55	9756.434	1180
1181	2084633.414	413277.444	9475.60	2.80	9478.396	1181
1182	2084642.730	415066.982	9955.03	2.42	9957.450	1182
1183	2084646.865	410672.962	9488.18	2.99	9491.168	1183
1184	2084647.897	410472.402	9558.08	0.99	9559.068	1184
1185	2084652.777	414497.343	9894.39	2.14	9896.528	1185
1186	2084656.939	407715.413	9512.70	-0.10	9512.603	1186
1187	2084657.242	413900.189	9601.28	1.08	9602.358	1187
1188	2084659.525	417300.769	10051.91	0.29	10052.197	1188
1189	2084673.262	418033.371	9759.78	-0.53	9759.247	1189
1190	2084675.430	418476.162	9752.88	1.07	9753.947	1190
1191	2084676.902	410940.257	9378.72	NR 2011		1191
1192	2084688.819	409568.516	9063.66	0.34	9064.003	1192
1194	2084699.531	409247.748	8944.68	0.69	8945.371	1194
1195	2084701.183	412953.099	9433.71	0.34	9434.053	1195
1196	2084701.933	408210.023	9410.77	NR 2011		1196
1197	2084704.635	417715.639	9889.08	1.30	9890.378	1197
1199	2084724.262	409854.540	9253.27	1.28	9254.546	1199
1200	2084733.242	415538.053	9701.61	1.68	9703.288	1200
1201	2084733.818	408447.372	9279.73	NR 2011		1201
1202	2084745.768	415862.404	9643.88	0.80	9644.683	1202
1203	2084747.621	408976.418	8992.05	NR 2011		1203
1205	2084787.612	416960.865	9899.42	0.53	9899.953	1205
1207	2084803.486	413586.068	9445.56	12.98	9458.541	1207
1208	2084807.808	416292.557	9678.30	1.43	9679.727	1208
1209	2084809.829	408002.247	9483.39	NR 2011		1209
1212	2084864.155	417352.952	9965.14	0.55	9965.693	1212
1213	2084872.008	416108.752	9651.49	3.58	9655.073	1213
1214	2084888.061	414777.810	10047.31	2.23	10049.544	1214
1215	2084898.268	414206.405	9755.94	3.14	9759.081	1215
1216	2084910.545	418445.815	9698.22	-0.42	9697.804	1216
1217	2084922.018	412394.653	9268.33	-0.92	9267.414	1217
1218	2084927.855	413283.427	9300.32	1.33	9301.653	1218
1219	2084933.245	414482.987	9905.21	1.08	9906.290	1219
1220	2084945.040	415387.822	9705.20	1.86	9707.061	1220
1221	2084946.731	416541.110	9694.70	-0.61	9694.089	1221
1222	2084949.622	415095.256	9852.25	-0.10	9852.152	1222
1223	2084950.974	412164.329	9062.68	0.20	9062.880	1223
1224	2084967.907	411186.482	9156.57	NR 2011		1224
1225	2084971.048	413916.100	9619.30	5.53	9624.828	1225
1226	2084978.256	417043.783	9860.54	0.92	9861.456	1226
1227	2084983.358	412994.074	9262.48	-0.21	9262.274	1227
1228	2084984.163	418052.077	9707.34	-0.83	9706.507	1228

1229	2084988.197	409296.253	8884.19	0.02	8884.210	1229
1230	2084992.310	415606.703	9631.83	3.36	9635.185	1230
1231	2085013.226	412681.436	9205.49	2.38	9207.871	1231
1232	2085016.434	409009.440	8955.07	NR 2011		1232
1233	2085026.961	410478.571	9521.27	0.96	9522.230	1233
1234	2085042.485	407436.431	9259.72	1.69	9261.413	1234
1235	2085044.147	411840.299	8808.69	2.87	8811.562	1235
1236	2085049.623	417719.847	9809.80	2.19	9811.988	1236
1237	2085054.918	407769.943	9310.95	1.74	9312.691	1237
1238	2085067.242	411512.583	8930.21	NR 2011		1238
1239	2085068.048	410136.312	9333.16	1.61	9334.768	1239
1241	2085081.727	408142.841	9382.23	0.09	9382.323	1241
1242	2085116.823	413580.896	9464.23	-3.30	9460.934	1242
1243	2085118.866	409570.418	8977.56	1.41	8978.968	1243
1244	2085146.835	416279.746	9566.59	3.40	9569.994	1244
1245	2085149.131	417389.805	9900.29	0.23	9900.520	1245
1246	2085150.899	408505.282	9202.67	NR 2011		1246
1247	2085159.278	409802.120	9163.27	-0.31	9162.965	1247
1248	2085165.741	418490.949	9698.66	-0.27	9698.393	1248
1249	2085167.926	415869.312	9575.27	1.23	9576.497	1249
1250	2085196.658	414178.183	9743.61	-1.31	9742.298	1250
1251	2085215.401	414764.044	9943.02	-0.97	9942.046	1251
1252	2085219.122	414487.673	9891.85	-0.72	9891.135	1252
1253	2085222.594	409157.379	8853.02	-0.96	8852.057	1253
1254	2085243.970	415105.963	9778.89	-0.87	9778.022	1254
1255	2085245.575	413316.491	9326.17	-6.68	9319.493	1255
1256	2085245.783	417107.040	9787.57	-4.14	9783.427	1256
1257	2085247.679	413898.190	9643.69	4.25	9647.938	1257
1258	2085247.798	416693.982	9654.03	0.81	9654.842	1258
1259	2085252.668	415388.477	9657.79	1.18	9658.965	1259
1260	2085255.229	412989.660	9119.63	-0.48	9119.151	1260
1261	2085285.425	418069.694	9637.54	-0.82	9636.716	1261
1262	2085288.420	412448.527	8996.35	-5.87	8990.481	1262
1263	2085337.511	415655.462	9517.44	-1.17	9516.269	1263
1264	2085356.409	413571.013	9485.95	-2.17	9483.781	1264
1265	2085361.361	417746.588	9745.27	0.48	9745.750	1265
1266	2085362.422	412684.307	8946.34	-2.44	8943.901	1266
1267	2085401.500	412179.691	8892.80	-1.48	8891.325	1267
1268	2085421.119	409806.459	9167.41	2.37	9169.777	1268
1269	2085427.683	408906.306	8913.09	NR 2011		1269
1270	2085432.155	417409.335	9875.56	-0.66	9874.900	1270
1271	2085451.462	408329.003	9231.92	-1.52	9230.399	1271
1272	2085452.450	418484.828	9652.68	-1.42	9651.262	1272
1273	2085461.917	413829.670	9638.18	-0.35	9637.835	1273
1274	2085477.156	409552.917	8940.05	0.55	8940.598	1274
1275	2085486.195	410478.830	9519.11	-5.31	9513.803	1275
1276	2085486.682	416216.955	9452.16	-2.72	9449.445	1276
1277	2085489.699	411844.079	8742.83	NR 2011		1277
1278	2085501.529	407888.781	9166.76	-0.92	9165.838	1278
1279	2085503.212	410185.261	9368.15	1.16	9369.312	1279
1280	2085509.395	415872.627	9498.25	0.92	9499.167	1280
1282	2085517.245	407498.433	8996.76	2.98	8999.741	1282
1283	2085523.931	414772.996	9810.83	-2.24	9808.595	1283
1284	2085530.083	415084.342	9659.46	-1.88	9657.579	1284
1285	2085532.225	418699.932	9733.30	-0.98	9732.317	1285

1286	2085532.443	416938.862	9659.66	-2.54	9657.116	1286
1287	2085534.566	408126.472	9142.65	-0.09	9142.560	1287
1288	2085550.704	415384.289	9546.85	-1.00	9545.852	1288
1289	2085551.293	416634.136	9538.34	-1.40	9536.938	1289
1290	2085552.646	414210.309	9753.60	0.45	9754.052	1290
1291	2085554.432	413294.841	9403.71	-1.68	9402.034	1291
1292	2085558.085	414565.563	9910.84	-0.03	9910.813	1292
1293	2085567.491	418077.424	9571.66	0.12	9571.780	1293
1294	2085576.378	411100.734	9204.34	NR 2011		1294
1295	2085599.529	409279.139	8800.45	1.91	8802.361	1295
1296	2085610.734	417175.191	9754.69	-2.52	9752.171	1296
1297	2085629.519	417740.436	9714.08	-0.57	9713.511	1297
1298	2085674.724	412920.547	9210.08	-0.07	9210.012	1298
1299	2085680.295	413590.972	9568.56	-1.64	9566.916	1299
1300	2085680.723	417447.179	9842.30	0.36	9842.662	1300
1301	2085691.777	412632.076	8985.84	-1.73	8984.115	1301
1302	2085746.748	418442.036	9582.36	0.17	9582.526	1302
1303	2085775.259	416409.361	9341.41	0.27	9341.680	1303
1304	2085778.168	410053.619	9240.52	2.56	9243.084	1304
1305	2085779.904	416036.905	9407.13	0.91	9408.042	1305
1307	2085789.289	415666.264	9322.07	0.00	9322.068	1307
1308	2085816.041	408347.421	9031.67	-11.29	9020.383	1308
1309	2085818.378	413893.604	9696.39	-0.25	9696.141	1309
1310	2085820.483	418062.112	9544.63	-0.96	9543.670	1310
1311	2085824.871	410521.382	9453.28	0.08	9453.357	1311
1312	2085829.305	414307.711	9769.27	0.96	9770.230	1312
1313	2085840.888	413295.211	9446.33	-1.24	9445.087	1313
1314	2085843.788	409708.918	9015.02	2.29	9017.313	1314
1315	2085847.377	411236.002	9078.01	NR 2011		1315
1316	2085852.218	415087.739	9633.34	-2.17	9631.166	1316
1317	2085852.818	416633.935	9436.50	7.99	9444.492	1317
1318	2085861.238	409093.047	8766.51	1.13	8767.636	1318
1319	2085872.908	416969.173	9595.17	0.47	9595.640	1319
1320	2085877.074	407675.693	8898.85	-1.32	8897.530	1320
1321	2085884.224	410839.724	9324.17	NR 2011		1321
1322	2085893.117	415383.401	9521.48	-0.26	9521.222	1322
1323	2085897.078	408024.533	8898.48	0.02	8898.495	1323
1324	2085898.364	411967.723	8664.78	NR 2011		1324
1325	2085915.538	412306.330	8813.19	-0.19	8813.003	1325
1326	2085918.211	414762.976	9814.44	-2.15	9812.292	1326
1327	2085923.328	409408.426	8819.49	0.59	8820.076	1327
1328	2085940.494	408713.549	8904.98	-0.92	8904.057	1328
1329	2085966.660	418324.805	9402.97	0.34	9403.314	1329
1330	2085975.628	418624.577	9556.89	6.50	9563.393	1330
1332	2086002.143	409878.211	9165.99	1.34	9167.334	1332
1333	2086027.832	417747.924	9676.15	-0.91	9675.245	1333
1334	2086032.733	407444.845	8933.80	1.41	8935.212	1334
1335	2086041.053	414869.475	9751.65	-0.70	9750.948	1335
1336	2086046.761	412803.570	9091.91	-2.28	9089.635	1336
1337	2086052.894	416184.018	9284.81	-0.91	9283.902	1337
1338	2086085.837	410241.843	9332.10	0.95	9333.045	1338
1339	2086088.885	415843.918	9207.95	2.72	9210.672	1339
1340	2086095.593	413498.497	9490.70	2.13	9492.828	1340
1341	2086098.857	414208.380	9702.07	1.73	9703.801	1341
1342	2086099.018	417220.033	9686.97	0.33	9687.301	1342

1343	2086105.800	413676.079	9567.99	7.05	9575.038	1343
1344	2086128.610	411164.224	9177.83	NR 2011		1344
1345	2086136.141	410551.745	9497.48	1.66	9499.141	1345
1346	2086156.398	415309.722	9512.17	-1.65	9510.525	1346
1347	2086160.907	414443.218	9749.20	0.49	9749.694	1347
1348	2086161.289	418046.164	9515.06	-0.03	9515.035	1348
1349	2086163.233	414648.656	9750.90	1.70	9752.599	1349
1350	2086188.262	413295.760	9387.39	-0.74	9386.648	1350
1351	2086196.405	408280.713	8784.34	1.17	8785.513	1351
1352	2086225.618	418398.784	9343.19	-1.60	9341.590	1352
1353	2086239.631	413030.627	9256.68	-0.45	9256.234	1353
1354	2086241.186	416955.572	9564.13	0.81	9564.935	1354
1355	2086250.074	409441.022	8840.67	-9.79	8830.879	1355
1356	2086252.761	408019.583	8804.27	NR 2011		1356
1357	2086269.848	414999.756	9621.88	0.97	9622.846	1357
1358	2086271.777	408540.610	8754.40	1.28	8755.676	1358
1359	2086291.801	416653.226	9355.81	-4.75	9351.057	1359
1360	2086299.375	418727.723	9453.10	-2.15	9450.951	1360
1361	2086317.581	417738.590	9659.22	0.10	9659.322	1361
1362	2086328.030	417044.618	9600.53	1.32	9601.847	1362
1363	2086328.325	409143.252	8709.79	2.00	8711.789	1363
1364	2086335.333	410595.985	9416.68	0.73	9417.411	1364
1365	2086343.236	412589.959	8896.76	0.48	8897.241	1365
1366	2086348.562	411771.337	8730.43	NR 2011		1366
1367	2086349.628	414496.877	9715.57	1.97	9717.536	1367
1368	2086350.339	417457.992	9751.06	0.19	9751.254	1368
1369	2086351.580	408850.323	8715.54	3.45	8718.991	1369
1370	2086360.523	407785.671	8915.28	NR 2011		1370
1371	2086367.216	407274.805	9066.75	NR 2011		1371
1372	2086370.383	416263.066	9037.06	2.92	9039.978	1372
1373	2086378.844	410266.821	9328.51	2.99	9331.501	1373
1374	2086382.350	416458.368	9205.57	0.88	9206.446	1374
1375	2086399.029	413710.900	9422.14	-0.36	9421.777	1375
1376	2086413.631	411090.210	9162.66	NR 2011		1376
1377	2086421.258	413008.660	9226.39	-2.25	9224.142	1377
1378	2086441.732	415292.056	9464.91	1.51	9466.415	1378
1379	2086454.266	407597.640	9033.60	NR 2011		1379
1380	2086465.783	416856.105	9475.76	-2.61	9473.150	1380
1381	2086471.540	418122.833	9437.84	2.10	9439.943	1381
1383	2086479.295	409910.633	9206.34	1.12	9207.459	1383
1384	2086496.747	414792.288	9603.06	NR 2011		1384
1385	2086503.385	414082.248	9562.91	-1.87	9561.039	1385
1386	2086520.899	412263.280	8674.20	2.41	8676.614	1386
1387	2086530.645	418875.103	9403.74	-2.06	9401.676	1387
1388	2086541.350	413368.569	9274.77	-0.91	9273.865	1388
1389	2086554.851	410711.714	9322.43	2.64	9325.071	1389
1390	2086573.944	409143.048	8679.30	1.72	8681.019	1390
1391	2086576.603	416004.785	9031.85	3.97	9035.818	1391
1392	2086587.951	418517.599	9216.61	-0.63	9215.978	1392
1393	2086590.151	411494.115	8864.65	NR 2011		1393
1394	2086594.484	409521.522	8839.07	-1.02	8838.049	1394
1395	2086599.624	413551.857	9262.93	6.84	9269.771	1395
1396	2086607.136	414318.419	9674.31	1.82	9676.134	1396
1397	2086650.547	413907.010	9452.25	-0.36	9451.888	1397
1398	2086659.841	412522.355	8793.20	1.35	8794.548	1398

1399	2086662.619	415657.692	9163.87	NR 2011		1399
1400	2086663.788	410178.504	9174.17	-1.76	9172.414	1400
1401	2086668.039	417572.559	9690.95	0.74	9691.691	1401
1402	2086678.559	417731.027	9652.78	1.17	9653.949	1402
1403	2086685.426	417205.672	9630.92	-0.36	9630.556	1403
1404	2086717.787	414988.379	9476.07	NR 2011		1404
1405	2086719.849	416248.704	9049.01	5.43	9054.439	1405
1407	2086739.593	408527.792	8792.19	NR 2011		1407
1408	2086749.315	407579.464	9120.99	NR 2011		1408
1409	2086766.705	414571.508	9679.68	0.81	9680.492	1409
1410	2086782.513	407852.835	9007.47	NR 2011		1410
1411	2086793.307	408219.955	8915.65	NR 2011		1411
1412	2086806.539	415291.258	9323.96	NR 2011		1412
1413	2086813.620	412928.901	8906.95	1.23	8908.178	1413
1414	2086814.120	412121.240	8581.76	1.58	8583.342	1414
1415	2086828.379	410783.818	9297.23	-0.71	9296.520	1415
1416	2086846.592	417432.090	9653.40	-0.11	9653.294	1416
1417	2086857.764	418853.024	9272.73	-0.14	9272.591	1417
1418	2086869.446	418016.409	9470.85	-2.73	9468.119	1418
1419	2086879.115	409035.470	8660.40	1.71	8662.114	1419
1420	2086882.224	413423.003	9181.86	-1.23	9180.627	1420
1421	2086891.514	411236.878	9019.82	NR 2011		1421
1422	2086896.053	413733.339	9340.74	6.02	9346.764	1422
1423	2086897.215	416506.228	9173.01	1.15	9174.156	1423
1424	2086905.668	409892.692	8838.56	0.45	8839.014	1424
1425	2086935.492	409481.380	8706.11	1.98	8708.091	1425
1426	2086959.164	416942.663	9507.74	0.01	9507.751	1426
1427	2086976.137	414088.959	9542.66	1.01	9543.673	1427
1428	2086977.232	415105.449	9435.26	NR 2011		1428
1429	2086985.855	410281.528	8916.55	-0.97	8915.584	1429
1430	2087008.500	418555.015	9114.72	NR 2011		1430
1431	2087012.206	410550.628	9156.83	1.89	9158.717	1431
1432	2087018.457	410871.502	9238.87	4.09	9242.955	1432
1433	2087039.975	415835.532	8949.33	NR 2011		1433
1434	2087060.465	412619.813	8694.50	2.37	8696.874	1434
1435	2087109.563	413418.661	9220.34	1.10	9221.435	1435
1436	2087110.310	414694.096	9556.47	NR 2011		1436
1437	2087112.368	416152.178	8950.32	3.85	8954.169	1437
1438	2087160.828	417677.457	9618.64	0.52	9619.155	1438
1439	2087170.940	412104.695	8536.86	0.57	8537.429	1439
1440	2087181.697	418624.738	9025.07	NR 2011		1440
1441	2087186.378	419081.910	9235.51	2.09	9237.601	1441
1442	2087188.691	410839.087	9208.50	-0.40	9208.102	1442
1443	2087190.374	409474.372	8593.79	3.76	8597.553	1443
1444	2087196.488	417195.500	9401.62	2.48	9404.101	1444
1445	2087198.920	415432.261	9163.91	NR 2011		1445
1446	2087218.712	413068.956	8974.53	-1.18	8973.352	1446
1447	2087235.551	408153.168	9160.50	NR 2011		1447
1448	2087238.405	409832.556	8648.78	-1.89	8646.890	1448
1449	2087258.256	411142.682	8994.18	NR 2011		1449
1450	2087262.133	418006.967	9446.83	-1.12	9445.709	1450
1451	2087279.784	409144.181	8655.79	-0.94	8654.848	1451
1452	2087280.622	414397.735	9656.36	-0.30	9656.060	1452
1453	2087302.909	407880.794	9253.92	NR 2011		1453
1454	2087323.178	416869.653	9225.19	0.93	9226.123	1454

1455	2087331.474	410581.760	8911.77	2.53	8914.298	1455
1456	2087335.753	412796.965	8863.44	0.43	8863.870	1456
1457	2087339.561	410185.481	8718.65	0.50	8719.151	1457
1458	2087347.036	416478.286	9037.14	2.44	9039.582	1458
1459	2087386.697	414008.244	9515.93	3.51	9519.439	1459
1460	2087391.601	411947.409	8494.55	NR 2011		1460
1461	2087410.177	415784.156	8936.53	NR 2011		1461
1462	2087437.826	411407.449	8767.75	NR 2011		1462
1463	2087443.087	408472.073	8881.36	NR 2011		1463
1465	2087458.956	412401.917	8644.10	4.22	8648.321	1465
1467	2087475.164	416196.980	8846.85	0.88	8847.725	1467
1468	2087482.967	410954.357	8999.83	16.39	9016.220	1468
1469	2087489.645	413639.245	9349.32	1.54	9350.859	1469
1470	2087504.657	408778.199	8723.66	4.37	8728.025	1470
1471	2087530.851	417701.429	9589.46	0.54	9589.996	1471
1472	2087532.234	409359.589	8595.03	NR 2011		1472
1473	2087534.442	414737.682	9526.79	NR 2011		1473
1474	2087534.447	409980.753	8566.05	0.81	8566.864	1474
1475	2087543.893	409030.638	8707.32	2.25	8709.570	1475
1476	2087544.143	409632.031	8567.36	-0.54	8566.816	1476
1478	2087553.765	413156.388	9219.50	0.35	9219.850	1478
1479	2087564.268	415085.749	9408.05	NR 2011		1479
1480	2087566.355	418553.679	9092.91	NR 2011		1480
1481	2087569.360	414206.583	9634.50	-0.03	9634.467	1481
1482	2087571.901	415329.246	9252.89	NR 2011		1482
1483	2087572.908	414346.182	9669.14	-0.14	9669.002	1483
1484	2087574.710	410579.301	8773.11	1.33	8774.437	1484
1485	2087581.094	417276.219	9347.04	-0.01	9347.028	1485
1486	2087592.729	410306.566	8655.51	-0.20	8655.314	1486
1487	2087616.632	416853.317	9049.76	1.77	9051.534	1487
1488	2087617.739	416510.372	8931.42	2.91	8934.327	1488
1489	2087638.873	419010.214	9019.45	-1.03	9018.419	1489
1490	2087667.322	412047.102	8475.29	0.83	8476.115	1490
1491	2087671.669	412644.001	8785.34	3.85	8789.188	1491
1492	2087717.836	415636.696	9016.52	NR 2011		1492
1493	2087747.742	411667.227	8536.56	NR 2011		1493
1494	2087750.506	419238.758	9082.48	-1.35	9081.126	1494
1496	2087768.004	415014.365	9381.26	5.85	9387.110	1496
1497	2087771.545	417416.395	9394.08	-1.28	9392.803	1497
1498	2087795.009	416823.135	9002.92	1.80	9004.717	1498
1499	2087795.632	418554.775	9082.22	NR 2011		1499
1500	2087800.649	415970.703	8865.73	NR 2011		1500
1502	2087818.907	411251.973	8669.13	NR 2011		1502
1503	2087822.240	417955.044	9463.86	-1.51	9462.353	1503
1504	2087832.070	408664.412	8903.35	-5.76	8897.595	1504
1505	2087841.083	414490.402	9622.72	-0.80	9621.921	1505
1506	2087852.499	412326.635	8637.84	0.19	8638.032	1506
1507	2087853.806	409923.446	8500.29	NR 2011		1507
1508	2087855.130	413564.997	9417.28	3.45	9420.725	1508
1509	2087866.637	409644.703	8584.83	NR 2011		1509
1510	2087873.631	410913.709	8762.78	0.95	8763.730	1510
1511	2087884.694	412938.439	9031.79	-0.75	9031.039	1511
1512	2087901.227	413179.165	9209.01	-1.44	9207.571	1512
1513	2087912.594	414276.753	9678.87	-0.92	9677.946	1513
1515	2087928.479	410510.873	8583.29	0.65	8583.937	1515

1516	2087932.852	414801.461	9464.65	NR 2011		1516
1517	2087939.004	413923.144	9610.70	0.58	9611.281	1517
1518	2087946.779	412093.475	8535.93	-4.00	8531.931	1518
1519	2087946.990	418759.482	8994.47	NR 2011		1519
1520	2087985.922	409074.223	8933.41	NR 2011		1520
1522	2088012.132	409266.595	8809.08	NR 2011		1522
1523	2088045.638	417122.710	9066.24	0.22	9066.458	1523
1524	2088064.228	410336.471	8462.68	0.80	8463.479	1524
1525	2088079.605	415188.986	9368.45	NR 2011		1525
1526	2088101.564	414227.916	9719.22	-1.26	9717.958	1526
1527	2088110.106	419245.851	8956.30	-0.66	8955.645	1527
1528	2088119.238	417668.291	9414.90	1.57	9416.465	1528
1530	2088134.663	413541.723	9420.24	-1.84	9418.399	1530
1531	2088137.077	412603.615	8826.61	-0.02	8826.592	1531
1532	2088138.742	411681.195	8390.33	-2.18	8388.147	1532
1533	2088148.054	418831.533	8933.25	NR 2011		1533
1534	2088167.536	412017.666	8531.78	-0.49	8531.288	1534
1535	2088173.046	417844.766	9513.77	1.40	9515.166	1535
1536	2088174.427	409981.049	8486.29	-1.14	8485.150	1536
1537	2088175.658	410694.793	8499.05	2.18	8501.226	1537
1538	2088184.571	413999.882	9649.47	-1.63	9647.837	1538
1539	2088191.587	416200.179	8803.33	NR 2011		1539
1540	2088198.982	418558.991	9072.17	NR 2011		1540
1542	2088228.630	414939.905	9495.17	0.17	9495.337	1542
1543	2088230.331	416531.424	8728.76	3.72	8732.477	1543
1544	2088235.429	414522.951	9635.79	NR 2011		1544
1545	2088239.426	415894.522	8949.25	NR 2011		1545
1546	2088240.327	416870.028	8883.90	1.31	8885.214	1546
1547	2088259.512	415475.348	9289.39	-1.99	9287.396	1547
1548	2088259.659	412326.419	8678.90	-2.35	8676.550	1548
1549	2088273.657	411236.206	8481.16	-0.19	8480.970	1549
1551	2088305.253	418058.509	9442.83	NR 2011		1551
1552	2088319.773	412725.537	8884.16	-1.87	8882.290	1552
1556	2088376.439	417412.395	9170.78	1.09	9171.872	1556
1557	2088376.767	419224.829	8831.20	-0.56	8830.640	1557
1558	2088376.785	415161.378	9452.20	NR 2011		1558
1559	2088388.805	413412.006	9312.02	-3.29	9308.731	1559
1561	2088426.230	414236.262	9748.11	0.16	9748.266	1561
1563	2088429.005	417628.015	9364.32	-0.10	9364.223	1563
1564	2088430.497	413046.604	9108.87	-0.80	9108.072	1564
1566	2088439.212	411473.379	8376.04	0.04	8376.081	1566
1567	2088439.499	418859.932	8939.51	NR 2011		1567
1571	2088520.323	412135.186	8700.38	-0.79	8699.595	1571
1572	2088546.862	417099.006	8946.64	0.10	8946.740	1572
1574	2088588.122	415742.701	9025.91	NR 2011		1574
1575	2088603.701	416138.282	8807.03	NR 2011		1575
1576	2088612.274	416350.568	8693.60	NR 2011		1576
1577	2088620.282	416721.525	8739.90	-2.04	8737.861	1577
1578	2088659.932	414516.565	9613.89	0.38	9614.272	1578
1579	2088662.752	414266.507	9699.61	1.67	9701.275	1579
1580	2088669.174	417601.335	9211.66	0.72	9212.375	1580
1581	2088680.060	415170.926	9393.80	NR 2011		1581
1582	2088700.555	417889.665	9402.66	-0.18	9402.482	1582
1583	2088712.963	413999.391	9623.21	-1.03	9622.181	1583
1584	2088716.869	414899.859	9471.71	NR 2011		1584

1585	2088722.561	419103.545	8856.66	NR 2011		1585
1586	2088727.307	413716.660	9517.37	-3.00	9514.375	1586
1587	2088727.433	412808.787	9191.72	0.56	9192.284	1587
1588	2088739.601	413445.462	9396.89	-2.29	9394.604	1588
1589	2088748.034	417402.152	9037.19	13.82	9051.011	1589
1590	2088749.462	412392.181	8895.79	-0.08	8895.706	1590
1591	2088761.770	418088.678	9430.22	-0.98	9429.244	1591
1592	2088764.425	413106.692	9303.18	-0.63	9302.550	1592
1593	2088775.638	411154.602	8314.51	-0.86	8313.655	1593
1594	2088833.931	410771.325	8424.73	NR 2011		1594
1595	2088836.637	416487.265	8579.27	1.20	8580.471	1595
1597	2088853.274	412110.961	8664.52	1.25	8665.765	1597
1599	2088855.373	411489.007	8332.95	0.40	8333.352	1599
1601	2088907.354	412487.953	8895.75	-0.04	8895.706	1601
1602	2088918.266	419263.210	8816.82	NR 2011		1602
1603	2088955.942	415196.139	9240.03	NR 2011		1603
1604	2088956.850	413137.148	9281.32	0.69	9282.012	1604
1605	2088972.235	416369.287	8654.24	NR 2011		1605
1606	2088978.406	415497.136	9083.55	NR 2011		1606
1607	2088980.182	412919.449	9154.84	-0.64	9154.199	1607
1608	2088985.256	417332.499	8941.73	0.65	8942.379	1608
1609	2088990.978	417859.382	9202.33	1.65	9203.983	1609
1610	2088994.210	416695.632	8647.11	2.22	8649.329	1610
1611	2088995.713	414892.649	9369.51	NR 2011		1611
1612	2088998.677	415796.965	8907.56	NR 2011		1612
1613	2088998.707	416091.620	8775.73	NR 2011		1613
1614	2089000.225	414590.398	9507.33	NR 2011		1614
1615	2089004.198	414312.787	9614.19	0.08	9614.272	1615
1617	2089010.515	414052.547	9582.41	0.29	9582.701	1617
1618	2089013.483	419371.904	8790.70	NR 2011		1618
1619	2089024.504	413456.562	9378.24	-1.32	9376.924	1619
1620	2089034.898	416999.055	8758.47	1.99	8760.459	1620
1621	2089043.304	418237.369	9434.59	0.60	9435.191	1621
1622	2089052.619	410689.557	8530.08	NR 2011		1622
1623	2089059.619	413756.709	9426.62	-2.11	9424.514	1623
1624	2089103.758	411539.667	8312.82	-0.74	8312.085	1624
1626	2089219.869	418973.487	9018.74	NR 2011		1626
1628	2089277.473	413989.493	9459.82	-3.34	9456.483	1628
1629	2089294.561	416369.807	8664.21	NR 2011		1629
1630	2089296.528	412943.995	9178.99	-1.46	9177.529	1630
1631	2089298.700	415254.106	9271.79	NR 2011		1631
1632	2089299.515	412246.533	8631.13	0.67	8631.804	1632
1633	2089301.253	413723.408	9343.40	-2.10	9341.299	1633
1634	2089302.401	413449.529	9227.28	-0.43	9226.846	1634
1635	2089304.934	413117.119	9179.07	0.25	9179.323	1635
1636	2089305.560	414264.568	9585.97	0.92	9586.888	1636
1637	2089308.183	418229.730	9277.93	2.70	9280.634	1637
1638	2089308.230	411933.444	8473.11	-0.38	8472.730	1638
1639	2089309.113	414544.194	9576.40	0.92	9577.317	1639
1640	2089319.693	417516.444	8900.39	1.62	8902.005	1640
1641	2089326.455	414932.218	9411.51	-1.55	9409.958	1641
1642	2089327.813	416526.367	8599.31	NR 2011		1642
1643	2089339.415	412447.842	8766.24	-1.73	8764.508	1643
1644	2089346.577	414416.514	9607.62	0.74	9608.357	1644
1645	2089367.738	416855.299	8595.70	1.65	8597.353	1645

1646	2089379.271	417232.294	8733.22	0.42	8733.638	1646
1647	2089387.082	418426.036	9385.62	0.87	9386.491	1647
1648	2089387.834	417804.111	8997.75	2.45	9000.198	1648
1649	2089403.223	419192.477	8959.17	NR 2011		1649
1650	2089406.719	416021.787	8849.81	NR 2011		1650
1651	2089431.061	415652.290	9072.08	NR 2011		1651
1652	2089436.271	411334.855	8306.69	3.43	8310.122	1652
1653	2089484.349	411060.777	8418.99	NR 2011		1653
1654	2089495.381	410643.491	8646.40	NR 2011		1654
1655	2089528.940	415012.308	9421.04	NR 2011		1655
1656	2089553.297	412806.380	8883.83	-0.14	8883.686	1656
1657	2089571.815	410314.933	8859.74	NR 2011		1657
1658	2089572.350	417578.741	8825.03	0.06	8825.090	1658
1659	2089574.804	412108.412	8527.24	1.24	8528.481	1659
1660	2089576.654	418467.734	9333.07	-0.04	9333.034	1660
1661	2089583.559	417881.264	8962.19	-0.38	8961.806	1661
1662	2089592.312	414011.137	9447.16	-0.91	9446.248	1662
1663	2089595.198	411675.161	8307.18	-0.20	8306.981	1663
1664	2089596.395	413412.705	9153.16	-0.96	9152.205	1664
1665	2089597.648	416986.888	8559.16	3.76	8562.924	1665
1666	2089598.344	414683.048	9581.80	-0.83	9580.973	1666
1667	2089600.573	413093.472	8938.40	2.18	8940.580	1667
1668	2089600.577	416089.091	8786.69	NR 2011		1668
1669	2089603.375	418245.340	9159.33	-0.41	9158.918	1669
1670	2089603.824	412506.335	8724.39	0.14	8724.527	1670
1671	2089607.254	417190.321	8634.16	-0.39	8633.775	1671
1672	2089609.095	413703.210	9296.99	-0.75	9296.236	1672
1673	2089610.122	414491.419	9619.02	0.17	9619.190	1673
1674	2089613.841	415806.467	8949.51	NR 2011		1674
1675	2089615.888	418570.328	9387.99	0.22	9388.209	1675
1676	2089617.164	416628.178	8568.94	NR 2011		1676
1677	2089617.362	415352.940	9235.58	-1.157	9234.423	1677
1678	2089624.560	416388.679	8654.05	NR 2011		1678
1679	2089630.817	414250.750	9567.50	0.84	9568.344	1679
1681	2089720.168	419221.215	9030.94	NR 2011		1681
1682	2089751.237	410955.796	8484.73	NR 2011		1682
1683	2089771.494	410617.720	8670.85	NR 2011		1683
1684	2089786.737	413781.544	9293.61	-0.90	9292.713	1684
1685	2089831.304	410426.959	8782.91	NR 2011		1685
1686	2089835.616	412012.319	8407.91	0.69	8408.603	1686
1687	2089851.473	418450.855	9143.90	-0.71	9143.191	1687
1688	2089851.930	417283.698	8620.12	2.24	8622.362	1688
1689	2089873.730	417573.935	8716.98	1.66	8718.638	1689
1690	2089882.314	411605.237	8218.54	-0.36	8218.185	1690
1691	2089887.868	412900.811	8734.80	-1.39	8733.408	1691
1692	2089889.902	414004.447	9403.55	-2.23	9401.317	1692
1693	2089893.457	415499.671	9151.62	NR 2011		1693
1694	2089897.602	416423.349	8676.96	NR 2011		1694
1695	2089899.131	417909.697	8866.76	1.55	8868.305	1695
1696	2089903.384	418210.356	8982.90	-0.48	8982.422	1696
1697	2089907.523	416985.704	8476.83	1.42	8478.247	1697
1698	2089908.228	415075.939	9363.13	2.03	9365.160	1698
1699	2089914.275	412485.531	8557.52	0.34	8557.862	1699
1700	2089918.034	414699.463	9574.12	-0.46	9573.662	1700
1701	2089922.413	414521.686	9608.92	1.43	9610.351	1701

1702	2089927.811	413109.713	8853.41	1.90	8855.305	1702
1703	2089928.832	414304.255	9563.48	0.94	9564.423	1703
1704	2089930.623	415799.972	9009.20	NR 2011		1704
1705	2089933.532	416088.808	8867.34	NR 2011		1705
1706	2089934.442	418784.879	9347.83	-0.19	9347.637	1706
1707	2089939.551	416698.987	8543.55	NR 2011		1707
1708	2089951.281	412226.814	8449.23	-0.12	8449.107	1708
1709	2089981.822	413510.982	9148.18	-0.69	9147.486	1709
1710	2090073.489	410345.998	8745.83	NR 2011		1710
1711	2090079.115	419085.006	9201.63	NR 2011		1711
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1713	2090112.032	410603.144	8620.77	NR 2011		1713
1715	2090139.423	413165.151	8926.35	-4.12	8922.235	1715
1716	2090171.408	412895.676	8789.41	-1.57	8787.843	1716
1717	2090171.780	410883.750	8470.53	NR 2011		1717
1718	2090172.586	415391.971	9335.17	-3.64	9331.529	1718
1719	2090184.306	417890.864	8728.16	-0.60	8727.558	1719
1720	2090187.703	413471.937	9160.19	-0.81	9159.384	1720
1721	2090188.382	416679.042	8543.78	NR 2011		1721
1722	2090188.543	417212.550	8482.24	-0.56	8481.681	1722
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1726	2090198.599	419042.473	9282.67	1.47	9284.136	1726
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1731	2090202.037	418516.906	8989.21	-3.75	8985.462	1731
1732	2090205.607	413695.624	9224.90	-1.05	9223.855	1732
1733	2090212.331	414548.476	9640.13	-0.34	9639.795	1733
1734	2090212.753	414713.883	9583.69	0.54	9584.230	1734
1735	2090220.047	416968.086	8417.35	14.74	8432.089	1735
1736	2090229.449	411917.976	8321.28	0.69	8321.966	1736
1737	2090268.628	415156.221	9420.95	2.17	9423.118	1737
1738	2090280.133	411583.081	8183.85	-0.61	8183.242	1738
1739	2090344.977	412325.219	8540.80	-0.74	8540.063	1739
1740	2090428.213	417305.494	8416.77	-3.13	8413.642	1740
1741	2090449.005	417922.623	8644.18	0.55	8644.729	1741
1742	2090467.746	418522.725	8887.46	0.21	8887.666	1742
1743	2090472.001	412857.642	8840.73	0.15	8840.882	1743
1744	2090472.286	410376.083	8672.91	NR 2011		1744
1745	2090473.345	413175.637	9154.36	-1.62	9152.737	1745
1747	2090490.023	414348.257	9595.90	1.16	9597.057	1747
1748	2090493.195	416387.584	8719.08	NR 2011		1748
1749	2090498.523	415192.398	9387.60	NR 2011		1749
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1751	2090500.741	416081.338	8858.84	NR 2011		1751
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1753	2090506.489	415784.643	8997.88	NR 2011		1753
1754	2090506.884	416978.630	8474.59	NR 2011		1754
1755	2090508.656	414894.134	9554.71	-0.92	9553.789	1755
1756	2090508.705	413675.236	9329.50	-1.69	9327.807	1756
1757	2090509.701	411131.666	8297.25	NR 2011		1757
1758	2090513.302	419110.893	9184.73	0.82	9185.547	1758
1759	2090514.320	418195.904	8718.37	NR 2011	8718.572	1759

1760	2090514.439	417556.887	8494.85	-1.51	8493.344	1760
1761	2090523.519	414543.419	9734.63	-0.06	9734.574	1761
1762	2090534.088	415514.145	9205.17	NR 2011		1762
1763	2090545.494	411867.549	8316.03	0.83	8316.862	1763
1764	2090552.499	412551.201	8658.48	-0.57	8657.913	1764
1765	2090561.219	414044.673	9510.30	-1.64	9508.659	1765
1766	2090577.125	416713.146	8604.62	NR 2011		1766
1767	2090584.528	411538.046	8194.22	0.67	8194.889	1767
1768	2090623.530	410702.921	8500.98	NR 2011		1768
1769	2090697.645	414253.823	9579.09	0.42	9579.511	1769
1770	2090730.460	412096.669	8391.06	2.54	8393.599	1770
1772	2090745.939	416942.164	8519.99	NR 2011		1772
1773	2090771.387	416358.803	8850.30	-3.97	8846.332	1773
1774	2090771.554	412810.353	8754.90	-1.22	8753.679	1774
1775	2090773.019	413994.264	9465.40	0.46	9465.855	1775
1776	2090784.244	414584.236	9707.53	0.33	9707.855	1776
1777	2090793.002	417621.507	8409.48	3.18	8412.662	1777
1778	2090796.576	410186.758	8795.49	NR 2011		1778
1779	2090800.297	414789.689	9578.33	-1.15	9577.184	1779
1780	2090800.688	418817.468	8876.37	0.66	8877.028	1780
1781	2090801.031	416692.015	8654.31	NR 2011		1781
1782	2090802.952	419135.049	9026.82	-1.65	9025.175	1782
1783	2090806.459	413361.232	9152.50	0.04	9152.538	1783
1784	2090806.607	417884.924	8485.95	0.46	8486.406	1784
1785	2090814.385	415200.564	9386.92	NR 2011		1785
1786	2090816.734	413667.301	9274.40	2.03	9276.429	1786
1787	2090817.683	418201.656	8596.32	3.05	8599.367	1787
1788	2090818.794	413111.791	8918.47	-2.22	8916.254	1788
1789	2090820.330	418473.344	8708.84	2.73	8711.567	1789
1790	2090821.699	415728.398	9244.79	NR 2011		1790
1791	2090841.554	415475.986	9325.74	1.34	9327.075	1791
1792	2090850.678	412469.928	8570.55	-4.11	8566.438	1792
1793	2090854.067	411086.020	8271.47	NR 2011		1793
1794	2090896.430	417256.892	8386.41	NR 2011		1794
1795	2090904.035	416077.729	9055.80	13.06	9068.858	1795
1796	2090919.760	411864.674	8324.88	-0.93	8323.950	1796
1797	2090952.017	411503.805	8154.72	1.93	8156.647	1797
1799	2091014.445	410549.547	8502.02	NR 2011		1799
1800	2091020.248	418740.553	8730.53	-0.46	8730.069	1800
1801	2091031.606	418188.821	8513.28	2.37	8515.645	1801
1802	2091032.962	415763.586	9291.61	-9.27	9282.344	1802
1803	2091054.547	417299.861	8400.40	2.05	8402.453	1803
1804	2091064.498	413024.172	8923.45	-2.71	8920.737	1804
1805	2091077.217	415413.230	9414.73	-3.84	9410.888	1805
1806	2091087.171	414373.255	9639.24	1.22	9640.459	1806
1807	2091087.988	416411.208	8826.44	NR 2011		1807
1808	2091090.607	419116.685	8882.99	-2.00	8880.992	1808
1809	2091099.416	417892.457	8394.90	1.87	8396.770	1809
1810	2091099.993	416683.070	8669.29	NR 2011		1810
1811	2091100.416	417602.207	8255.81	0.51	8256.321	1811
1812	2091104.149	414897.265	9600.29	-4.10	9596.193	1812
1813	2091121.720	417027.999	8493.96	-0.55	8493.410	1813
1814	2091128.137	409978.767	8772.55	NR 2011		1814
1815	2091134.158	418479.469	8588.68	0.51	8589.190	1815
1816	2091134.573	413748.534	9297.84	-1.68	9296.163	1816

1817	2091137.559	413290.985	9099.17	-0.09	9099.079	1817
1818	2091143.437	416110.953	9028.61	NR 2011		1818
1819	2091160.022	413981.240	9437.72	0.16	9437.883	1819
1820	2091183.955	412432.574	8682.94	0.39	8683.332	1820
1821	2091185.019	415143.467	9567.19	-1.63	9565.563	1821
1822	2091201.334	414618.739	9768.66	-0.32	9768.342	1822
1823	2091267.541	411624.788	8211.87	6.92	8218.785	1823
1824	2091289.507	410293.151	8549.07	NR 2011		1824
1825	2091333.641	413040.386	9139.06	-0.91	9138.151	1825
1826	2091338.548	418811.829	8645.16	1.81	8646.965	1826
1827	2091341.598	410590.705	8379.23	NR 2011		1827
1828	2091349.792	418492.846	8515.82	2.68	8518.498	1828
1829	2091353.447	411915.288	8362.55	-2.56	8359.994	1829
1830	2091357.140	419097.199	8763.85	1.15	8764.997	1830
1831	2091362.766	413223.613	9216.49	-0.99	9215.501	1831
1832	2091367.963	413428.212	9272.80	-2.00	9270.799	1832
1833	2091369.463	411233.192	8083.88	0.55	8084.428	1833
1834	2091379.986	415566.413	9324.94	NR 2011		1834
1835	2091381.711	416082.517	9057.24	NR 2011		1835
1836	2091389.098	418147.616	8374.37	4.03	8378.400	1836
1837	2091398.552	417897.562	8306.39	2.96	8309.349	1837
1838	2091408.418	416396.489	8855.43	NR 2011		1838
1839	2091416.878	416657.011	8739.90	NR 2011		1839
1840	2091422.202	409865.402	8675.51	NR 2011		1840
1841	2091427.910	417258.294	8501.74	-0.46	8501.285	1841
1842	2091446.109	415778.756	9284.81	NR 2011		1842
1843	2091483.389	417631.580	8296.15	NR 2011		1843
1844	2091486.220	417032.072	8607.55	NR 2011		1844
1845	2091542.562	412212.780	8506.69	-2.19	8504.498	1845
1846	2091543.871	414924.686	9639.37	-2.62	9636.755	1846
1847	2091545.416	414704.487	9694.87	0.56	9695.429	1847
1848	2091565.419	412534.900	8690.68	-1.02	8689.658	1848
1849	2091566.992	413423.295	9242.73	-0.94	9241.792	1849
1850	2091570.565	415557.123	9369.21	NR 2011		1850
1851	2091585.018	414492.302	9723.36	0.61	9723.972	1851
1852	2091592.464	416154.370	9063.60	NR 2011		1852
1853	2091599.645	414091.091	9545.77	0.26	9546.027	1853
1854	2091614.916	415259.168	9498.62	NR 2011		1854
1855	2091668.147	413847.484	9416.36	0.93	9417.287	1855
1856	2091670.419	413189.029	9095.44	-0.27	9095.172	1856
1857	2091687.240	412280.404	8555.92	-2.79	8553.127	1857
1858	2091687.754	418479.997	8383.54	-0.16	8383.385	1858
1859	2091695.055	417874.375	8199.13	NR 2011		1859
1860	2091695.714	418766.271	8513.81	2.162	8515.972	1860
1861	2091696.810	415821.537	9297.46	NR 2011		1861
1862	2091698.947	418194.120	8250.13	3.86	8253.988	1862
1863	2091700.136	417591.707	8371.87	NR 2011		1863
1864	2091700.287	417293.957	8529.94	NR 2011		1864
1865	2091716.848	410245.201	8405.51	NR 2011		1865
1866	2091740.605	411410.277	8213.12	1.71	8214.831	1866
1867	2091764.929	411755.643	8394.97	-4.07	8390.898	1867
1868	2091780.722	409969.446	8494.64	NR 2011		1868
1869	2091796.875	411077.903	8076.49	2.14	8078.629	1869
1870	2091799.254	411975.840	8479.69	-2.87	8476.823	1870
1871	2091821.232	410676.845	8199.24	0.04	8199.280	1871

1872	2091852.003	415249.143	9501.81	2.69	9504.504	1872
1873	2091857.999	413522.937	9221.07	0.13	9221.197	1873
1874	2091858.858	416763.636	8821.39	NR 2011		1874
1875	2091862.400	417048.765	8665.51	NR 2011		1875
1876	2091868.203	418843.725	8480.18	-1.29	8478.888	1876
1877	2091872.375	419092.807	8563.10	2.98	8566.083	1877
1878	2091874.490	414963.523	9556.73	-0.50	9556.226	1878
1879	2091878.500	415812.579	9355.70	0.13	9355.831	1879
1881	2091885.498	412896.043	8913.85	-0.20	8913.651	1881
1882	2091889.133	415556.622	9400.42	-1.08	9399.340	1882
1883	2091897.431	417659.706	8374.26	NR 2011		1883
1884	2091897.486	416136.206	9269.21	312.78	9581.987	1884
1885	2091898.086	414681.578	9580.56	NR 2011		1885
1886	2091918.240	418379.225	8253.93	3.31	8257.244	1886
1887	2091919.894	413281.945	9117.36	0.46	9117.820	1887
1888	2091920.842	414100.638	9535.62	1.20	9536.822	1888
1889	2091924.586	418601.660	8365.78	1.52	8367.302	1889
1890	2091930.557	416508.274	9031.87	-4.58	9027.292	1890
1891	2091940.919	414406.193	9647.38	2.16	9649.536	1891
1892	2091945.522	413841.779	9400.35	0.32	9400.665	1892
1893	2091986.513	417900.300	8289.98	NR 2011		1893
1894	2092023.454	412562.598	8815.12	1.78	8816.898	1894
1895	2092096.726	411598.650	8366.22	0.17	8366.386	1895
1896	2092134.566	418287.790	8148.43	0.82	8149.247	1896
1897	2092151.254	414300.354	9623.18	0.93	9624.106	1897
1898	2092152.827	416732.554	8901.95	NR 2011		1898
1899	2092153.060	410325.020	8253.34	NR 2011		1899
1900	2092154.147	414661.828	9544.92	-3.33	9541.590	1900
1901	2092161.489	416132.595	9301.54	-0.01	9301.527	1901
1902	2092165.792	419144.920	8516.85	1.38	8518.232	1902
1903	2092167.032	418846.667	8378.13	0.14	8378.268	1903
1904	2092169.188	411923.535	8600.02	-2.28	8597.737	1904
1905	2092170.483	415853.677	9365.24	-9.33	9355.914	1905
1906	2092171.916	411242.650	8239.28	0.52	8239.804	1906
1907	2092173.902	415533.904	9354.14	4.34	9358.480	1907
1908	2092180.992	417341.561	8565.57	NR 2011		1908
1909	2092189.128	409962.283	8424.61	1.94	8426.546	1909
1910	2092193.149	415236.636	9390.96	-3.39	9387.569	1910
1911	2092193.522	412996.335	9126.70	0.13	9126.827	1911
1912	2092194.578	413583.919	9337.37	-0.81	9336.559	1912
1913	2092197.628	416373.804	9194.30	-1.04	9193.264	1913
1914	2092197.647	413794.809	9435.08	-0.58	9434.505	1914
1915	2092211.801	414931.782	9458.03	NR 2011		1915
1916	2092212.296	416996.293	8752.84	NR 2011		1916
1917	2092212.899	413378.886	9261.59	-1.12	9260.468	1917
1918	2092219.420	418550.607	8252.49	2.63	8255.117	1918
1919	2092227.215	412237.325	8776.18	-0.93	8775.254	1919
1920	2092229.309	414069.143	9553.19	-0.81	9552.385	1920
1921	2092280.802	417930.745	8286.20	NR 2011		1921
1923	2092314.468	410848.433	8031.06	-1.09	8029.967	1923
1924	2092324.764	417659.667	8431.16	-3.28	8427.880	1924
1925	2092407.267	417029.630	8790.53	NR 2011		1925
1926	2092416.179	419147.424	8506.57	-8.81	8497.762	1926
1927	2092439.825	418527.105	8195.21	3.08	8198.294	1927
1928	2092448.361	414655.667	9474.84	-1.11	9473.727	1928

1929	2092449.926	411623.930	8517.13	-2.22	8514.909	1929
1930	2092450.981	415845.645	9286.77	1.31	9288.083	1930
1931	2092456.619	413786.146	9508.58	0.36	9508.942	1931
1932	2092458.837	412005.488	8692.92	-1.29	8691.635	1932
1933	2092463.034	418848.468	8317.89	-1.16	8316.726	1933
1934	2092466.239	417651.519	8432.59	NR 2011		1934
1935	2092466.265	417936.866	8287.72	NR 2011		1935
1936	2092467.234	418295.537	8079.84	-0.91	8078.933	1936
1937	2092468.819	413442.375	9374.19	0.71	9374.903	1937
1938	2092470.103	417346.348	8608.64	NR 2011		1938
1939	2092471.694	414356.063	9553.15	-1.16	9551.987	1939
1940	2092473.299	416129.922	9312.40	0.05	9312.454	1940
1941	2092474.010	414975.820	9356.43	NR 2011		1941
1942	2092474.864	416728.358	8976.54	NR 2011		1942
1943	2092474.942	416457.501	9204.45	-1.47	9202.985	1943
1944	2092475.505	413191.305	9312.04	0.75	9312.785	1944
1945	2092476.563	415529.753	9244.28	4.49	9248.763	1945
1946	2092482.793	415247.356	9300.28	NR 2011		1946
1947	2092499.312	414107.259	9600.52	1.20	9601.722	1947
1948	2092520.678	409938.962	8231.81	3.18	8234.994	1948
1949	2092563.564	412856.224	9254.82	1.74	9256.560	1949
1950	2092592.396	411211.919	8280.80	0.06	8280.856	1950
1951	2092665.118	410314.767	8071.73	-4.11	8067.625	1951
1952	2092699.266	410875.245	8132.75	0.44	8133.189	1952
1953	2092721.781	417649.030	8456.57	-1.41	8455.162	1953
1954	2092757.514	413146.422	9389.09	-0.88	9388.215	1954
1955	2092768.683	418554.264	8121.97	1.16	8123.128	1955
1956	2092769.100	412328.215	9003.53	-2.33	9001.202	1956
1957	2092770.199	414330.502	9508.77	0.97	9509.736	1957
1958	2092770.780	414053.567	9562.00	-1.47	9560.530	1958
1959	2092771.964	419159.456	8471.46	1.25	8472.707	1959
1960	2092772.067	415260.372	9184.47	NR 2011		1960
1961	2092772.758	415521.545	9149.86	-0.86	9149.002	1961
1962	2092774.736	414942.953	9282.64	NR 2011		1962
1963	2092776.811	414649.642	9383.84	-0.71	9383.132	1963
1964	2092777.189	416452.100	9222.52	NR 2011		1964
1965	2092779.365	416746.038	9009.65	NR 2011		1965
1966	2092782.520	418868.190	8293.01	2.05	8295.060	1966
1967	2092782.799	413522.795	9516.03	1.65	9517.683	1967
1968	2092784.285	413869.573	9605.96	1.26	9607.219	1968
1969	2092789.244	417359.489	8622.31	NR 2011		1969
1970	2092791.234	416255.319	9301.88	1.24	9303.116	1970
1971	2092792.475	417062.767	8800.49	NR 2011		1971
1972	2092800.238	412922.755	9307.81	1.27	9309.076	1972
1973	2092801.060	418245.708	8147.04	NR 2011		1973
1974	2092821.927	415875.416	9185.66	4.63	9190.287	1974
1975	2092830.909	417964.133	8286.33	NR 2011		1975
1976	2092873.457	412024.783	8836.82	-0.62	8836.205	1976
1977	2092896.635	411642.244	8611.11	-0.95	8610.158	1977
1978	2092914.291	409944.009	8091.99	1.20	8093.192	1978
1979	2092969.815	410837.480	8145.63	-2.03	8143.600	1979
1980	2092985.754	411235.727	8400.91	-1.97	8398.937	1980
1981	2093033.677	419153.893	8378.53	3.19	8381.723	1981
1982	2093051.079	417058.981	8840.17	NR 2011		1982
1983	2093067.449	413422.853	9493.13	2.30	9495.432	1983

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1985	2093071.823	417947.222	8318.85	NR 2011		1985
1986	2093072.381	416442.731	9288.38	1.11	9289.491	1986
1987	2093074.701	414953.805	9221.70	NR 2011		1987
1988	2093078.622	415170.292	9129.94	1.45	9131.387	1988
1989	2093079.510	417355.600	8660.47	NR 2011		1989
1990	2093079.919	414322.268	9418.23	-1.85	9416.377	1990
1991	2093080.945	413212.808	9392.05	1.60	9393.645	1991
1992	2093081.059	414638.754	9335.57	NR 2011		1992
1993	2093081.590	417653.217	8485.68	NR 2011		1993
1994	2093081.702	412951.569	9283.31	1.66	9284.971	1994
1995	2093083.266	418165.592	8196.94	NR 2011		1995
1996	2093083.964	415844.224	9028.77	-1.16	9027.613	1996
1997	2093085.303	413729.209	9510.55	1.84	9512.385	1997
1998	2093092.682	416741.030	9062.48	NR 2011		1998
1999	2093101.117	418840.160	8204.30	2.44	8206.735	1999
2000	2093103.138	418599.051	8067.89	2.00	8069.894	2000
2001	2093104.420	414079.475	9420.81	1.51	9422.320	2001
2002	2093106.272	415467.819	8929.49	NR 2011		2002
2003	2093180.365	410337.189	8034.12	-0.30	8033.822	2003
2004	2093280.339	409975.159	8148.73	NR 2011		2004
2005	2093308.542	412067.340	8760.43	-0.46	8759.966	2005
2006	2093309.537	413561.482	9474.65	4.42	9479.074	2006
2007	2093323.856	415858.602	8893.53	1.30	8894.833	2007
2008	2093343.992	412385.467	8875.89	-1.34	8874.555	2008
2009	2093355.807	418845.288	8103.88	2.77	8106.646	2009
2010	2093357.532	416158.626	8990.63	3.17	8993.799	2010
2011	2093358.667	419142.031	8217.80	3.82	8221.622	2011
2012	2093363.569	416561.821	9245.55	-15.73	9229.823	2012
2013	2093364.913	414424.197	9322.50	-1.49	9321.014	2013
2014	2093370.246	417353.478	8686.88	NR 2011		2014
2015	2093370.365	416753.847	9080.33	NR 2011		2015
2016	2093370.673	418254.163	8195.95	NR 2011		2016
2017	2093370.980	417053.525	8861.40	NR 2011		2017
2018	2093371.073	417654.298	8509.03	NR 2011		2018
2019	2093372.973	411835.657	8641.39	1.19	8642.577	2019
2020	2093377.934	412891.744	9224.03	1.27	9225.303	2020
2021	2093378.110	414031.656	9297.99	13.87	9311.858	2021
2022	2093386.094	417913.573	8378.70	NR 2011		2022
2023	2093389.707	415512.101	8793.46	NR 2011		2023
2024	2093390.717	413798.945	9341.85	2.52	9344.374	2024
2025	2093392.234	418617.603	7968.08	10.23	7978.312	2025
2026	2093409.757	410811.845	8134.30	-1.37	8132.926	2026
2027	2093418.940	415235.672	8900.19	NR 2011		2027
2028	2093442.274	411235.617	8355.50	-0.75	8354.755	2028
2029	2093452.755	411560.260	8517.51	0.10	8517.611	2029
2030	2093461.917	414545.759	9297.14	1.69	9298.829	2030
2031	2093477.252	414881.404	9139.18	-1.41	9137.771	2031
2032	2093564.743	413520.442	9388.76	3.49	9392.254	2032
2033	2093571.862	410660.243	7977.85	-0.63	7977.220	2033
2034	2093591.675	410346.587	7964.34	NR 2011		2034
2035	2093595.694	410945.632	8165.47	-0.92	8164.554	2035
2036	2093601.227	412095.560	8633.30	-0.24	8633.056	2036
2037	2093613.618	413146.542	9231.08	2.43	9233.514	2037
2038	2093630.592	416421.293	9002.86	3.06	9005.918	2038

2039	2093638.196	412846.844	9106.87	1.68	9108.549	2039
2040	2093648.007	417926.736	8348.91	NR 2011		2040
2041	2093649.963	418667.168	7948.63	2.37	7950.997	2041
2042	2093652.371	417645.907	8509.57	NR 2011		2042
2043	2093664.584	413504.188	9353.17	2.00	9355.169	2043
2044	2093665.347	418857.112	8067.33	1.97	8069.296	2044
2045	2093667.681	412523.744	8865.93	-0.53	8865.396	2045
2046	2093669.057	418233.245	8213.58	1.56	8215.142	2046
2047	2093670.467	417353.186	8680.24	NR 2011		2047
2048	2093670.800	413717.087	9294.43	0.41	9294.838	2048
2049	2093671.211	411765.652	8490.99	0.26	8491.253	2049
2050	2093671.577	414054.141	9149.55	NR 2011		2050
2051	2093671.587	415241.263	8802.95	-1.43	8801.523	2051
2052	2093672.638	416612.828	9193.39	2.00	9195.386	2052
2053	2093677.843	415521.267	8682.52	NR 2011		2053
2054	2093681.851	414921.600	8971.56	-4.68	8966.881	2054
2055	2093683.488	415909.172	8740.67	3.24	8743.908	2055
2056	2093688.168	419126.054	8156.18	2.24	8158.418	2056
2057	2093695.008	411496.007	8377.55	-1.74	8375.808	2057
2058	2093704.218	416152.733	8823.94	3.28	8827.218	2058
2059	2093754.915	414406.770	9111.90	0.01	9111.913	2059
2060	2093772.279	414622.368	9140.07	0.25	9140.323	2060
2061	2093773.464	410489.157	7906.29	-0.50	7905.791	2061
2062	2093779.021	417137.431	8807.19	NR 2011		2062
2064	2093827.953	410840.081	8138.01	-0.01	8137.999	2064
2065	2093830.170	411226.468	8242.90	-0.66	8242.243	2065
2066	2093917.827	414715.361	8974.93	NR 2011		2066
2067	2093947.967	411534.948	8265.89	-2.76	8263.131	2067
2068	2093948.027	412929.324	9105.18	0.99	9106.165	2068
2069	2093961.689	413253.878	9258.68	-1.26	9257.421	2069
2070	2093962.747	415262.484	8680.88	1.06	8681.943	2070
2071	2093965.021	412161.109	8615.72	-4.01	8611.706	2071
2072	2093971.255	413429.424	9280.32	2.40	9282.719	2072
2073	2093972.939	414949.529	8822.77	2.79	8825.561	2073
2074	2093973.664	414000.731	9065.87	NR 2011		2074
2075	2093976.897	413751.430	9157.22	NR 2011		2075
2076	2093994.769	411139.435	8133.41	-1.61	8131.805	2076
2077	2094004.049	412550.060	8851.54	-0.44	8851.097	2077
2078	2094022.478	411923.000	8505.75	-1.05	8504.696	2078
2079	2094029.398	410730.564	7940.14	2.37	7942.508	2079
2080	2094067.556	414286.497	8849.63	NR 2011		2080
2081	2094156.598	410390.650	7961.57	NR 2011		2081
2082	2094230.098	411471.664	8290.15	-0.85	8289.299	2082
2083	2094231.119	412147.536	8677.35	0.52	8677.869	2083
2084	2094245.772	413351.172	9269.77	2.75	9272.524	2084
2085	2094247.397	412793.961	9070.58	-0.54	9070.038	2085
2086	2094272.376	414956.856	8688.28	-10.85	8677.430	2086
2087	2094275.835	413916.422	8954.35	NR 2011		2087
2088	2094284.439	415225.312	8573.61	-1.51	8572.105	2088
2089	2094290.025	413572.909	9201.41	5.87	9207.277	2089
2090	2094294.360	411815.424	8498.04	-0.94	8497.103	2090
2091	2094326.521	412437.556	8876.36	0.42	8876.778	2091
2093	2094340.846	414649.826	8688.14	-0.12	8688.021	2093
2094	2094358.830	411106.713	8123.35	0.24	8123.594	2094
2095	2094372.052	410828.595	7939.99	-0.34	7939.650	2095

2096	2094373.487	414343.031	8689.73	NR 2011		2096
2097	2094476.766	413581.295	9122.22	NR 2011		2097
2098	2094518.287	413321.514	9255.49	5.62	9261.109	2098
2099	2094529.387	413948.973	8880.62	NR 2011		2099
2100	2094540.412	411481.074	8377.97	0.28	8378.252	2100
2101	2094546.623	412151.639	8788.82	0.48	8789.302	2101
2102	2094569.415	411876.136	8625.59	-0.68	8624.914	2102
2103	2094577.203	414960.711	8501.87	-1.07	8500.799	2103
2104	2094579.145	412499.555	9100.66	-0.66	9099.997	2104
2105	2094583.443	414370.462	8608.94	NR 2011		2105
2106	2094590.945	410664.194	7857.16	-2.19	7854.967	2106
2107	2094604.441	414711.967	8489.78	-1.59	8488.190	2107
2108	2094618.793	415251.548	8403.88	0.09	8403.970	2108
2109	2094684.645	412811.619	9073.21	0.98	9074.186	2109
2110	2094730.613	411271.643	8198.62	-0.62	8198.001	2110
2112	2094802.812	413854.108	8905.98	NR 2011		2112
2113	2094803.733	413549.750	9147.32	NR 2011		2113
2114	2094811.742	413322.922	9241.09	7.08	9248.167	2114
2115	2094818.068	414489.473	8488.40	NR 2011		2115
2116	2094828.828	414845.361	8338.98	-2.04	8336.939	2116
2117	2094829.869	414182.916	8686.60	NR 2011		2117
2118	2094833.176	410800.128	7859.32	-1.78	7857.536	2118
2119	2094852.063	411120.504	8060.54	1.01	8061.551	2119
2120	2094864.480	415242.099	8286.73	0.07	8286.799	2120
2121	2094904.138	412558.289	8805.56	1.73	8807.285	2121
2122	2094924.796	412855.439	8929.77	0.30	8930.070	2122
2123	2094933.029	411417.594	8263.12	-1.41	8261.713	2123
2124	2094953.568	411805.084	8567.11	0.77	8567.881	2124
2125	2094999.032	412161.184	8672.09	0.00	8672.088	2125
2126	2095088.008	415285.972	8133.35	1.40	8134.752	2126
2127	2095098.603	413402.231	9221.49	1.79	9223.280	2127
2128	2095127.231	413619.940	9093.38	NR 2011		2128
2129	2095138.856	413155.485	9059.39	3.18	9062.572	2129
2130	2095147.874	414321.778	0.00	0.00		2130
2131	2095164.424	414956.820	0.00	0.00		2131
2132	2095167.851	411121.552	8031.25	-1.72	8029.534	2132
2133	2095177.921	414619.935	8594.69	NR 2011		2133
2134	2095179.007	413936.301	8203.72	NR 2011		2134
2135	2095195.298	410849.418	7842.82	0.68	7843.502	2135
2136	2095264.714	412050.379	8465.31	-0.03	8465.279	2136
2137	2095298.662	411778.391	8368.21	1.85	8370.063	2137
2138	2095326.686	412981.314	8897.28	1.00	8898.280	2138
2139	2095343.853	412428.869	8552.92	-0.94	8551.985	2139
2140	2095344.088	411437.334	8131.28	2.21	8133.485	2140
2141	2095352.526	412699.966	8709.88	0.85	8710.727	2141
2142	2095370.566	413350.878	9224.46	3.67	9228.125	2142
2143	2095404.916	411310.346	8041.48	1.00	8042.476	2143
2144	2095424.985	413673.849	9051.75	NR 2011		2144
2145	2095465.874	413999.920	8821.85	NR 2011		2145
2146	2095481.194	410937.348	7801.91	1.87	7803.778	2146
2147	2095492.218	414330.742	8608.81	NR 2011		2147
2148	2095519.451	414798.776	8361.75	NR 2011		2148
2149	2095639.445	411842.717	8220.43	0.08	8220.512	2149
2150	2095653.860	412372.736	8460.94	0.23	8461.169	2150
2151	2095662.321	412627.305	8622.02	1.47	8623.487	2151

2152	2095671.259	411536.877	8074.19	0.69	8074.878	2152
2153	2095672.619	413259.554	9120.71	0.66	9121.373	2153
2154	2095681.474	412112.601	8293.80	-0.10	8293.698	2154
2155	2095686.852	410993.540	7779.03	-0.59	7778.441	2155
2156	2095711.439	415147.588	8151.89	NR 2011		2156
2157	2095724.034	413877.129	8963.10	NR 2011		2157
2158	2095727.634	412988.861	8843.52	2.96	8846.481	2158
2159	2095733.971	413546.003	9202.80	3.56	9206.356	2159
2160	2095742.560	411252.530	7890.18	2.20	7892.379	2160
2161	2095748.263	414655.791	8474.15	NR 2011		2161
2162	2095770.992	414208.573	8722.35	NR 2011		2162
2163	2095909.082	412694.781	8614.08	-0.15	8613.930	2163
2164	2095935.044	412359.259	8408.37	-1.02	8407.347	2164
2165	2095952.431	411658.740	8025.89	1.53	8027.415	2165
2166	2095978.688	411022.869	7752.18	1.92	7754.099	2166
2167	2096022.059	412160.251	8286.16	0.96	8287.115	2167
2168	2096024.064	411277.121	7820.88	7.69	7828.570	2168
2169	2096026.896	412922.184	8726.61	1.47	8728.082	2169
2170	2096045.919	414455.143	8528.28	NR 2011		2170
2171	2096061.717	413265.525	8963.60	0.58	8964.183	2171
2172	2096064.096	414827.650	8314.27	NR 2011		2172
2173	2096070.686	413503.450	9155.97	2.14	9158.107	2173
2174	2096078.193	414140.532	8689.61	NR 2011		2174
2175	2096085.441	415130.111	8129.19	NR 2011		2175
2176	2096098.389	413809.044	8905.87	NR 2011		2176
2177	2096308.832	411486.628	7889.18	2.24	7891.415	2177
2178	2096322.831	411759.199	8032.44	0.27	8032.714	2178
2179	2096346.729	414441.374	8471.33	NR 2011		2179
2180	2096363.396	413887.091	8799.67	1.14	8800.812	2180
2181	2096366.466	411138.813	7725.12	1.88	7726.996	2181
2182	2096388.246	412121.606	8227.08	0.40	8227.481	2182
2183	2096396.753	413124.541	8986.03	0.85	8986.880	2183
2184	2096427.825	414149.404	8644.73	NR 2011		2184
2185	2096428.557	415177.775	8083.06	-2.93	8080.132	2185
2186	2096435.667	412444.283	8443.42	0.86	8444.277	2186
2187	2096454.961	413499.927	8807.26	3.88	8811.140	2187
2188	2096462.188	414854.369	8270.84	-1.53	8269.311	2188
2189	2096469.763	412846.823	8747.56	-1.46	8746.100	2189
2190	2096641.775	412048.681	8141.16	0.23	8141.385	2190
2191	2096661.049	411670.999	7948.80	1.45	7950.247	2191
2192	2096675.304	413136.429	8806.04	-0.48	8805.565	2192
2193	2096694.576	414343.550	8530.18	0.52	8530.698	2193
2194	2096724.413	414010.005	8559.02	1.51	8560.530	2194
2195	2096742.663	412566.370	8474.74	-0.79	8473.950	2195
2196	2096852.542	414814.317	8276.58	1.09	8277.673	2196
2197	2096860.332	413563.479	8516.98	0.01	8516.993	2197
2198	2097043.469	415225.866	8109.85	-0.52	8109.333	2198
2199	2097088.508	414145.518	8330.76	0.94	8331.696	2199
2200	2097156.112	411737.582	7888.59	-0.71	7887.883	2200
2201	2097164.378	413194.448	8571.84	0.64	8572.476	2201
2202	2097172.689	412412.597	8230.46	-1.28	8229.183	2202
2203	2097187.210	412055.173	7950.34	-0.16	7950.183	2203
2204	2097208.321	412644.618	8293.40	-1.26	8292.141	2204
2205	2097217.623	413848.672	8236.95	-0.56	8236.393	2205
2206	2097222.505	412956.697	8426.64	2.95	8429.588	2206

2207	2097224.737	413572.232	8374.84	NR 2011		2207
2208	2097238.073	414420.058	8211.21	1.99	8213.198	2208
2209	2097245.433	411415.830	7663.42	-0.30	7663.122	2209
2210	2097269.419	414900.753	8021.34	1.19	8022.525	2210
2211	2097373.819	411930.186	7895.73	1.34	7897.067	2211
2212	2097426.521	412948.889	8380.22	-0.34	8379.879	2212
2213	2097457.838	413489.295	8348.25	-1.22	8347.027	2213
2214	2097462.282	412549.946	8095.69	-0.93	8094.756	2214
2215	2097473.369	412225.102	8002.26	-1.53	8000.729	2215
2216	2097480.359	413169.331	8494.35	-1.85	8492.504	2216
2217	2097488.599	414141.455	8065.12	0.48	8065.597	2217
2218	2097495.771	413756.152	8184.22	-3.51	8180.711	2218
2219	2097552.161	414466.820	8010.44	2.43	8012.869	2219
2220	2097714.743	414905.863	7761.50	-0.56	7760.939	2220

MACRO-INVERTEBRATE STUDY

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December 5, 2011

Dana Marrelli
UtahAmerican Energy, Inc.
West Ridge Mine
P.O. Box 910
East Carbon, UT 84520

RE: Crandall Canyon Macroinvertebrate Study

Dear Dana,

Enclosed is the bound copy of the Spring 2011 Macroinvertebrate Report for the Crandall Canyon Mine. This is the same as the electronic copy that we sent earlier. We will begin work on the Fall 2011 report once we receive the lab report.

Thank you for the opportunity to conduct this ongoing work. Feel free to contact me if you have any questions or comments.

Regards,

Karla Knoop, Hydrologist

JBR Environmental Consultants, Inc.

Corporate Headquarters
8160 S. Highland Dr.
Sandy, Utah 84093
[p] 801.943.4144
[f] 801.942.1852

www.jbrenv.com

Crandall Canyon Mine Macroinvertebrate Study July 2011

Prepared for:
Genwal Resources, Inc.
Crandall Canyon Mine
P.O. BOX 910
East Carbon, Utah 84520

Prepared by:
JBR Environmental Consultants, Inc.
8160 S. Highland Drive,
Sandy, Utah 84093

801.943.4144

December 5, 2011

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Appendix 1 BugLab Report

Appendix 2 Macroinvertebrate Metrics

Crandall Canyon Mine Macroinvertebrate Study July 2011

1.0 Introduction

On July 14, 2011, 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 several years. However, intercepted groundwater continues to discharge from the sealed portals and Crandall Creek is the receiving stream for the discharged water.

Beginning in the fall of 2009, JBR has sampled the creek's benthic macroinvertebrates twice yearly to determine whether or not the mine discharge is affecting Crandall Creek's aquatic community, and prepared biannual reports based upon the laboratory data (JBR 2010; JBR 2011a; JBR 2011b). This report discusses the results from the July 14, 2011 sampling event. After giving some relevant background information, it describes the data collection and analysis methodology, provides the laboratory data, and discusses the study results to date.

1.1 Background

The Crandall Canyon Mine began discharging groundwater in late 1995, and did so more or less continuously for 12 years. During operations, groundwater entering the underground mine had to be collected and pumped to the surface to ensure safe working conditions. Except for some passive in-mine settling, this 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 pumped groundwater discharge.

Subsequent to mine closure in mid-2007 and 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. 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 gravity-flow rates have been similar to the flow rates that prevailed during the operational pumping, water quality changed once the discharge resumed in early 2008 (JBR 2010). In particular, total iron concentrations increased by up to three orders of magnitude and exceeded the established UPDES permit limits. The iron-laden discharge 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. In early 2010, Genwal began operating an iron treatment system, and total iron concentrations have consistently been kept at less than 1.0 mg/L since March 2010. However, the iron-stained substrate is still present.

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 even toxic depending upon its chemical form and its concentration. Largely as a function of the water's pH and 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.

Taking all of these things into account, EPA has conservatively recommended a (nationwide) 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.

1.2 Purpose of Study

In 2009, due to ongoing elevated iron concentrations associated with Genwal's permitted groundwater discharge, the relevant regulatory (DWQ, DOGM) and management (U.S. Forest Service (USFS), DWR) agencies became concerned about the potential impacts of the 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 twice each year (in June and September) and prepare comprehensive reports that describe and evaluate each study's results.

This report is intended to meet the ongoing DOGM requirements for the biannual sampling and reporting. Its purpose is to assess both the spatial and temporal variation in the macroinvertebrate community of Crandall Creek with the goal of determining what, if any, iron-caused impacts have occurred or are still occurring in that community.

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, these repeat studies 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

Prior to the initiation of sampling in 2009 in response to the previously noted DOGM citation, Crandall Creek's macroinvertebrate community had been periodically assessed by others. In 1980, macroinvertebrate samples were collected at several locations along Crandall Creek before the mine start-up. 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. In addition, the USFS samples benthic macroinvertebrates in Huntington Creek every five years. Brief descriptions of each of these other studies were given in a previous JBR report (JBR 2010).

To comply with DOGM Citation #10044, JBR collected macroinvertebrate samples in Crandall Creek in September 2009 (JBR 2010), in June 2010 (JBR 2011a), and again in September 2010 (JBR 2011b). During these studies, samples were collected at three locations. The uppermost sampling reach (CRANDUP-01) was upstream of any influence of the mine's groundwater discharge, thus serving as a reference reach. The middle reach (CRANDMD-02) included the area immediately downstream of the discharge location where flow mixing, aeration, and iron precipitation were occurring. The downstream reach (CRANDLWR-03) was a short distance upstream of the confluence with Huntington Creek, outside of the area with a visibly impacted substrate. During the September 2009 event, sample collection methodology was generally based upon the reach-wide, multi-habitat sample methodology outlined in the (EMAP) Field Operations Manual for Wadeable Streams (EPA 2001), modified as per discussions with the Manti-La Sal National Forest fisheries biologist. During the 2010 sampling events, targeted-riffle samples were added to the protocol.

Overall, the study results from the 2009 and 2010 sampling indicated that the Crandall Creek macroinvertebrate community downstream of the mine's discharge appeared to have been negatively impacted. However, both downstream reaches of the creek were still supporting a variety of macroinvertebrates, signifying that the mine discharge had not completely decimated macroinvertebrate populations.

3.0 Site Locations and Descriptions

3.1 Site Locations

Prolonged snow melt runoff with high flow rates prohibited collecting macroinvertebrate samples in June 2011. With prior approval from DOGM, sampling was postponed until July. Although flows were still elevated, macroinvertebrate samples were collected on July 14, 2011 after peak runoff had diminished. The samples were collected at the same three sites that were sampled during the 2009 and 2010 sampling events. The uppermost site (CRANDUP-01) is near the upstream edge of the upper parking lot and outside of any influence of the mine's groundwater discharge. Its downstream endpoint is approximately 2 meters above the flow measurement flume and the reach extends upstream approximately 150 meters. The middle site (CRANDMD-02) includes the area immediately downstream of the discharge location where flow mixing and aeration are occurring, and where the iron previously precipitated. Its upstream endpoint (Transect K) is approximately 5 meters downstream of the discharge point, with the reach extending downstream approximately 150 meters. The downstream site (CRANDLWR-03) was chosen to be approximately 2 meters upstream of the mine road crossing near the confluence of Crandall Creek and Huntington Creek, and its reach extended upstream from that point approximately 150 meters.

As per EMAP protocol, during the September 2009 study 11 cross-section transects were established at regular intervals within each of these reaches, and were flagged and marked (JBR 2010). These same transects were used in the 2010 studies.

3.2 Site Descriptions

The report that presented the 2009 study results (JBR 2010) described stream morphology, substrate, and riparian vegetation. During the June 2010 (JBR 2011a) sampling, additional observations were made on bed substrate at each reach, in order to provide some context for variation in macroinvertebrate communities among the three reaches. Substrate at CRANDMD-02 is notable for iron-stained particles and the presence (seasonally) of filamentous algae. CRANDLWR-03 substrate is generally calcified and cemented in place.

July 2011 channel conditions were generally similar to those noted during the previous sampling events. Snow melt runoff had subsided, but a thunderstorm event elevated flows and resulted in turbidity during sampling. At Site CRANDMD-02, filamentous algae appeared to be reduced (likely due to season and scour from snow melt), and surface iron staining also appeared to be less noticeable (however, kicking up substrate during sampling re-exposed iron-stained particles). The following photos provide a visual description of the site conditions at the time of the July 2011 sampling.

CRANDUP-01 on July 14, 2011

CRANDMID-02 on July 14, 2011

CRANDLWR-03 on July 14, 2011

4.0 Methods

JBR collected two macroinvertebrate samples, a multi-habitat sample and a riffle sample, from each of the locations described above. Sample collection for the multi-habitat sample was the same as described in JBR (2010) and was based upon the reach-wide sample methodology outlined in the (EMAP) Field Operations Manual for Wadeable Streams (EPA 2001). The specific application of this 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 4.1.1 below describes the modified methodology. The riffle sample was collected following the EMAP targeted riffle sample methodology. Section 4.1.2 below describes the targeted riffle 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. It 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 (Judson and Miller 2011) is attached as Appendix 1.

4.1 Sample Collection Methods

4.1.1 Modified Multi-Habitat Sample Collection

The EMAP methodology for the multi-habitat 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 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, multi-habitat 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, where possible.

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 500-micron mesh D-frame kick net. 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 kick net 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 (e.g., multi-habitat or riffle)
   * Stream Name
   * Site I.D.
   * Forest (Manti-La Sal National Forest)
   * Date and Time of Collection
   * Number of Jars

4.1.2 Targeted Riffle Sample Collection

The EMAP methodology for the targeted riffle sample specifies that eight macroinvertebrate subsamples be taken within available riffle macrohabitat units within the delineated reach. These subsamples are then combined into a composite targeted riffle sample. The sample locations are identified by surveying the delineated reach prior to sampling to visually estimate the number and area of riffle units. If the reach contains more than one distinct riffle macrohabitat unit but less than eight, the eight sampling points are allocated among the units to spread the effort throughout the reach as much as possible, with it possible to collect more than one kick sample from a single riffle unit. If the number of riffle macrohabitat units is greater than eight, one or more habitats is skipped at random. Within each riffle unit, EMAP specifies that the sample locations be chosen at random from nine equal quadrats (visually estimated). However, as already noted, Crandall Creek is a narrow stream at all sites, and particularly CRANDUP-01. As a result, the riffle samples from each macrohabitat unit were not chosen randomly, rather the site that was most suitable to sampling was chosen (i.e., the location that allowed placement of the sampler). The samples were collected in a downstream-to-upstream order to avoid including organisms dislodged from upstream samples.

Once locations were chosen, samples were collected and composited following the same procedures outlined for the modified multi-habitat sample.

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 Judson and Miller 2011). For all six samples, 100 percent of the sample material was processed (i.e., sub-sampling procedures were not 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 (Judson and Miller 2011) 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 (Judson and Miller 2011), 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, Community Tolerant Quotient (CTQd), Hilsenhoff Biotic Index (HBI), 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 given in their report (Judson and Miller 2011), which can be found in Appendix 1.

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.

Instead, as was done for the previous JBR reports (2010; 2011a; 2011b) on macroinvertebrate sampling in Crandall Creek, 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 (Barbour et al 1999). Metrics that would be expected to decrease as site conditions worsen (e.g., richness) are shown in blue and those that would be expected to increase as site conditions worsen (e.g., 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 (e.g., impact), there is a greater likelihood that there is a degradation between sites as a result of mine discharge. 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 laboratory results report that was prepared by the BugLab (Judson and Miller 2011) is provided in full as Appendix 1. That report includes the raw data (taxonomic lists of organisms that were sampled, counts, etc.) as well as numerous tables giving various metrics and indices that the lab calculated based upon the data. The BugLab's report (Judson and Miller 2011) does not discuss or interpret the study results. This section focuses on those tasks, beginning with a brief summary of the data and a general discussion of the results.

A total of 61 operational taxonomic units (OTUs) were identified in the 6-sample set, which is similar to the June 2010 sampling event, when 65 OTUs were reported (JBR 2011a). At 31, the number of families and number of genera were within the ranges those previously reported in JBR (2010; 2011a; 2011b). Variations in these numbers can be caused by flow conditions, time of year, macroinvertebrate life cycles, and environmental degradation.

All of the insect orders most commonly found in macroinvertebrate communities (Coleoptera, Diptera, Ephemeroptera, Plecoptera, and Tricoptera) as well as individuals from some non-insect classes were represented in both sample sets. Composition (e.g., proportion of members of the order Diptera) continues to show that none of the three Crandall Creek sites is in optimum condition, though there is variation among the sites, which will be described further below. CTQd, which can range from about 20 in the best quality streams up to about 100 in the poorest, was between 63 and 84 in the Crandall Creek July 2011 samples. Though this range of values is improved over the previous two sampling events (JBR 2011a and 2011b), it still indicates a stream that is providing less than ideal aquatic habitat.

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. Knowing that (1) Crandall Creek overall has an aquatic community that is not optimum, and (2) in spite of Genwal's 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 the majority of the metrics discussed below, there continues to be a less healthy macroinvertebrate community at both CRANDMD-02 and CRANDLWR-03, which are downstream of the discharge, than at CRANDUP-01, which is upstream of the discharge.

Habitat differences among the three sites (described briefly above in Section 3.2) could be at least partially reflected in the results and their interpretation. For example, CRANDUP-01 and CRANDLWR-03 have similar substrate size compositions, but at the latter much of the substrate is embedded and cemented. This lack of interstitial spaces results in poor physical habitat for macroinvertebrates at CRANDLWR-03. Therefore, the site comparisons in Section 5.2 must consider that habitat is degraded at this site due to characteristics unrelated to any that have potentially occurred due to the discharges of iron-laden water. Additionally, the substrate at CRANDMD-02 is similar to that at the other two sites, but proportionally has more graveled

riffle reaches than the other two sites. These features generally offer the best physical habitat for macroinvertebrates, but at CRANDMD-02, much of this high-quality substrate is now iron-stained and covered with filamentous algae.

5.1 Comparison of Targeted Riffle and Multi-Habitat Samples

As with the 2009 and 2010 analyses (JBR 2010; 2011a; 2011b), numerous metrics and indices have been calculated and graphed for the September 2010 samples. These graphs are included in Appendix 2. They provide a visual means to determine whether there were differences between the samples collected from targeted riffle sites and those collected from the multi-habitat sites.

One of the reasons that the first study report (JBR 2010) recommended that targeted riffle samples should be collected along with the multi-habitat ones during future monitoring events was based upon the observation that habitat types varied somewhat between each reach. It was felt that the spatial data comparison would be more robust using the results of targeted riffle sampling. In addition, Utah's DWQ monitoring program calls for macroinvertebrate samples to be collected using only a targeted riffle method (DWQ 2006). Collecting targeted riffle samples in Crandall Creek, as well as continuing to collect multi-habitat samples, would allow a broader means of data interpretation in the future, as the data set grows.

Notably, at CRANDMD-02 the riffle sample reflected much better macroinvertebrate habitat than did the multi-habitat sample. Overall, however, conclusions regarding trends or spatial differences are the same regardless of sample types, so both riffle and multi-habitat results are used in the following discussions.

5.2 Spatial Variation in Macroinvertebrate Community

As noted above, numerous metrics and indices based upon the September 2010 sampling at CRANDUP-01, CRANDMD-02, and CRANDLWR-03 have been calculated and graphed. These graphs are included in Appendix 2 and provide a visual aid for analyzing 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, 14 of the targeted riffle sample results and 16 of the multi-habitat samples results indicate a decline in macroinvertebrate community health between CRANDUP-01 and CRANDMD-02. These are similar percentages as were shown with the 2009 and 2010 samples (JBR 2010; 2011a; 2011b). The noted decline in the aquatic community between these two sites is based upon a range of tolerance, community composition, diversity, and feeding group metrics, which strengthens the conclusion that the mine discharge has negatively affected habitat. Similarly, based upon the majority of the

metrics (and again across metric types), CRANDUP-01 has a healthier macroinvertebrate community than does CRANDLWR-03.

5.3 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 for temporal comparisons due to unknowns in either sampling locations and/or collection methodology. Instead, the four sets of data collected by JBR from September 2009, June 2010, and September 2011, and July 2011) are examined herein to assess temporal variation.

Examination of the graphed metrics does not show a strong overall trend in either improvement or degradation at any of the sites across the period of sampling; some metrics indicate improvement, some indicate degradation, and others are essentially the same. The previous sample report (JBR 2011b) noted that CRANDUP-01 had poorer macroinvertebrate conditions in June 2010 than in either of the two September sampling events. This was likely due to the high snowmelt runoff that was occurring at the time of sampling.

Comparisons made among like seasons when stream flow rates and macroinvertebrate life cycles are more likely to be similar may be more meaningful; however to date there are only two sampling events for each season, which limits interpretations. The July 2011 samples indicated improvements over the June 2010 samples at all three sites. While these noted improvements were reflected at CRANDMD-02 (particularly in the riffle set) and CRANDLWR-03, the fact that improvements were also reflected at the upstream, unaffected site precludes an interpretation that the downstream improvements reflect recovery from the iron-laden mine discharges. Instead, these differences could be all or partially due to more optimum flow conditions (e.g., later in the runoff cycle) during the more recent sampling event, for example.

5.4 Metric Refinement

With the inclusion of the latest set of data, collected July 2011, a total of four sampling events are now available for analysis. While a set of four events limits the potential for robust statistical analysis (especially given the different seasons represented) or development of an integrated index, the large number (20) of metrics can be winnowed down. As noted above in Section 4.2, there was some redundancy among the 20 metrics that were initially selected. However, different metric types (e.g., tolerance, diversity, community composition, feeding mechanism) were represented. Reducing the number of metrics that are looked at from here out should reduce the redundancy but still include a variety of metric measures; the new set of metrics should also reflect the same general conclusions as does the full set.

In order to refine the set of metrics upon which subsequent reports will focus, the range (as indicated by the highest and lowest value) of each metric across the four data sets was compared for each of the three sites. The riffle samples and the multi-habitat samples were both included in this analysis. The spread in the values of each metric encompasses at least

some measure of seasonality, natural variation, or trends, albeit within the short timeframe between fall 2009 and spring 2011. The primary goal of the monitoring has been to determine whether or not the sites downstream of the mine discharge have been affected by it, and the data collected to date consistently shows that CRANDMD-02 and CRANDLWR-03 have poorer macroinvertebrate communities than does CRANDUP-01. The metrics that may show this result most clearly may be those where the distributions in the data between the upstream and downstream sites are the most divergent.

For each metric, the maximum and minimum values at the site immediately below the mine discharge (CRANDMD-02) were compared with those at the upstream, unaffected site (CRANDUP-01) and categorized as being either: within the spread of values, completely outside the it, or overlapping it. None of the 20 metrics had completely disparate spreads between CRANDUP-01 and CRANDMD-02 (i.e., there was always some overlap). For 9 out of the 20 metrics (richness, EPT taxa abundance, number of intolerant taxa, HBI, number of clinger taxa, number of long-lived taxa, percent scrapers, percent chironomids, and percent tolerant organisms), the CRANDMD-02 range was within the range reported for CRANDUP-01. The remaining 11 metrics were outside the range in one direction of the other (though sometime only minimally); in all but one of those, the direction outside the overlap reflected degradation at the downstream site compared to the upstream (i.e., was consistent with the overall interpretation using all 20 metrics). Coincidently or not, several of these are metrics that have been noted to be indicative of mining and/or elevated trace elements. Further, these divergent metrics encompassed tolerance, diversity, community composition, and feeding mechanism measures. A comparison between CRANDUP-01 and CRANDLWR-03 showed similar results, but with fewer metrics found to be within the CRANDUP-01 range. A table at the end of Appendix 2 shows this comparison.

6.0 Recommendations for Future Study

JBR recommends that future sampling events use the same methodology and equipment as was used in 2010. Samples should include both a multi-habitat sample at each site and a targeted riffle sample at each site.

Future sample reports should focus on a reduced set of metrics. The following 10 metrics are recommended based upon the assessment in Section 5.4: Shannon's Diversity; evenness; CTQd; percent shredders; ratio of specialist feeders to generalist feeders; percent EPT; ratio of EPT to Chironomids; percent Heptageniidae, Chloroperlidae, & Rhyacophila; percent Baetis, Hydropsychidae, & Orthocladiinae; and percent of Baetis to all Ephemeroptera. In addition, percent scrapers will also be retained as a metric, due to its potential usefulness to tie into the presence/absence of filamentous algae. (Note that any of the other "discarded" metrics will either still be available within the BugLab reports or can easily be calculated from data contained with those reports.) In addition to the spread of values as indicated by the maximum

and minimum, box-and-whisker plots should also be considered to provide a more refined analysis.

7.0 Summary and Conclusions

In July 2011, benthic macroinvertebrate samples were collected from three reaches of Crandall Creek. One reach was located upstream of Genwal's Crandall Canyon Mine groundwater discharge while the other two reaches were located downstream of the discharge. One of the primary goals of the study was to determine whether the previously 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 sample collection, and numerous indices and metrics were calculated for ease in interpreting results.

Overall, the study results indicate that the Crandall Creek macroinvertebrate community immediately downstream of the mine discharge continues to show negative impacts of the mine water discharge. Although the furthest downstream reach of Crandall Creek (CRANDLWR-03) also has a degraded macroinvertebrate community, its poor substrate condition (embedded and cemented) is likely a contributing (if not dominating) factor affecting macroinvertebrate community health at that site. However, both downstream reaches of the creek are still supporting a variety of macroinvertebrates, indicating that neither the past iron-laden discharge nor the continuing treated discharge has completely eliminated macroinvertebrate populations.

8.0 References

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Cuffney, T.F., Gurtz, M.E., and Meador, M.R. 1993. Methods for collecting benthic invertebrate samples as part of the National Water Quality Assessment Program: United States Geological Survey Open File Report 93-406.

Davis, Jeffrey C., G. Wayne Minshall, Christopher T. Robinson, and Peter Landres. 2001. Monitoring Wilderness Stream Ecosystems. U.S.D.A. Forest Service, Rocky Mountain Research Station. General Technical Report RMRS-GTR-70. January 2001.

Division of Water Quality (DWQ). 2006. Utah Division of Water Quality Monitoring Manual.

Environmental Protection Agency (EPA). 2009. National Recommended Water Quality Criteria, accessed online in December 2009, at http://www.epa.gov/waterscience/criteria/wqctable /#gold.

Environmental Protection Agency (EPA). 2009a. Classification of Macroinvertebrates, accessed online in December 2009, at http://www.epa.gov/bioiweb1/html/invertclass.html.

Environmental Protection Agency (EPA). 2001. Environmental Monitoring and Assessment Program (EMAP) Field Operations Manual for Wadeable Streams.

Hem, John D. 1985. Study and Interpretation of the Chemical characteristics of Natural Water. Third Edition. U.S. Geological Survey Water-Supply Paper 2254.

JBR Environmental Consultants, Inc. (JBR). 2010. Crandall Canyon Mine Macroinvertebrate Study September 2009. Prepared for Genwal Resources, Inc. January 27, 2010.

JBR Environmental Consultants, Inc. (JBR). 2011a. Crandall Canyon Mine Macroinvertebrate Study June 2010. Prepared for Genwal Resources, Inc. January 17, 2011.

JBR Environmental Consultants, Inc. (JBR). 2011b. Crandall Canyon Mine Macroinvertebrate Study September 2011. Prepared for Genwal Resources, Inc. August 22, 2011.

Judson, Sarah and Miller, Scott. 2011. Aquatic Invertebrate Report for Samples Collected by JBR Environmental Consultants, Inc. Report prepared on September 28, 2011, by Sarah Judson and Scott Miller, U.S. Bureau of Land Management, National Aquatic Monitoring Center, Department of Watershed Sciences, Utah State University.

Kiffney, Peter M. and William H. Clements. 1994. Effects of Heavy Metals on a Macroinvertebrate Assemblage from a Rocky Mountain Stream in Experimental Microcosms. Journal of North American Benthological Association, Vol. 13, No. 4 (Dec., 1994), pp. 511-523.

Mize, Scott V. and Jeffrey R. Deacon. 2002. Relations of Benthic Macroinvertebrates to Concentrations of Trace Elements in Water, Streambed Sediments, and Transplanted Bryophytes and Stream Habitat Conditions in Nonmining and Mining Areas of the Upper Colorado River Basin, Colorado, 1995–98. U.S. Geological Survey, Water-Resources Investigations Report 02–4139.

Moretti, Miles. 1995. Letter from Utah Division of Wildlife Resources Regional Supervisor to Allen Childs, Genwal Mining Company General Manager dated August 11, 1995. Letter included in Appendix 3-2 of Genwal Resources, Inc. Crandall Canyon Mine MRP.

APPENDIX 1
BUGLAB REPORT

Aquatic Invertebrate Report For Samples Collected By JBR Environmental Consultants - Sandy, UT

Report prepared for:
Dave Kikkert
JBR Environmental Consultants - Sandy, UT
8160 S. Highland Drive
Sandy, UT 84093
801-943-4144; dkikkert@jbrenv.com

Report prepared by:
Sarah Judson and Scott Miller
U.S.D.I. Bureau of Land Management
National Aquatic Monitoring Center
Department of Watershed Sciences
5210 Old Main Hill
Utah State University
Logan, Utah 84322-5210
Sarah: 435.797.3310; sarah.judson@usu.edu
Scott: 435.797.2612; scott.miller@usu.edu

28 September 2011

Sampling Locations

Table 1. Sampling site locations

Station	Location	Latitude	Longitude	Elevation (meters)
CRANDLWR-03	Crandall Creek, Lower, Emery County, UT	39.464	-111.1460	2363
CRANDMD-02	Crandall Creek, Middle, Emery County, UT	39.460	-111.1650	2384
CRANDUP-01	Crandall Creek, Upstream, Emery County, UT	39.460	-111.1680	2389

Methods

Field sampling

Samples were collected on July 14, 2011 (Table 2). Aquatic invertebrates were collected quantitavely and qualitatively from riffle and reachwide habitats with a Kick 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
146827	CRANDLWR-03	07/14/2011	Reachwide	Kick Net	0.37	100	77
146828	CRANDLWR-03	07/14/2011	Targeted Riffle	Kick Net	0.74	100	647
146825	CRANDMD-02	07/14/2011	Reachwide	Kick Net	0.37	100	201
146826	CRANDMD-02	07/14/2011	Targeted Riffle	Kick Net	0.74	100	456
146823	CRANDUP-01	07/14/2011	Reachwide	Kick Net	0.37	100	230
146824	CRANDUP-01	07/14/2011	Targeted Riffle	Kick Net	0.74	100	551

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 ≤ 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 (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
146823	07/14/2011	CRANDUP-01	622	435	Baetidae	26.53
146824	07/14/2011	CRANDUP-01	741	619	Heptageniidae	34.82
146825	07/14/2011	CRANDMD-02	541	73	Chironomidae	64.14
146826	07/14/2011	CRANDMD-02	614	291	Baetidae	25.57
146827	07/14/2011	CRANDLWR-03	207	97	Chironomidae	26.09
146828	07/14/2011	CRANDLWR-03	871	348	Chironomidae	37.43
Mean			599.3	310.5		35.76

Diversity indices

Sample	Sampling Date	Station	Total taxa richness	Total genera richness	Total family richness	EPT taxa richness	Shannon diversity index	Evenness
146823	07/14/2011	CRANDUP-01	35	21	20	15	2.700	0.760
146824	07/14/2011	CRANDUP-01	26	19	17	11	2.030	0.620
146825	07/14/2011	CRANDMD-02	22	16	17	8	1.870	0.600
146826	07/14/2011	CRANDMD-02	33	21	22	13	2.550	0.730
146827	07/14/2011	CRANDLWR-03	18	9	13	8	2.450	0.850
146828	07/14/2011	CRANDLWR-03	28	16	21	13	2.140	0.640
Mean			27.0	17.0	18.3	11.3	2.290	0.700

Genera richness by major taxonomic group.

Sample	Sampling Date	Station	Coleoptera	Diptera	Ephemerotpera	Heteroptera	Megaloptera	Odonata	Plecoptera	Trichoptera	Annelida	Custacea	Mollusca
146823	07/14/2011	CRANDUP-01	1	13	6	0	0	0	5	4	1	0	1
146824	07/14/2011	CRANDUP-01	1	11	5	0	0	0	3	3	0	0	1
146825	07/14/2011	CRANDMD-02	3	9	5	0	0	0	2	1	0	0	1
146826	07/14/2011	CRANDMD-02	1	13	6	0	0	0	3	4	1	0	1
146827	07/14/2011	CRANDLWR-0	0	4	4	0	0	0	1	3	1	0	1
146828	07/14/2011	CRANDLWR-0	0	9	5	0	0	0	4	4	1	0	0
Mean			1.0	9.8	5.2	0.0	0.0	0.0	3.0	3.2	0.7	0.0	0.8

Total abundance by major taxonomic group.

Sample	Sampling Date	Station	Coleoptera	Diptera	Ephemerotpera	Heteroptera	Megaloptera	Odonata	Plecoptera	Trichoptera	Annelida	Custacea	Mollusca
146823	07/14/2011	CRANDUP-01	3	138	370	0	0	0	41	24	16	0	5
146824	07/14/2011	CRANDUP-01	3	98	531	0	0	0	47	40	0	0	4
146825	07/14/2011	CRANDMD-02	57	401	54	0	0	0	16	3	0	0	5
146826	07/14/2011	CRANDMD-02	40	215	250	0	0	0	24	16	13	0	4
146827	07/14/2011	CRANDLWR-03	0	70	78	0	0	0	5	13	5	0	5
146828	07/14/2011	CRANDLWR-03	0	422	305	0	0	0	27	16	20	0	0
Mean			17.2	224.0	264.7	0.0	0.0	0.0	26.7	18.7	9.0	0.0	3.8

Biotic Indices

Sample	Sampling date	Station	Hilsenhoff Biotic Index		USFS Community CTQd
			Index	Indication	
146823	07/14/2011	CRANDUP-01	3.53	Possible slight organic pollution	69
146824	07/14/2011	CRANDUP-01	3.65	Possible slight organic pollution	63
146825	07/14/2011	CRANDMD-02	5.01	Some organic pollution	84
146826	07/14/2011	CRANDMD-02	3.55	Possible slight organic pollution	75
146827	07/14/2011	CRANDLWR-03	3.74	Possible slight organic pollution	83
146828	07/14/2011	CRANDLWR-03	4.35	Possible slight organic pollution	77
Mean			3.97		75.2

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 <= 2. Tolerant taxa have a HBI score >= 8. 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				Tolerant Taxa			
			Richness		Abundance		Richness		Abundance	
146823	07/14/2011	CRANDUP-01	9	(26)	100	(16)	0	(0)	0	(0)
146824	07/14/2011	CRANDUP-01	7	(27)	120	(16)	0	(0)	0	(0)
146825	07/14/2011	CRANDMD-02	5	(23)	24	(4)	0	(0)	0	(0)
146826	07/14/2011	CRANDMD-02	8	(24)	82	(13)	1	(3)	1	(0)
146827	07/14/2011	CRANDLWR-0	2	(11)	11	(5)	0	(0)	0	(0)
146828	07/14/2011	CRANDLWR-0	6	(21)	40	(5)	0	(0)	0	(0)
Mean			6.2	(22)	62.8	(10)	0.2	(1)	0.2	(0)

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	
146823	07/14/2011	CRANDUP-01	4	(11)	4	(11)	3	(9)	9	(26)	12	(34)	3	(9)
146824	07/14/2011	CRANDUP-01	1	(4)	3	(12)	4	(15)	6	(23)	11	(42)	1	(4)
146825	07/14/2011	CRANDMD-02	2	(9)	2	(9)	2	(9)	6	(27)	8	(36)	2	(9)
146826	07/14/2011	CRANDMD-02	4	(12)	3	(9)	3	(9)	9	(27)	12	(36)	2	(6)
146827	07/14/2011	CRANDLWR-0	1	(6)	1	(6)	2	(11)	5	(28)	9	(50)	0	(0)
146828	07/14/2011	CRANDLWR-0	2	(7)	2	(7)	2	(7)	7	(25)	14	(50)	0	(0)
Mean			2.3	(8)	2.5	(9)	2.7	(10)	7.0	(26)	11.0	(42)	1.3	(5)

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	
146823	07/14/2011	CRANDUP-01	16	(3)	192	(31)	14	(2)	289	(46)	100	(16)	11	(2)
146824	07/14/2011	CRANDUP-01	11	(1)	283	(38)	19	(3)	312	(42)	114	(15)	3	(0)
146825	07/14/2011	CRANDMD-02	5	(1)	40	(7)	8	(1)	355	(66)	78	(14)	54	(10)
146826	07/14/2011	CRANDMD-02	8	(1)	83	(14)	7	(1)	324	(53)	148	(24)	43	(7)
146827	07/14/2011	CRANDLWR-0	5	(2)	11	(5)	8	(4)	126	(61)	57	(28)	0	(0)
146828	07/14/2011	CRANDLWR-0	11	(1)	7	(1)	3	(0)	651	(75)	198	(23)	0	(0)
Mean			9.3	(2)	102.7	(16)	9.8	(2)	342.8	(57)	115.8	(20)	18.5	(3)

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

Sample	Sampling Date	Station	Total taxa	Ephemeroptera taxa	Plecoptera taxa	Trichoptera taxa	Long-lived taxa	Intolerant taxa	Clinger taxa	% tolerant individuals	% contribution dominant taxon	% predators
146823	07/14/2011	CRANDUP-01	35	6	3	4	2	9	11	0.00	23.95	16.08
146824	07/14/2011	CRANDUP-01	26	5	2	3	2	7	11	0.00	33.47	15.38
146825	07/14/2011	CRANDMD-02	22	4	2	1	3	5	7	0.00	53.79	14.42
146826	07/14/2011	CRANDMD-02	33	5	3	3	2	8	9	0.16	25.57	24.10
146827	07/14/2011	CRANDLWR-03	18	2	0	2	0	2	4	0.00	26.09	27.54
146828	07/14/2011	CRANDLWR-03	28	3	1	3	1	6	7	0.00	36.17	22.73
Mean			27.0	4.2	1.8	2.7	1.7	6.2	8.2	0.03	33.17	20.04

Taxonomic list and counts for 6 samples collected on July 14, 2011. Count is the total number of individuals identified and retained. Samples heading refers to the number of samples containing that taxon.

Order	Family	Subfamily/Genus/Species	Samples	Count
Phylum: Annelida				
Class: Clitellata	SubClass: Oligochaeta			
			4	33
Phylum: Arthropoda				
Class: Arachnida	SubClass: Acari			
Trombidiformes			4	11
Trombidiformes	Arrenuridae	Arrenurus	3	4
Trombidiformes	Hydryphantidae	Protzia	1	3
Trombidiformes	Hydryphantidae	Wandesia	1	1
Trombidiformes	Lebertiidae	Lebertia	5	79
Trombidiformes	Sperchonidae	Sperchon	3	29
Class: Insecta	SubClass: Pterygota			
Coleoptera	Dytiscidae		1	1
Coleoptera	Elmidae	Narpus concolor	4	51
Coleoptera	Elmidae	Optioservus quadrimaculatus	1	2
Diptera			1	2
Diptera	Ceratopogonidae		3	4
Diptera	Ceratopogonidae	Ceratopogoninae Sphaeromiini Probezzia	4	27
Diptera	Chironomidae		4	20
Diptera	Chironomidae	Chironominae	4	30
Diptera	Chironomidae	Orthocladiinae	6	487
Diptera	Chironomidae	Tanypodinae	4	14
Diptera	Empididae		2	3
Diptera	Empididae	Hemerodromiinae Hemerodromiini	2	14
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	5	57
Diptera	Empididae	Neoplasta	3	28
Diptera	Empididae	Wiedemannia	1	1
Diptera	Psychodidae	Pericoma	1	1
Diptera	Simuliidae		1	2
Diptera	Simuliidae	Simuliinae Prosimuliini Helodon	3	8
Diptera	Simuliidae	Simuliinae Simuliini Simulium	1	3
Diptera	Stratiomyidae	Caloparyphus	2	32
Diptera	Tabanidae	Tabanus	1	17
Diptera	Tipulidae	Dicranota	3	6
Diptera	Tipulidae	Limoniinae Antocha monticola	3	7
Diptera	Tipulidae	Limoniinae Eriopterini Ormosia	1	4
Diptera	Tipulidae	Limoniinae Hexatomini Limnophila	1	2
Diptera	Tipulidae	Tipulinae Tipula	3	4
Ephemeroptera	Ameletidae	Ameletus	4	7
Ephemeroptera	Baetidae		2	8
Ephemeroptera	Baetidae	Baetis	6	501
Ephemeroptera	Baetidae	Diphetor hageni	2	7
Ephemeroptera	Ephemerellidae	Drunella	4	69
Ephemeroptera	Heptageniidae		2	8
Ephemeroptera	Heptageniidae	Cinygmula	4	281
Ephemeroptera	Heptageniidae	Epeorus	5	111
Ephemeroptera	Leptophlebiidae		2	2

Hemiptera	Gerridae		1	1
Plecoptera	Chloroperlidae	Chloroperlinae	1	1
Plecoptera	Nemouridae	Amphinemurinae	1	7
Plecoptera	Nemouridae	Zapada	4	14
Plecoptera	Nemouridae	Zapada cinctipes	2	2
Plecoptera	Perlodidae		4	13
Plecoptera	Perlodidae	Isoperlinae Isoperla	5	58
Plecoptera	Taeniopterygidae		1	1
Trichoptera	Brachycentridae	Brachycentrus americanus	1	1
Trichoptera	Hydropsychidae	Arctopsychinae Parapsyche	1	1
Trichoptera	Hydropsychidae	Arctopsychinae Parapsyche elsis	2	3
Trichoptera	Hydropsychidae	Hydropsychinae Hydropsyche	2	2
Trichoptera	Limnephilidae		3	4
Trichoptera	Rhyacophilidae	Rhyacophila	3	19
Trichoptera	Rhyacophilidae	Rhyacophila angelita group	2	11
Trichoptera	Rhyacophilidae	Rhyacophila vofixa group	4	26
Trichoptera	Uenoidae	Neothremma	1	2
Phylum: Mollusca				
Class: Bivalvia	SubClass: Heterodonta			
Veneroida	Pisidiidae	Pisidiinae Pisidium	5	12
Phylum: Nemata				
Class:	SubClass:			
			2	3

Total: OTU Taxa: **61** Genera: **39** Families: **31** Individuals: **2162**

Literature Cited

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Cuffney, T.F., Gurtz, M.E., and Meador, M.R. 1993. Methods for collecting benthic invertebrate samples as part of the National Water Quality Assessment Program: United States Geological Survey Open File Report 93-406.

Hilsenhoff, W.L. 1987. An improved index of organic stream pollution. The Great Lakes Entomologist. 20:31-39.

Hilsenhoff, W. L. 1988. Rapid field assessment of organic pollution with a family level biotic index. The Journal of the North American Benthological Society. 7:65-68.

Karr, J.R. and E.W. Chu. 1998. Restoring life in running waters: better biological monitoring. Island Press, Washington, D.C.

Ludwig, J.A. and J.F. Reynolds. 1988. Statistical ecology: a primer on methods and computing. John Wiley and Sons. New York.

Merritt, R.W. K.W. Cummins, and M. B. Berg, editors. 2008. An introduction to the aquatic insects of North America. Kendall/Hunt Publishing Company, Dubuque, Iowa. 4th Edition.

Vinson, M.R. and C.P. Hawkins. 1996. Effects of sampling area and subsampling procedures on comparisons of taxa richness among streams. Journal of the North American Benthological Society 15:393-400.

Major taxonomic identification resources used. Numerous regional published papers and workshop proceedings are used as well. For a complete list contact the BugLab.

Adler, P.H., D.C. Currie, and D.M. Wood. 2004. The blackflies (Simuliidae) of North America. Cornell University Press.

Baumann, R.W., A.R. Gaufin, and R.F. Surdick. 1977. The stoneflies (Plecoptera) of the Rocky Mountains. Memoirs of the American Entomological Society Number 31.

Brown, H. P. 1976. Aquatic Dryopoid Beetles (Coleoptera) of the United States. U. S. EPA. Cincinnati, Ohio.

Burch, J. B. 1973. Biota of Freshwater Ecosystems Identification Manual No. 11, Freshwater Unionacean Clams (Mollusca: Pelecypoda) of North America. U. S. Environmental Protection Agency, Project # 18050, Contract # 14-12-894.

Burch, J. B. 1973. Freshwater Unionacean Clams (Mollusca:gastropoda) of North America. U. S. Environmental Protection Agency, EPA-600\3-82-023. Contract # 68-03-1290.

Burch, J. B. and J. L. Tottenham. 1980. North American Freshwater Snails: Species lists, ranges, and illustrations. Walkerana 1:1-215.

Burch, J. B. 1982. North American Freshwater Snails: Identification keys, generic synonymy, supplemental notes, glossary, reference, index. Walkerana 1:217-365.

Burch, J. B. 1988. North American Freshwater Snails: Introduction, systematics, nomenclature, identification, morphology, habitats, and distribution. Walkerana 2:1-80.

Clarke, A.H. 1981. The freshwater molluscs of Canada. National Museum of Canada. Ottawa.

Edmunds, G. F., Jr., S. L. Jensen and L. Berner. 1976. The Mayflies of North and Central America. North Central Publishing Co., St. Paul, Minnesota.

Johannsen, O. A. 1977. Aquatic Diptera: Eggs, Larvae, and Pupae of Aquatic Flies. Published by the University, Ithaca, New York.

Klemm, D. J. 1972. Biota of Freshwater Ecosystems Identification Manual No. 8, Freshwater Leeches (Annelida: Hirundinea) of North America. U.S. Environmental Protection Agency. Project # 18050, Contract # 14-12-894.

Klemm, D. J. 1985. A Guide to the Freshwater Annelida (Polychaeta, Naidid and Tubificid Oligochaeta and Hirudinea) of North America. Kendall/Hunt Publishing Co., Dubuque, Iowa.

Larson, D.J., Y. Alarie, and R.E. Roughley. 2000. Predaceous diving beetles (Coleoptera: Dytiscidae) of the nearctic region, with emphasis on the fauna of Canada and Alaska. NRC-CNRC Press, Ottawa.

McCafferty, W. P. 1981. Aquatic Entomology. Jones and Bartlett Publishers, Inc., Boston.

Merritt, R.W. K.W. Cummins, and M. B. Berg, editors. 2007. An introduction to the aquatic insects of North America. Kendall/Hunt Publishing Company, Dubuque, Iowa. 4th Edition.

Needham, J. G., M. J. Westfall, and M. L. May. 2000. Dragonflies of North America. Scientific Publishers. Gainesville, Florida.

Pennak, R. W. 1989. Freshwater Invertebrates of the United States, Third Edition, John Wiley and Sons, Inc, New York.

Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). University of North Texas Press, Denton Texas. 2nd Edition.

Thorp J. H. and A. P. Covich, editors. 1991. Ecology and Classification of Freshwater Invertebrates. Academic Press,

Taxa Lists for Individual Samples

Taxonomic list and densities of aquatic invertebrates identified and retained from a sample collected July 14, 2011 at station CRANDUP-01, Crandall Creek, Upstream, Emery county, Utah. The sample was collected from reachwide habitat using a Kick Net. The total area sampled was 0.370 square meters. The percentage of the sample that was identified and retained was 100% of the collected sample. A total of 230 individuals were removed, identified and retained. The sample identification number is 146823. OTU=operational taxonomic unit. Notes - identification to genus or species was not supported because: I - immature organisms, D- damaged organisms, M - poor slide mount, G - gender, U - indistinct 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	16.22	
Phylum: Arthropoda					
Class: Arachnida	SubClass: Acari				
Trombidiformes			adult	8.11	U
Trombidiformes	Lebertiidae	Lebertia	adult	8.11	
Trombidiformes	Sperchonidae	Sperchon	adult	5.41	
Class: Insecta	SubClass: Pterygota				
Coleoptera	Elmidae	Narpus concolor	larvae	2.70	
Diptera			larvae	5.41	U
Diptera	Ceratopogonidae		pupae	2.70	
Diptera	Ceratopogonidae	Ceratopogoninae Sphaeromiini Probezzia	larvae	13.51	
Diptera	Chironomidae		pupae	13.51	
Diptera	Chironomidae	Chironominae	larvae	37.84	
Diptera	Chironomidae	Orthocladiinae	larvae	24.32	
Diptera	Chironomidae	Tanypodinae	larvae	2.70	
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	larvae	13.51	
Diptera	Empididae	Wiedemannia	larvae	2.70	
Diptera	Simuliidae		pupae	5.41	U
Diptera	Tipulidae	Limoniinae Antocha monticola	larvae	2.70	
Diptera	Tipulidae	Limoniinae Eriopterini Ormosia	larvae	10.81	
Diptera	Tipulidae	Tipulinae Tipula	larvae	2.70	
Ephemeroptera	Ameletidae	Ameletus	larvae	8.11	
Ephemeroptera	Baetidae	Baetis	larvae	148.65	
Ephemeroptera	Baetidae	Diphetor hageni	larvae	16.22	
Ephemeroptera	Ephemerellidae	Drunella	larvae	35.14	
Ephemeroptera	Heptageniidae	Cinygmula	larvae	143.24	
Ephemeroptera	Heptageniidae	Epeorus	larvae	18.92	
Plecoptera	Nemouridae	Zapada	larvae	8.11	U
Plecoptera	Nemouridae	Zapada cinctipes	larvae	2.70	
Plecoptera	Perlodidae		larvae	8.11	I
Plecoptera	Perlodidae	Isoperlinae Isoperla	larvae	18.92	
Plecoptera	Taeniopterygidae		larvae	2.70	I
Trichoptera	Hydropsychidae	Arctopsychinae Parapsyche	larvae	2.70	I
Trichoptera	Rhyacophilidae	Rhyacophila	larvae	8.11	I
Trichoptera	Rhyacophilidae	Rhyacophila vofixa group	larvae	8.11	
Trichoptera	Uenoidae	Neothremma	larvae	5.41	I
Phylum: Mollusca					
Class: Bivalvia	SubClass: Heterodonta				
Veneroida	Pisidiidae	Pisidiinae Pisidium	adult	5.41	
Phylum: Nemata					
Class:	SubClass:				
			adult	2.70	

Total:	OTU Taxa:	**35**	Genera:	**23**	Families:	**20**	621.62	

Taxonomic list and densities of aquatic invertebrates identified and retained from a sample collected July 14, 2011 at station CRANDUP-01, Crandall Creek, Upstream, Emery county, Utah. The sample was collected from targeted riffle habitat using a Kick Net. The total area sampled was 0.743 square meters. The percentage of the sample that was identified and retained was 100% of the collected sample. A total of 551 individuals were removed, identified and retained. The sample identification number is 146824. OTU=operational taxonomic unit. Notes - identification to genus or species was not supported because: I - immature organisms, D- damaged organisms, M - poor slide mount, G - gender, U - indistinct characters or distribution, R - retained in our reference collection.

Order	Family	Subfamily/Genus/Species	Life Stage	Density	Notes
Phylum: Arthropoda					
Class: Arachnida	SubClass: Acari				
Trombidiformes	Arrenuridae	Arrenurus	adult	2.69	
Trombidiformes	Lebertiidae	Lebertia	adult	14.80	
Class: Insecta	SubClass: Pterygota				
Coleoptera	Elmidae	Narpus concolor	larvae	2.69	
Diptera	Ceratopogonidae		pupae	1.35	
Diptera	Ceratopogonidae	Ceratopogoninae Sphaeromiini Probezzia	larvae	2.69	
Diptera	Chironomidae		pupae	8.07	
Diptera	Chironomidae	Chironominae	larvae	4.04	
Diptera	Chironomidae	Orthocladiinae	larvae	49.78	
Diptera	Chironomidae	Tanypodinae	larvae	2.69	
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	larvae	12.11	
Diptera	Simuliidae	Simuliinae Prosimuliini Helodon	larvae	8.07	
Diptera	Simuliidae	Simuliinae Simuliini Simulium	larvae	4.04	
Diptera	Tipulidae	Dicranota	larvae	4.04	
Diptera	Tipulidae	Limoniinae Antocha monticola	larvae	1.35	
Ephemeroptera	Ameletidae	Ameletus	larvae	2.69	
Ephemeroptera	Baetidae	Baetis	larvae	238.15	
Ephemeroptera	Ephemerellidae	Drunella	larvae	32.29	
Ephemeroptera	Heptageniidae	Cinygmula	larvae	247.57	
Ephemeroptera	Heptageniidae	Epeorus	larvae	10.76	
Plecoptera	Nemouridae	Zapada	larvae	10.76	U
Plecoptera	Perlodidae		larvae	6.73	I
Plecoptera	Perlodidae	Isoperlinae Isoperla	larvae	29.60	
Trichoptera	Hydropsychidae	Arctopsychinae Parapsyche elsis	larvae	2.69	
Trichoptera	Rhyacophilidae	Rhyacophila	larvae	14.80	I
Trichoptera	Rhyacophilidae	Rhyacophila vofixa group	larvae	22.87	
Phylum: Mollusca					
Class: Bivalvia	SubClass: Heterodonta				
Veneroida	Pisidiidae	Pisidiinae Pisidium	adult	4.04	
Total: OTU Taxa: **26**	Genera: **20**	Families: **17**		741.37	

Taxonomic list and densities of aquatic invertebrates identified and retained from a sample collected July 14, 2011 at station CRANDMD-02, Crandall Creek, Middle, Emery county, Utah. The sample was collected from reachwide habitat using a Kick Net. The total area sampled was 0.372 square meters. The percentage of the sample that was identified and retained was 100% of the collected sample. A total of 201 individuals were removed, identified and retained. The sample identification number is 146825. OTU=operational taxonomic unit. Notes - identification to genus or species was not supported because: I - immature organisms, D- damaged organisms, M - poor slide mount, G - gender, U - indistinct characters or distribution, R - retained in our reference collection.

Order	Family	Subfamily/Genus/Species	Life Stage	Density	Notes
Phylum: Arthropoda					
Class: Arachnida		SubClass: Acari			
Trombidiformes			adult	5.38	U
Class: Insecta		SubClass: Pterygota			
Coleoptera	Dytiscidae		larvae	2.69	I
Coleoptera	Elmidae	Narpus concolor	larvae	48.44	
Coleoptera	Elmidae	Optioservus quadrimaculatus	adult	5.38	
Diptera	Ceratopogonidae	Ceratopogoninae Sphaeromiini Probezzia	larvae	10.76	
Diptera	Chironomidae	Chironominae	larvae	29.60	
Diptera	Chironomidae	Orthocladiinae	larvae	290.63	
Diptera	Chironomidae	Tanypodinae	larvae	26.91	
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	larvae	13.45	
Diptera	Simuliidae	Simuliinae Prosimuliini Helodon	pupae	2.69	
Diptera	Stratiomyidae	Caloparyphus	larvae	21.53	
Diptera	Tipulidae	Dicranota	larvae	2.69	
Diptera	Tipulidae	Tipulinae Tipula	larvae	2.69	
Ephemeroptera	Baetidae	Baetis	larvae	8.07	
Ephemeroptera	Baetidae	Diphetor hageni	larvae	2.69	
Ephemeroptera	Ephemerellidae	Drunella	larvae	2.69	
Ephemeroptera	Heptageniidae	Cinygmula	larvae	37.67	
Ephemeroptera	Leptophlebiidae		larvae	2.69	D
Plecoptera	Nemouridae	Zapada	larvae	2.69	U
Plecoptera	Perlodidae	Isoperlinae Isoperla	larvae	13.45	
Trichoptera	Rhyacophilidae	Rhyacophila vofixa group	larvae	2.69	
Phylum: Mollusca					
Class: Bivalvia		SubClass: Heterodonta			
Veneroida	Pisidiidae	Pisidiinae Pisidium	adult	5.38	
Total: OTU Taxa: **22**	Genera: **16**	Families: **17**		540.89	

Taxonomic list and densities of aquatic invertebrates identified and retained from a sample collected July 14, 2011 at station CRANDMD-02, Crandall Creek, Middle, Emery county, Utah. The sample was collected from targeted riffle habitat using a Kick Net. The total area sampled was 0.743 square meters. The percentage of the sample that was identified and retained was 100% of the collected sample. A total of 456 individuals were removed, identified and retained. The sample identification number is 146826. OTU=operational taxonomic unit. Notes - identification to genus or species was not supported because: I - immature organisms, D- damaged organisms, M - poor slide mount, G - gender, U - indistinct 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	13.45	
Phylum: Arthropoda					
Class: Arachnida	SubClass: Acari				
Trombidiformes			adult	5.38	U
Trombidiformes	Hydryphantidae	Protzia	adult	4.04	
Trombidiformes	Lebertiidae	Lebertia	adult	37.67	
Class: Insecta	SubClass: Pterygota				
Coleoptera	Elmidae	Narpus concolor	larvae	40.36	
Diptera	Ceratopogonidae	Ceratopogoninae Sphaeromiini Probezzia	larvae	21.53	
Diptera	Chironomidae		pupae	1.35	
Diptera	Chironomidae	Chironominae	larvae	2.69	
Diptera	Chironomidae	Orthocladiinae	larvae	106.29	
Diptera	Chironomidae	Tanypodinae	larvae	1.35	
Diptera	Empididae		pupae	2.69	
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	larvae	37.67	
Diptera	Empididae	Neoplasta	larvae	1.35	
Diptera	Psychodidae	Pericoma	larvae	1.35	
Diptera	Simuliidae	Simuliinae Prosimuliini Helodon	pupae	1.35	
Diptera	Stratiomyidae	Caloparyphus	larvae	32.29	
Diptera	Tipulidae	Dicranota	larvae	2.69	
Diptera	Tipulidae	Tipulinae Tipula	larvae	2.69	
Ephemeroptera	Ameletidae	Ameletus	larvae	1.35	
Ephemeroptera	Baetidae	Baetis	larvae	157.42	
Ephemeroptera	Ephemerellidae	Drunella	larvae	41.71	
Ephemeroptera	Heptageniidae	Cinygmula	larvae	40.36	
Ephemeroptera	Heptageniidae	Epeorus	larvae	8.07	
Ephemeroptera	Leptophlebiidae		larvae	1.35	D
Plecoptera	Nemouridae	Zapada	larvae	2.69	U
Plecoptera	Nemouridae	Zapada cinctipes	larvae	1.35	
Plecoptera	Perlodidae	Isoperlinae Isoperla	larvae	20.18	
Trichoptera	Hydropsychidae	Arctopsychinae Parapsyche elsis	larvae	1.35	
Trichoptera	Limnephilidae		larvae	1.35	I
Trichoptera	Rhyacophilidae	Rhyacophila	larvae	6.73	I,U
Trichoptera	Rhyacophilidae	Rhyacophila vofixa group	larvae	6.73	
Phylum: Mollusca					
Class: Bivalvia	SubClass: Heterodonta				
Veneroida	Pisidiidae	Pisidiinae Pisidium	adult	4.04	
Phylum: Nemata					
Class:	SubClass:				
			adult	2.69	

Total: OTU Taxa: **33** Genera: **23** Families: **22** 613.55

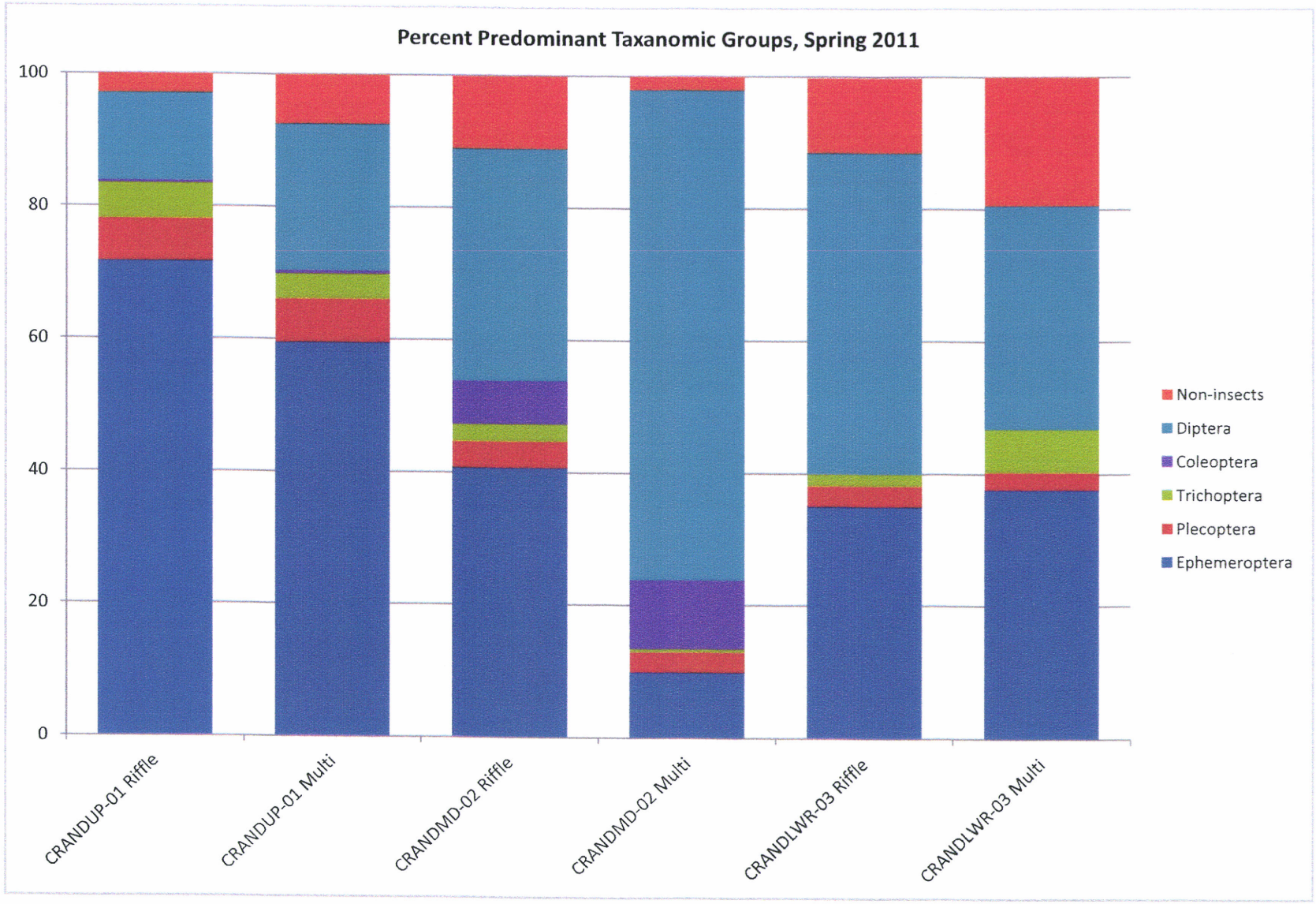
Taxonomic list and densities of aquatic invertebrates identified and retained from a sample collected July 14, 2011 at station CRANDLWR-03, Crandall Creek, Lower, Emery county, Utah. The sample was collected from reachwide habitat using a Kick Net. The total area sampled was 0.372 square meters. The percentage of the sample that was identified and retained was 100% of the collected sample. A total of 77 individuals were removed, identified and retained. The sample identification number is 146827. OTU=operational taxonomic unit. Notes - identification to genus or species was not supported because: I - immature organisms, D- damaged organisms, M - poor slide mount, G - gender, U - indistinct characters or distribution, R - retained in our reference collection.

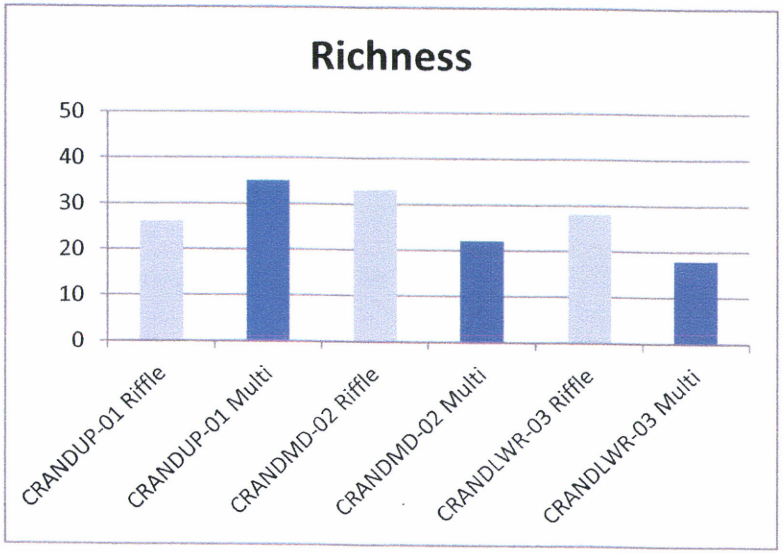
Order	Family	Subfamily/Genus/Species	Life Stage	Density	Notes
Phylum: Annelida					
Class: Clitellata	SubClass: Oligochaeta				
			adult	5.38	
Phylum: Arthropoda					
Class: Arachnida	SubClass: Acari				
Trombidiformes			adult	5.38	D,U
Trombidiformes	Arrenuridae	Arrenurus	adult	2.69	
Trombidiformes	Lebertiidae	Lebertia	adult	10.76	
Trombidiformes	Sperchonidae	Sperchon	adult	10.76	
Class: Insecta	SubClass: Pterygota				
Diptera	Chironomidae	Orthocladiinae	larvae	53.82	
Diptera	Empididae		pupae	2.69	
Diptera	Empididae	Hemerodromiinae Hemerodromiini	larvae	5.38	I
Diptera	Empididae	Neoplasta	larvae	8.07	
Ephemeroptera	Baetidae		larvae	10.76	
Ephemeroptera	Baetidae	Baetis	larvae	37.67	
Ephemeroptera	Heptageniidae		larvae	10.76	I,D
Ephemeroptera	Heptageniidae	Epeorus	larvae	18.84	
Plecoptera	Perlodidae		larvae	5.38	D
Trichoptera	Hydropsychidae	Hydropsychinae Hydropsyche	larvae	2.69	
Trichoptera	Limnephilidae		larvae	5.38	D
Trichoptera	Rhyacophilidae	Rhyacophila angelita group	larvae	5.38	
Phylum: Mollusca					
Class: Bivalvia	SubClass: Heterodonta				
Veneroida	Pisidiidae	Pisidiinae Pisidium	adult	5.38	
Total: OTU Taxa: **18**	Genera: **9**	Families: **13**		207.21	

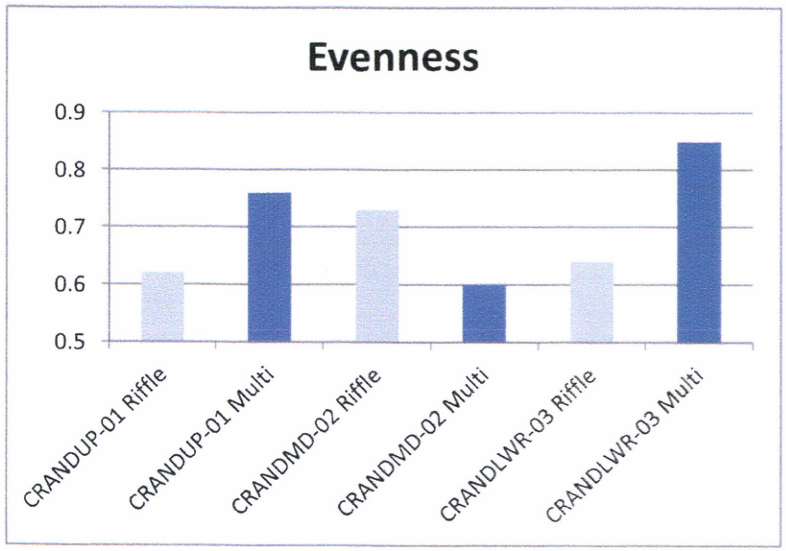
Taxonomic list and densities of aquatic invertebrates identified and retained from a sample collected July 14, 2011 at station CRANDLWR-03, Crandall Creek, Lower, Emery county, Utah. The sample was collected from targeted riffle habitat using a Kick Net. The total area sampled was 0.743 square meters. The percentage of the sample that was identified and retained was 100% of the collected sample. A total of 647 individuals were removed, identified and retained. The sample identification number is 146828. OTU=operational taxonomic unit. Notes - identification to genus or species was not supported because: I - immature organisms, D- damaged organisms, M - poor slide mount, G - gender, U - indistinct characters or distribution, R - retained in our reference collection.

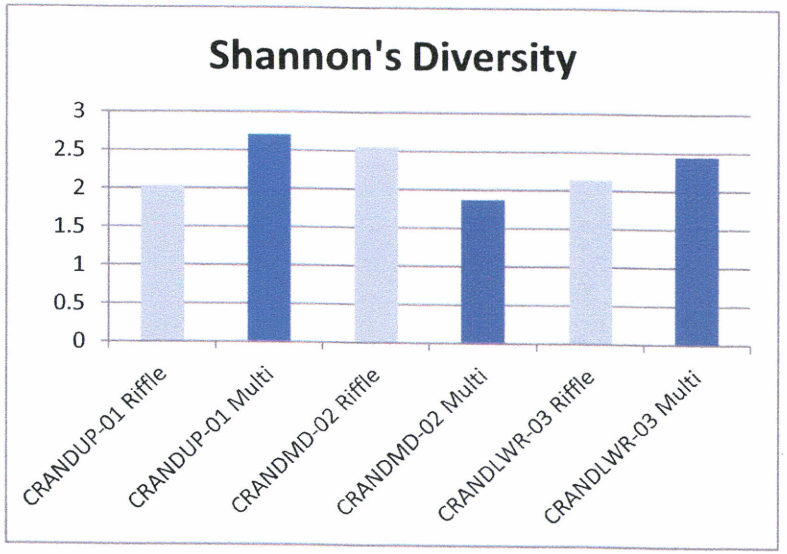
Order	Family	Subfamily/Genus/Species	Life Stage	Density	Notes
Phylum: Annelida					
Class: Clitellata	SubClass: Oligochaeta				
			adult	20.18	
Phylum: Arthropoda					
Class: Arachnida	SubClass: Acari				
Trombidiformes	Arrenuridae	Arrenurus	adult	1.35	
Trombidiformes	Hydryphantidae	Wandesia	adult	1.35	
Trombidiformes	Lebertiidae	Lebertia	adult	44.40	
Trombidiformes	Sperchonidae	Sperchon	adult	30.95	
Class: Insecta	SubClass: Pterygota				
Diptera	Ceratopogonidae		pupae	2.69	
Diptera	Chironomidae		pupae	10.76	
Diptera	Chironomidae	Orthocladiinae	larvae	314.85	
Diptera	Empididae	Hemerodromiinae Hemerodromiini	larvae	16.15	
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	larvae	13.45	
Diptera	Empididae	Neoplasta	larvae	32.29	
Diptera	Tabanidae	Tabanus	larvae	22.87	
Diptera	Tipulidae	Limoniinae Antocha monticola	larvae	3.36	
Diptera	Tipulidae	Limoniinae Hexatomini Limnophila	larvae	2.69	
Ephemeroptera	Ameletidae	Ameletus	larvae	1.35	
Ephemeroptera	Baetidae		larvae	5.38	D
Ephemeroptera	Baetidae	Baetis	larvae	181.64	
Ephemeroptera	Heptageniidae		larvae	5.38	D
Ephemeroptera	Heptageniidae	Epeorus	larvae	111.68	
Hemiptera	Gerridae		larvae	1.35	I
Plecoptera	Chloroperlidae	Chloroperlinae	larvae	1.35	D
Plecoptera	Nemouridae	Amphinemurinae	larvae	9.42	
Plecoptera	Perlodidae		larvae	4.04	D
Plecoptera	Perlodidae	Isoperlinae Isoperla	larvae	12.11	
Trichoptera	Brachycentridae	Brachycentrus americanus	larvae	1.35	
Trichoptera	Hydropsychidae	Hydropsychinae Hydropsyche	larvae	1.35	
Trichoptera	Limnephilidae		larvae	1.35	I
Trichoptera	Rhyacophilidae	Rhyacophila angelita group	larvae	12.11	
Total: OTU Taxa: **28**	Genera: **16**	Families: **21**		870.54	

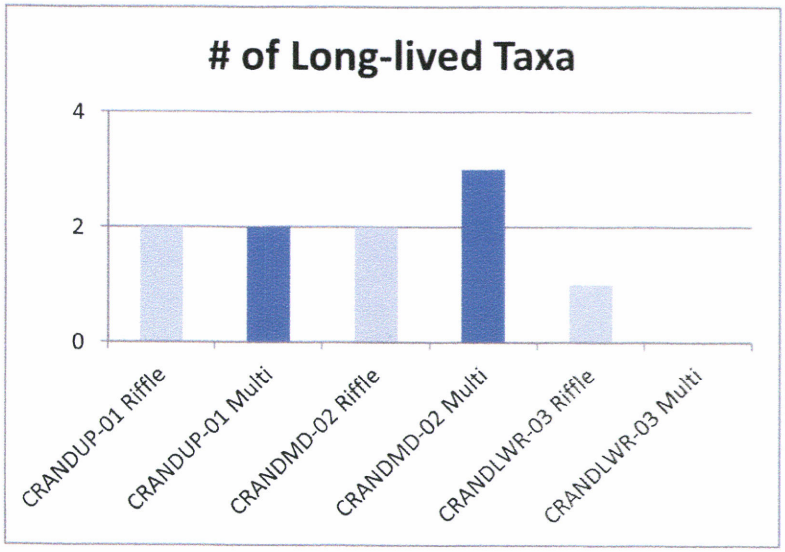
APPENDIX 2
MACROINVERTEBRATE METRICS

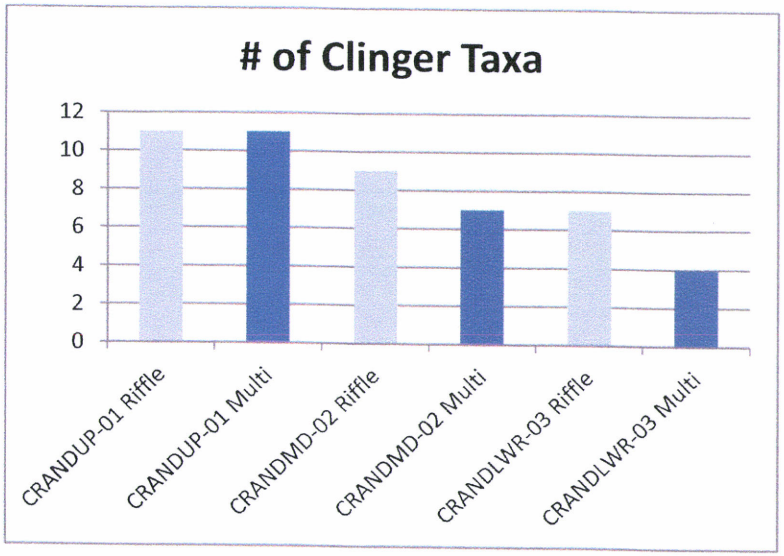

Percent Predominant Taxanomic Groups, Spring 2011
100
80
60
40
20
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi
Non-insects
Diptera
Coleoptera
Trichoptera
Plecoptera
Ephemeroptera

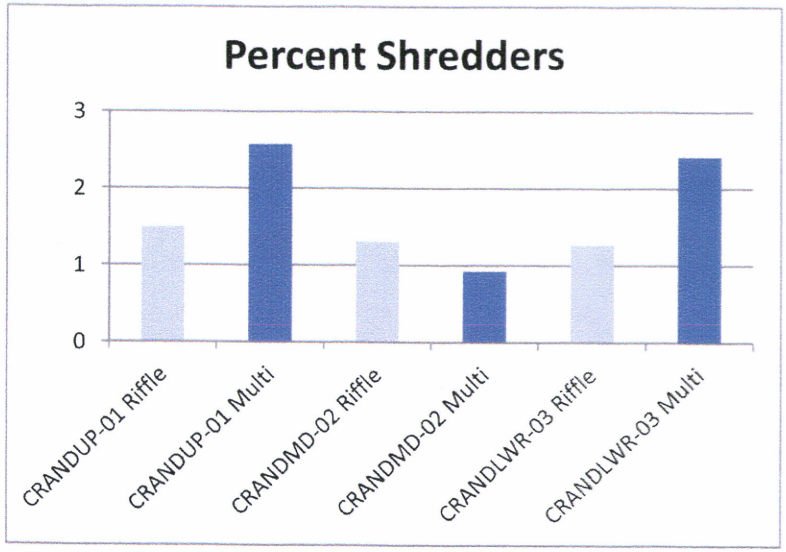

Richness
50
40
30
20
10
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

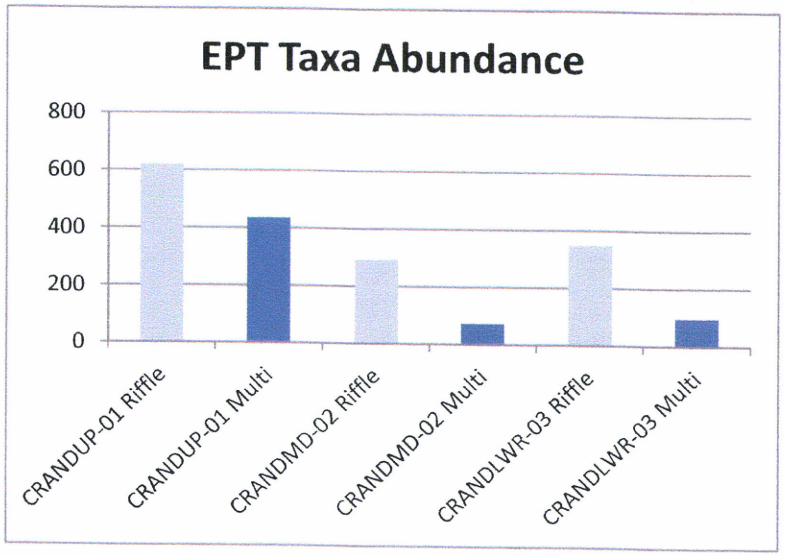

Evenness
0.9
0.8
0.7
0.6
0.5
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

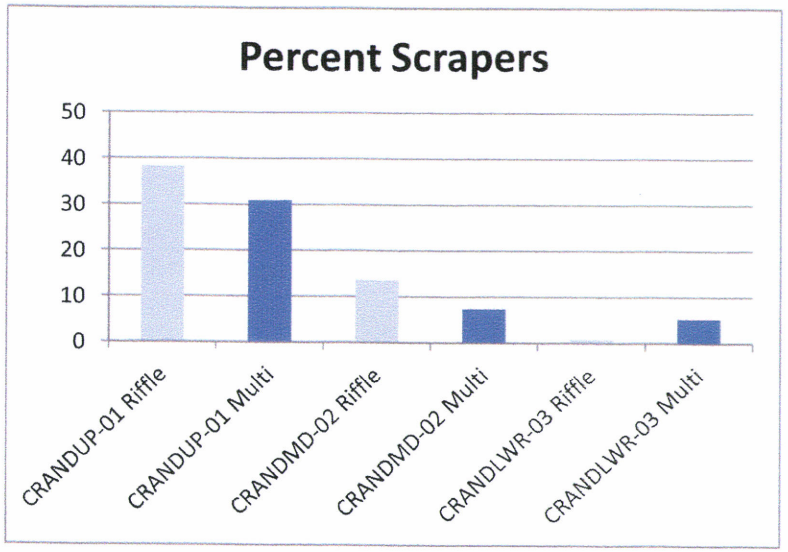

Shannon's Diversity
3
2.5
2
1.5
1
0.5
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

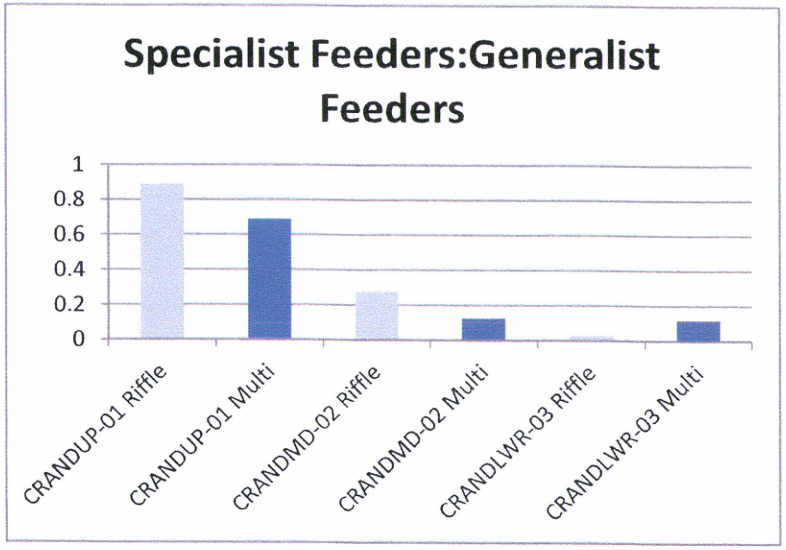

# of Long-lived Taxa
4
2
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

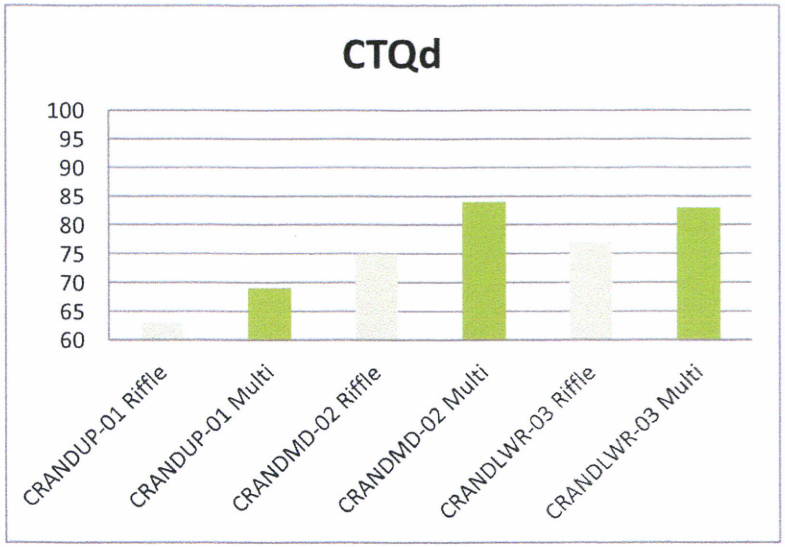

# of Clinger Taxa
12
10
8
6
4
2
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

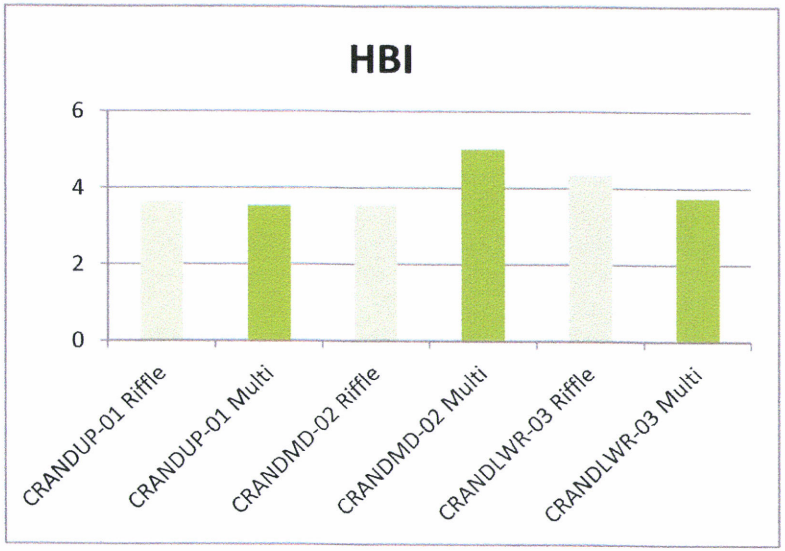

Percent Shredders
3
2
1
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

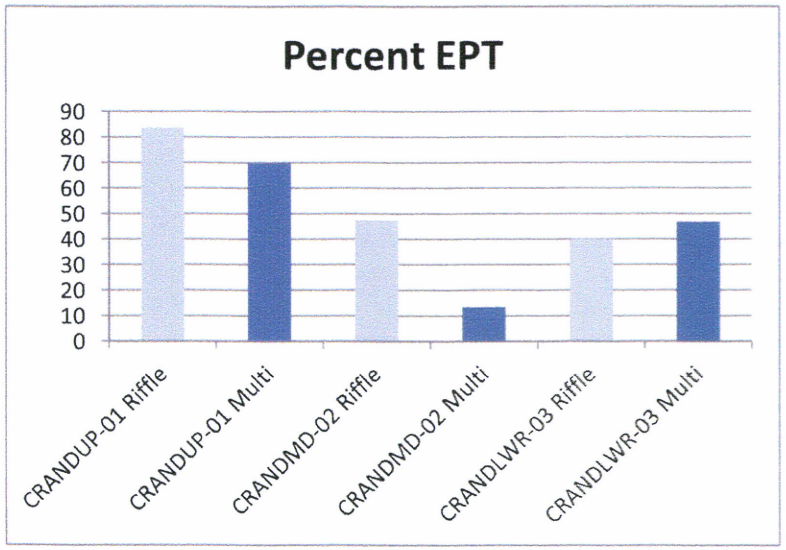

EPT Taxa Abundance
800
600
400
200
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

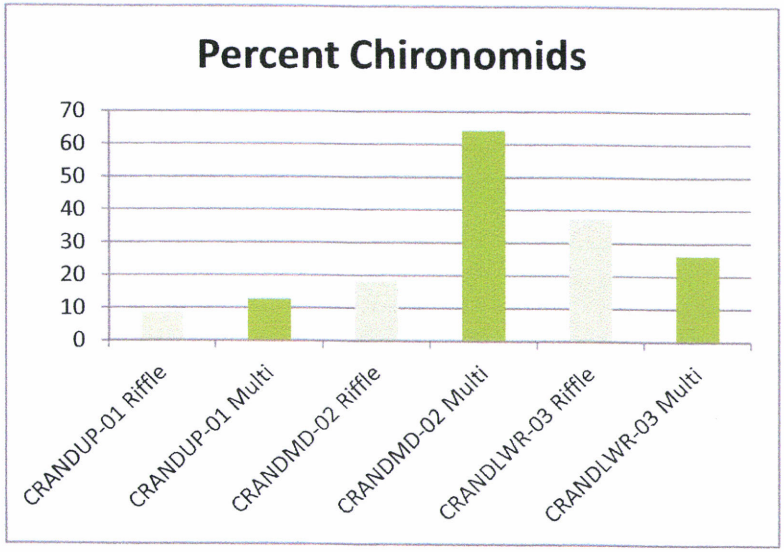

Percent Scrapers
50
40
30
20
10
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

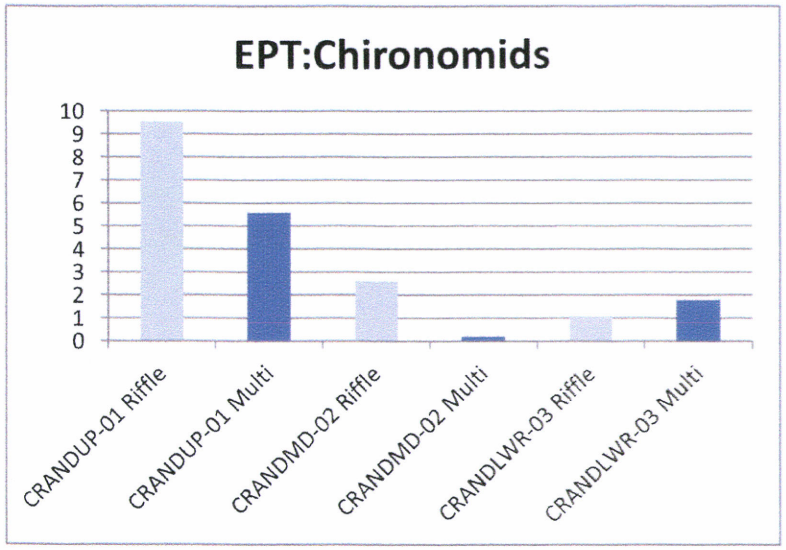

Specialist Feeders:Generalist Feeders
1
0.8
0.6
0.4
0.2
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

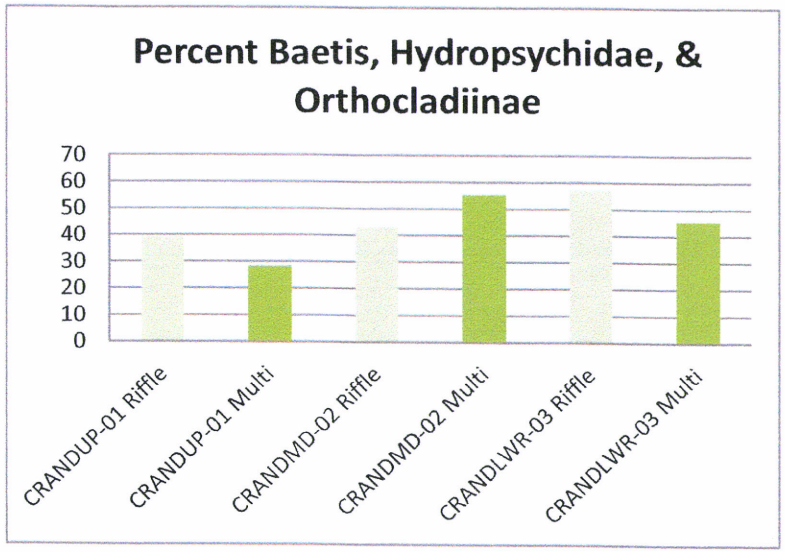

CTQd
100
95
90
85
80
75
70
65
60
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

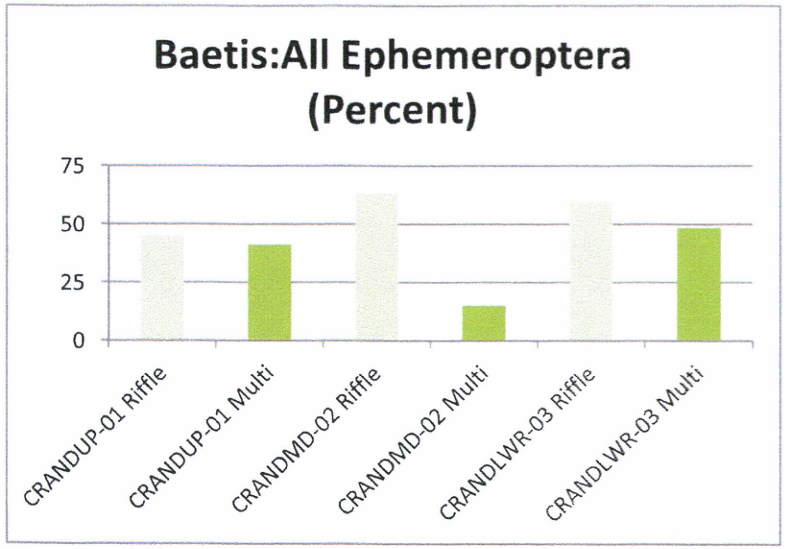

HBI
6
4
2
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

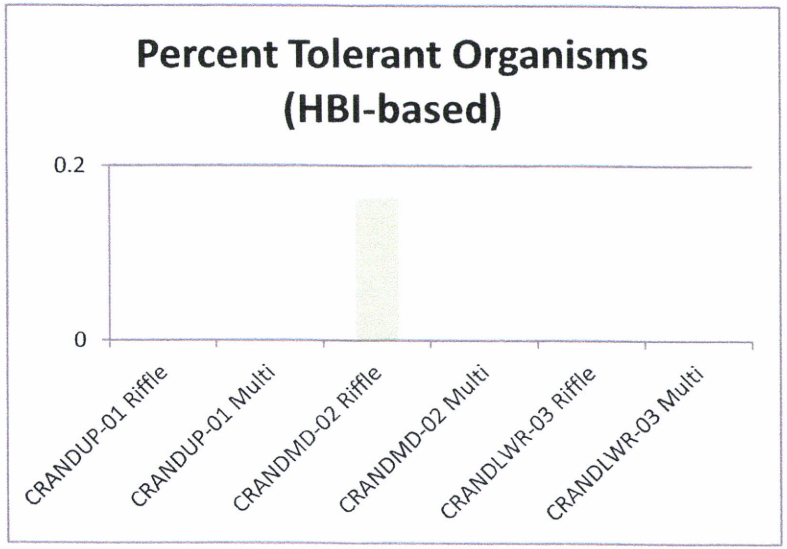

Percent EPT
90
80
70
60
50
40
30
20
10
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

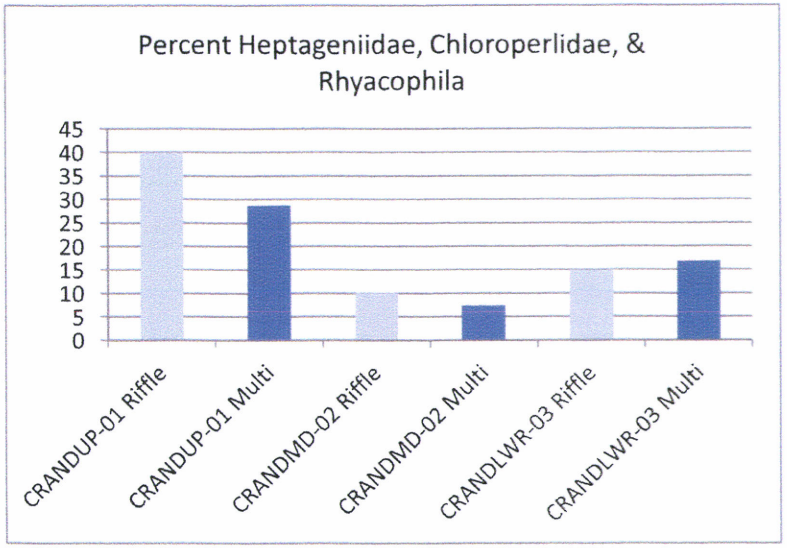

Percent Chironomids
70
60
50
40
30
20
10
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

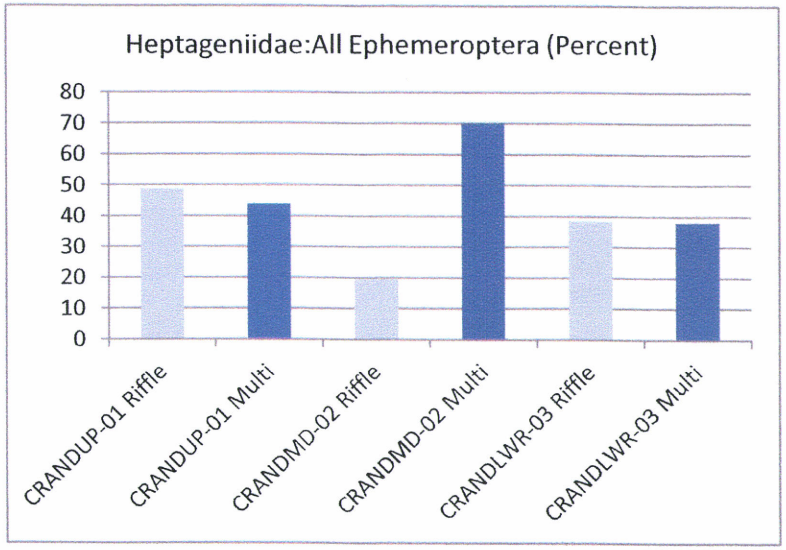

EPT:Chironomids
10
9
8
7
6
5
4
3
2
1
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

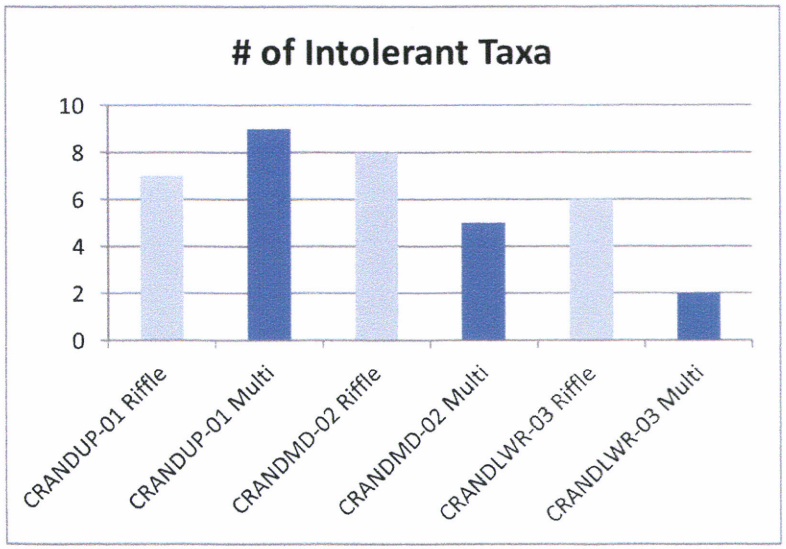

Percent Baetis, Hydropsychidae, & Orthocladiinae
70
60
50
40
30
20
10
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

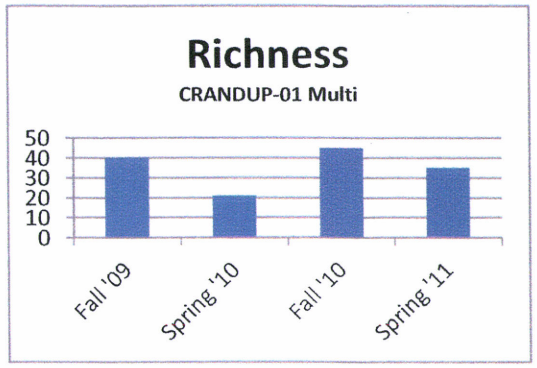

Baetis:All Ephemeroptera (Percent)
75
50
25
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

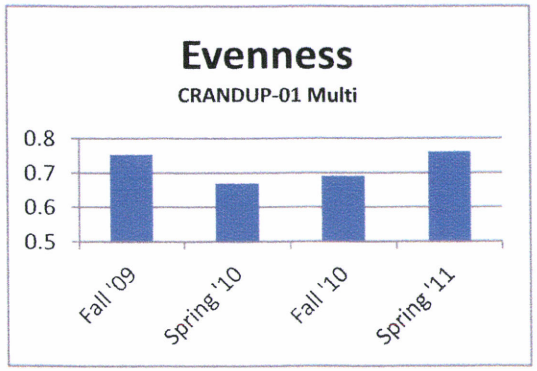

Percent Tolerant Organisms (HBI-based)
0.2
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

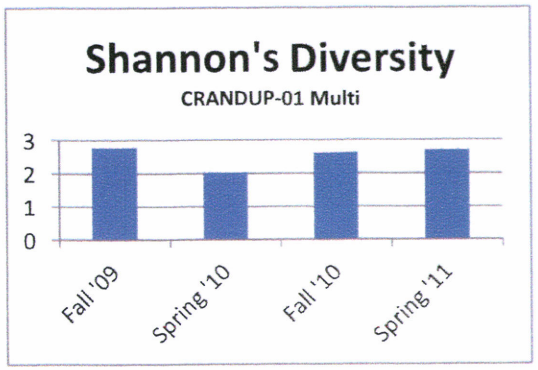

Percent Heptageniidae, Chloroperlidae, & Rhyacophila
45
40
35
30
25
20
15
10
5
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

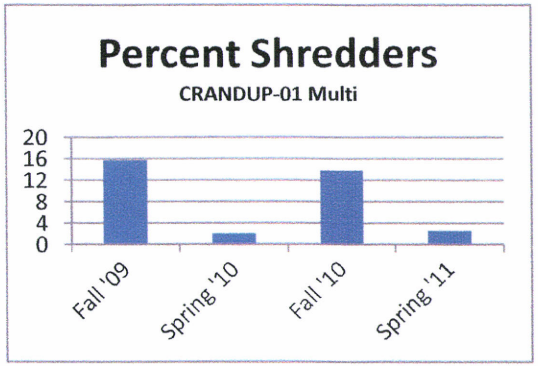

Heptageniidae:All Ephemeroptera (Percent)
80
70
60
50
40
30
20
10
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

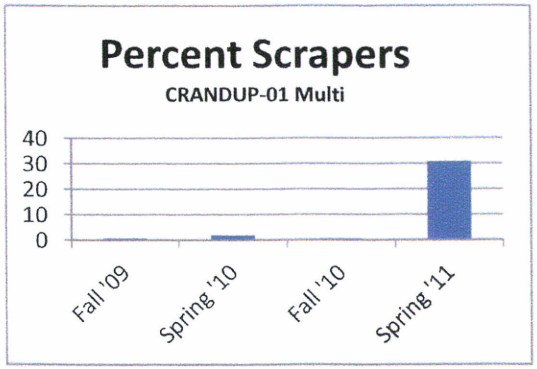

# of Intolerant Taxa
10
8
6
4
2
0
CRANDUP-01 Riffle
CRANDUP-01 Multi
CRANDMD-02 Riffle
CRANDMD-02 Multi
CRANDLWR-03 Riffle
CRANDLWR-03 Multi

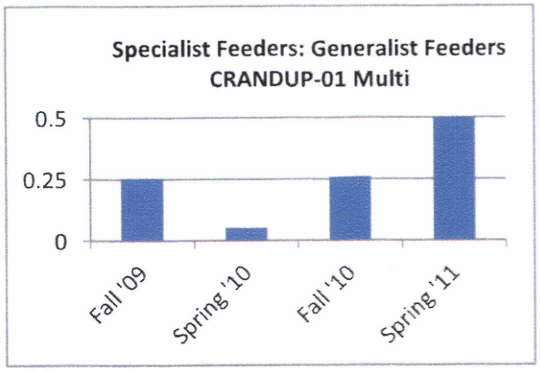

Richness
CRANDUP-01 Multi
50
40
30
20
10
0
Fall '09
Spring '10
Fall '10
Spring '11

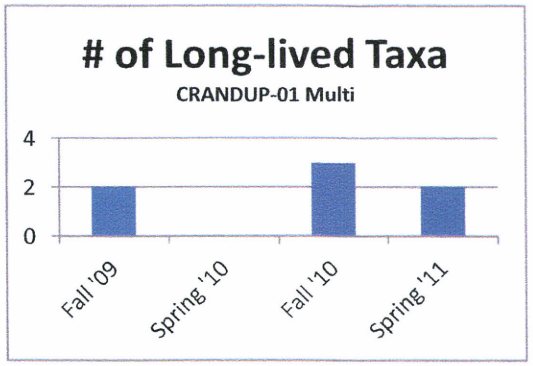

Evenness
CRANDUP-01 Multi
0.8
0.7
0.6
0.5
Fall '09
Spring '10
Fall '10
Spring '11

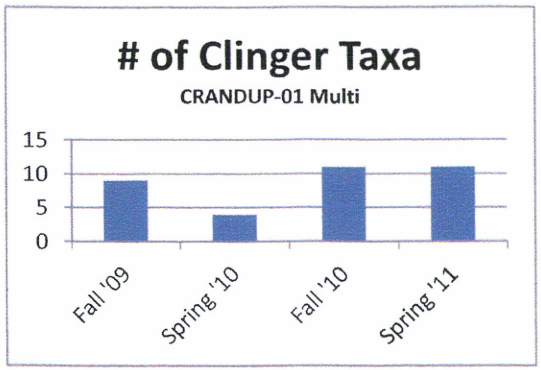

Shannon's Diversity
CRANDUP-01 Multi
3
2
1
0
Fall '09
Spring '10
Fall '10
Spring '11

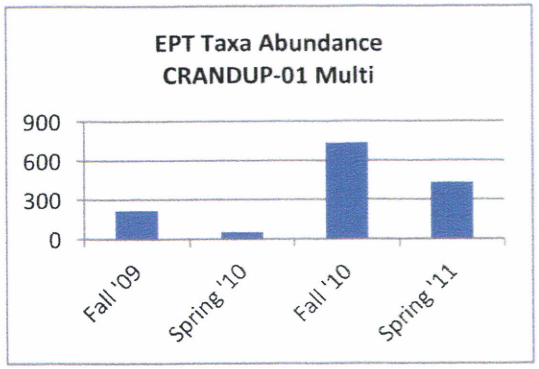

Percent Shredders
CRANDUP-01 Multi
20
16
12
8
4
0
Fall '09
Spring '10
Fall '10
Spring '11

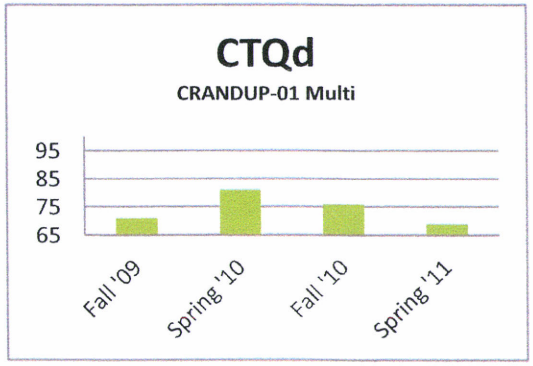

Percent Scrapers
CRANDUP-01 Multi
40
30
20
10
0
Fall '09
Spring '10
Fall '10
Spring '11

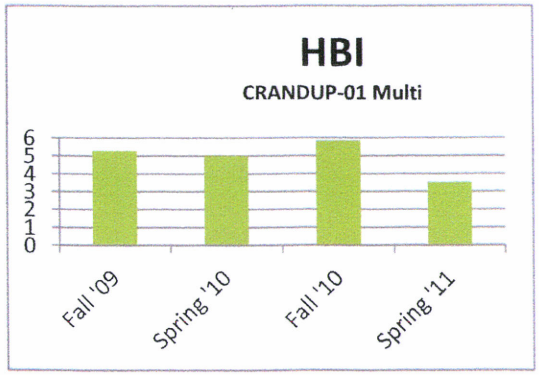

Specialist Feeders: Generalist Feeders
CRANDUP-01 Multi
0.5
0.25
0
Fall '09
Spring '10
Fall '10
Spring '11

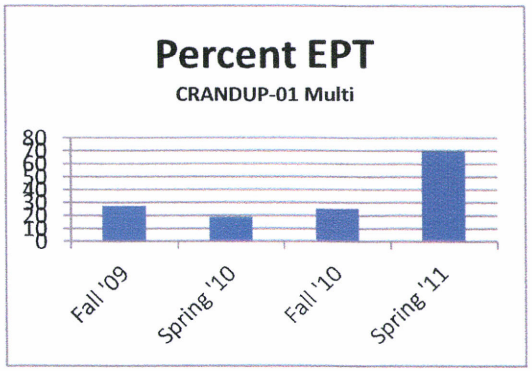

# of Long-lived Taxa
CRANDUP-01 Multi
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

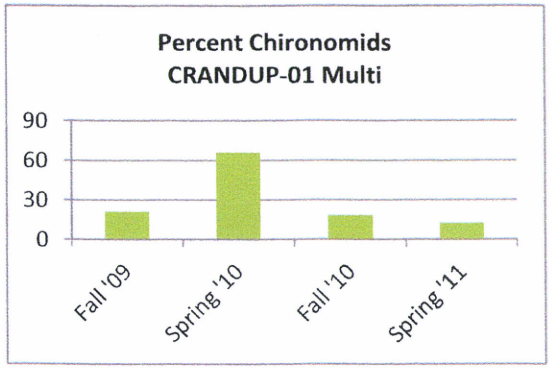

# of Clinger Taxa
CRANDUP-01 Multi
15
10
5
0
Fall '09
Spring '10
Fall '10
Spring '11

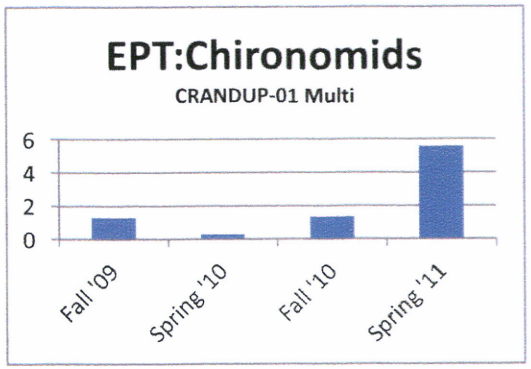

EPT Taxa Abundance
CRANDUP-01 Multi
900
600
300
0
Fall '09
Spring '10
Fall '10
Spring '11

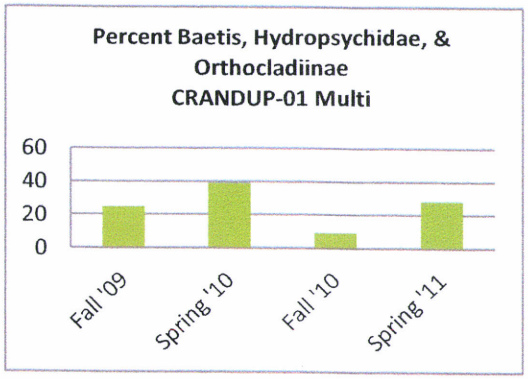

CTQd
CRANDUP-01 Multi
95
85
75
65
Fall '09
Spring '10
Fall '10
Spring '11

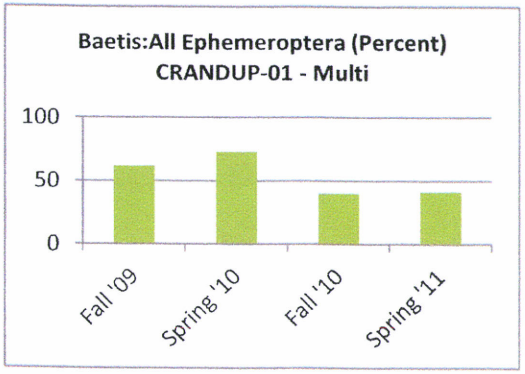

HBI
CRANDUP-01 Multi
6
5
4
3
2
1
0
Fall '09
Spring '10
Fall '10
Spring '11

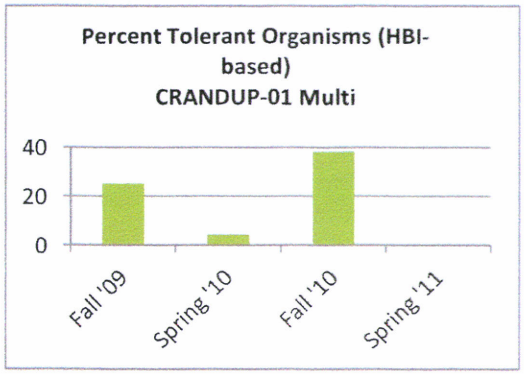

Percent EPT
CRANDUP-01 Multi
80
70
60
50
40
30
20
10
0
Fall '09
Spring '10
Fall '10
Spring '11

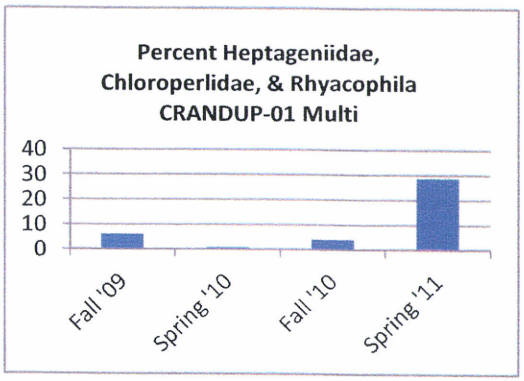

Percent Chironomids
CRANDUP-01 Multi
90
60
30
0
Fall '09
Spring '10
Fall '10
Spring '11

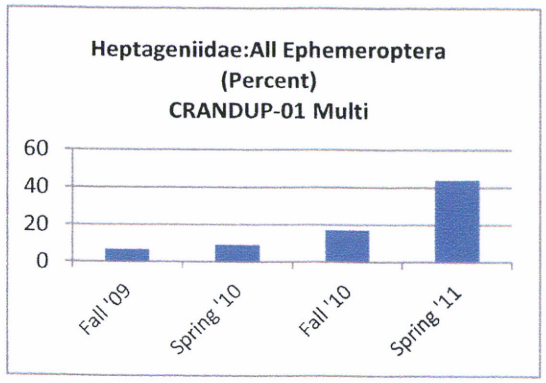

EPT:Chironomids
CRANDUP-01 Multi
6
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

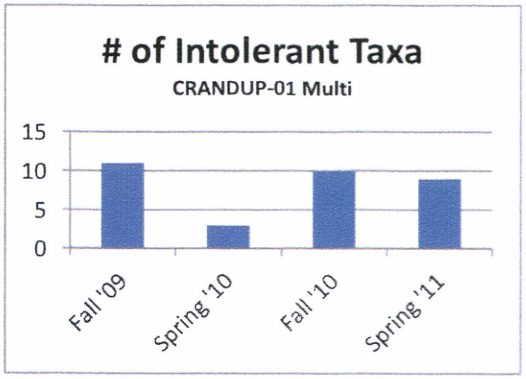

Percent Baetis, Hydropsychidae, & Orthocladiinae
CRANDUP-01 Multi
60
40
20
0
Fall '09
Spring '10
Fall '10
Spring '11

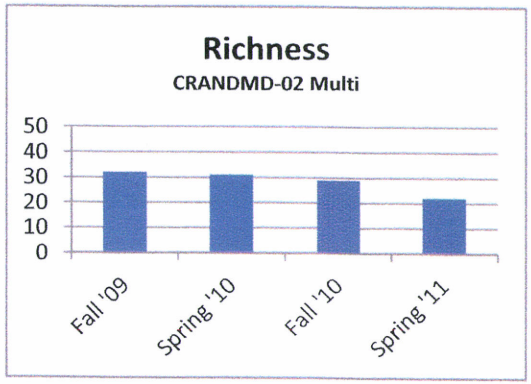

Baetis:All Ephemeroptera (Percent)
CRANDUP-01 - Multi
100
50
0
Fall '09
Spring '10
Fall '10
Spring '11

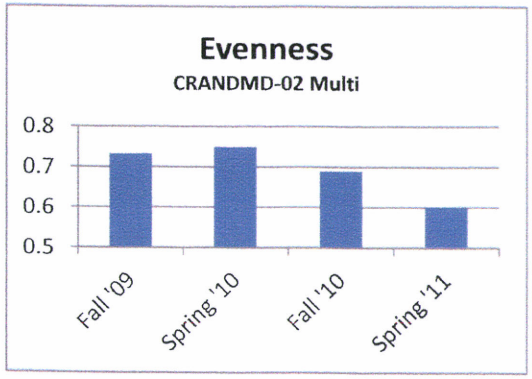

Percent Tolerant Organisms (HBI-based)
CRANDUP-01 Multi
40
20
0
Fall '09
Spring '10
Fall '10
Spring '11

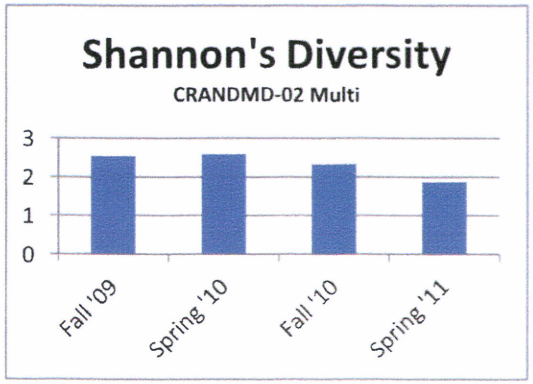

Percent Heptageniidae, Chloroperlidae, & Rhyacophila
CRANDUP-01 Multi
40
30
20
10
0
Fall '09
Spring '10
Fall '10
Spring '11

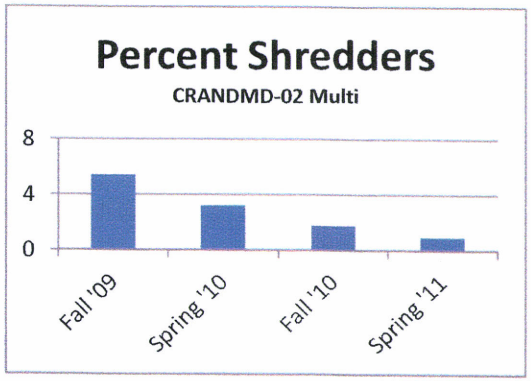

Heptageniidae:All Ephemeroptera (Percent)
CRANDUP-01 Multi
60
40
20
0
Fall '09
Spring '10
Fall '10
Spring '11

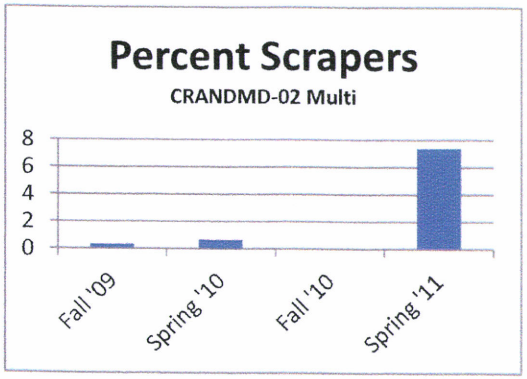

# of Intolerant Taxa
CRANDUP-01 Multi
15
10
5
0
Fall '09
Spring '10
Fall '10
Spring '11

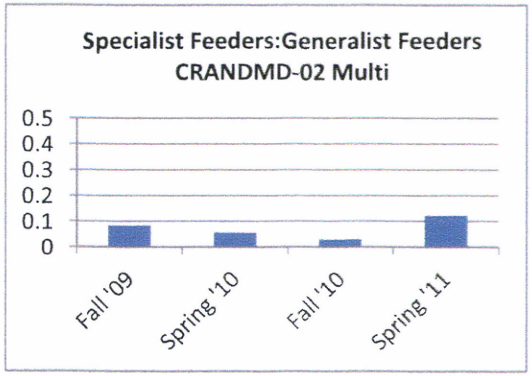

Richness
CRANDMD-02 Multi
50
40
30
20
10
0
Fall '09
Spring '10
Fall '10
Spring '11

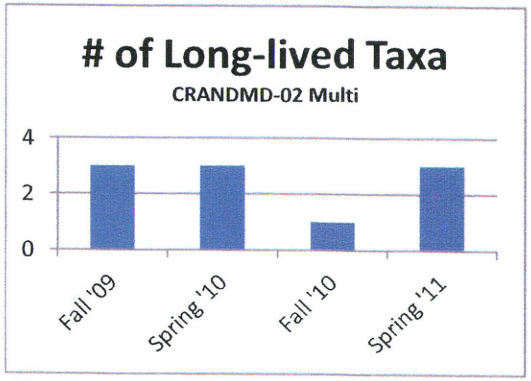

Evenness
CRANDMD-02 Multi
0.8
0.7
0.6
0.5
Fall '09
Spring '10
Fall '10
Spring '11

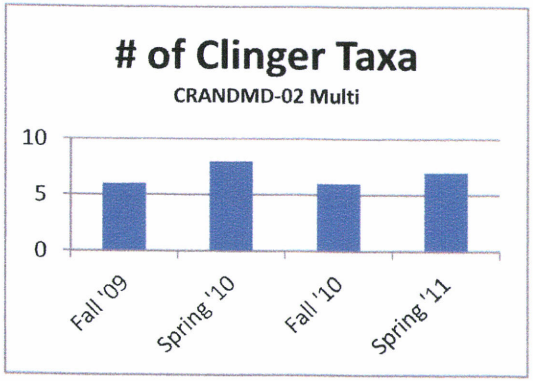

Shannon's Diversity
CRANDMD-02 Multi
3
2
1
0
Fall '09
Spring '10
Fall '10
Spring '11

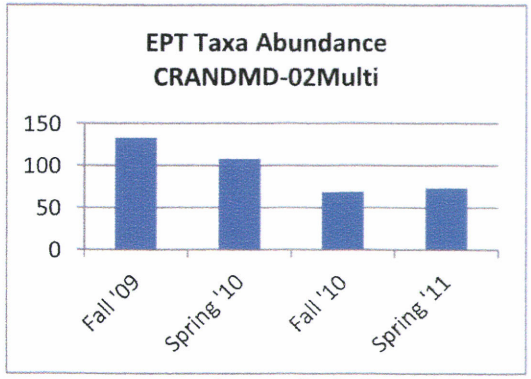

Percent Shredders
CRANDMD-02 Multi
8
4
0
Fall '09
Spring '10
Fall '10
Spring '11

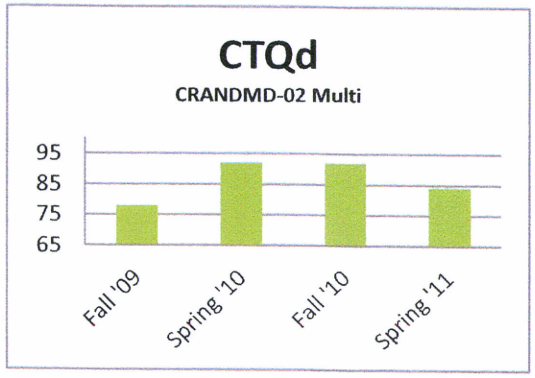

Percent Scrapers
CRANDMD-02 Multi
8
6
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

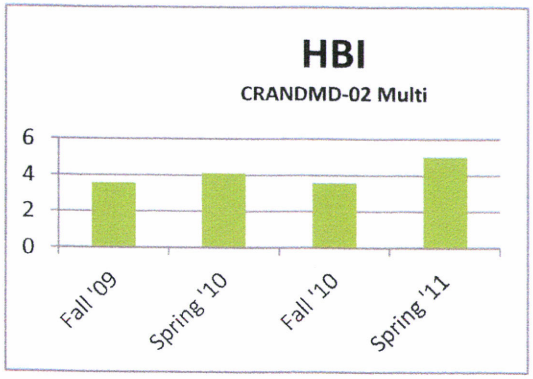

Specialist Feeders:Generalist Feeders
CRANDMD-02 Multi
0.5
0.4
0.3
0.2
0.1
0
Fall '09
Spring '10
Fall '10
Spring '11

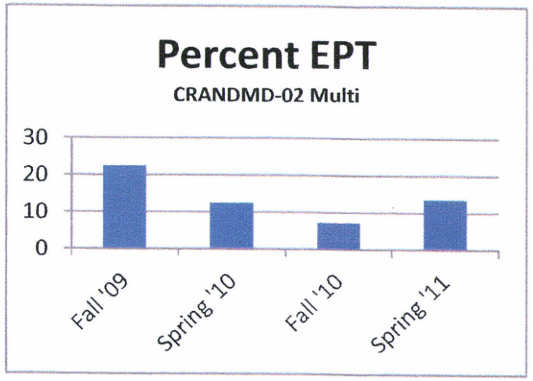

# of Long-lived Taxa
CRANDMD-02 Multi
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

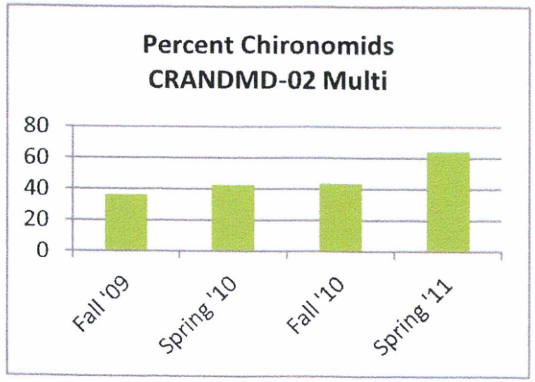

# of Clinger Taxa
CRANDMD-02 Multi
10
5
0
Fall '09
Spring '10
Fall '10
Spring '11

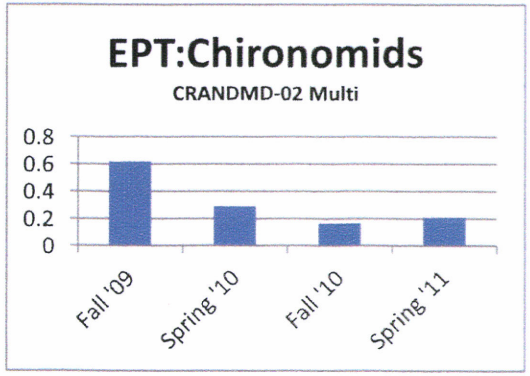

EPT Taxa Abundance
CRANDMD-02Multi
150
100
50
0
Fall '09
Spring '10
Fall '10
Spring '11

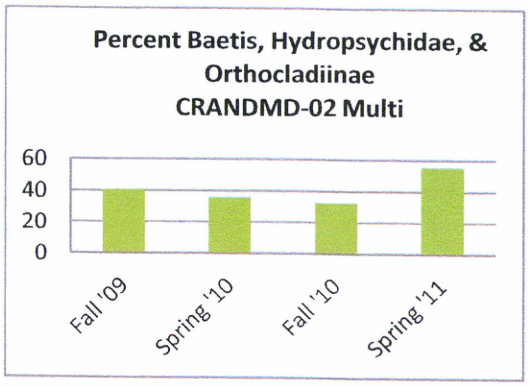

CTQd
CRANDMD-02 Multi
95
85
75
65
Fall '09
Spring '10
Fall '10
Spring '11

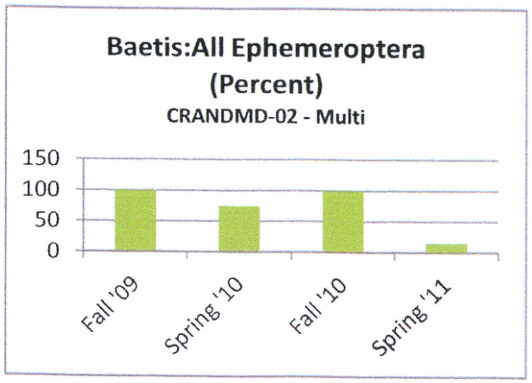

HBI
CRANDMD-02 Multi
6
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

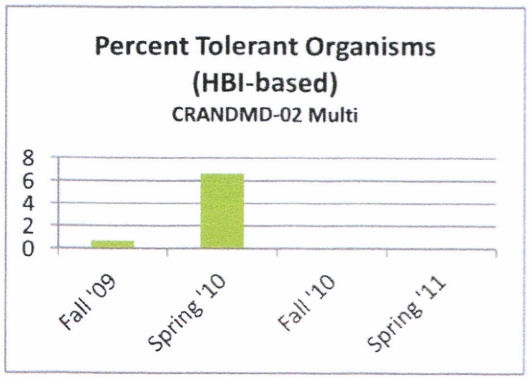

Percent EPT
CRANDMD-02 Multi
30
20
10
0
Fall '09
Spring '10
Fall '10
Spring '11

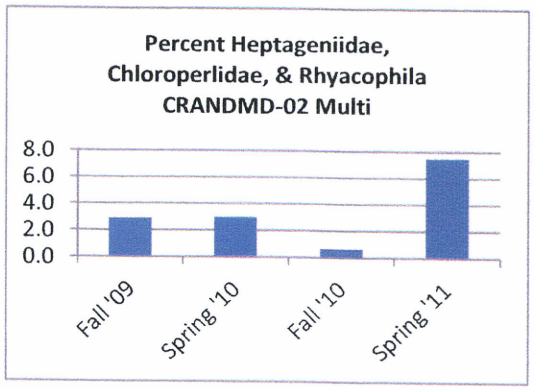

Percent Chironomids
CRANDMD-02 Multi
80
60
40
20
0
Fall '09
Spring '10
Fall '10
Spring '11

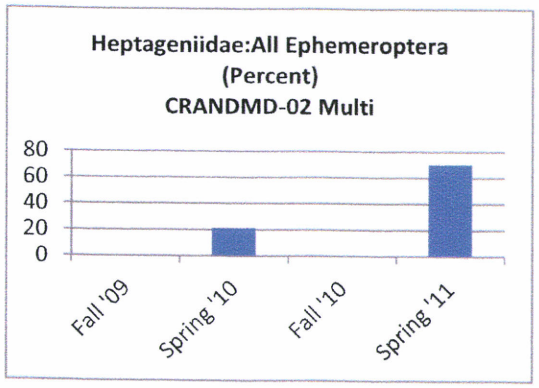

EPT:Chironomids
CRANDMD-02 Multi
0.8
0.6
0.4
0.2
0
Fall '09
Spring '10
Fall '10
Spring '11

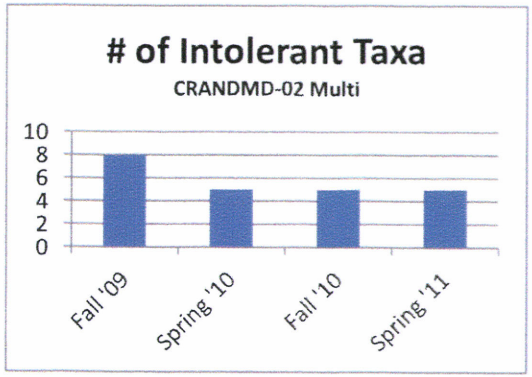

Percent Baetis, Hydropsychidae, & Orthocladiinae
CRANDMD-02 Multi
60
40
20
0
Fall '09
Spring '10
Fall '10
Spring '11

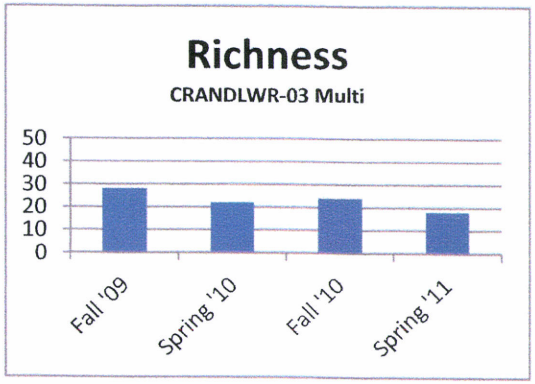

Baetis:All Ephemeroptera (Percent)
CRANDMD-02 - Multi
150
100
50
0
Fall '09
Spring '10
Fall '10
Spring '11

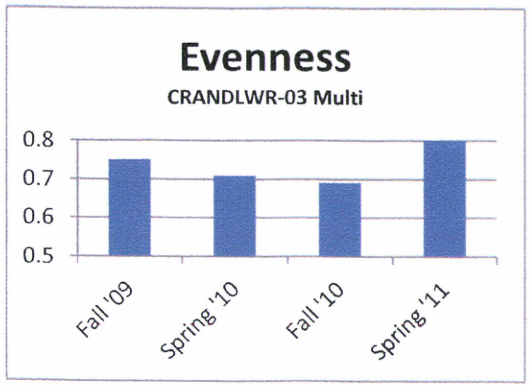

Percent Tolerant Organisms (HBI-based)
CRANDMD-02 Multi
8
6
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

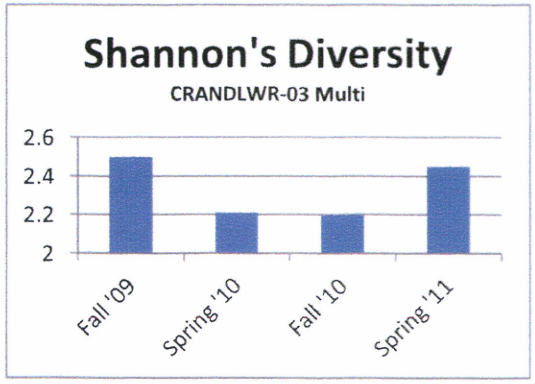

Percent Heptageniidae, Chloroperlidae, & Rhyacophila
CRANDMD-02 Multi
8.0
6.0
4.0
2.0
0.0
Fall '09
Spring '10
Fall '10
Spring '11

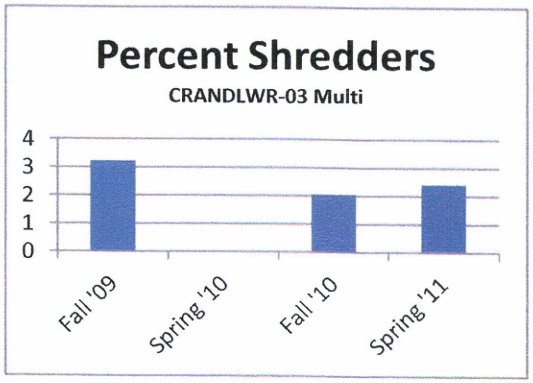

Heptageniidae:All Ephemeroptera (Percent)
CRANDMD-02 Multi
80
60
40
20
0
Fall '09
Spring '10
Fall '10
Spring '11

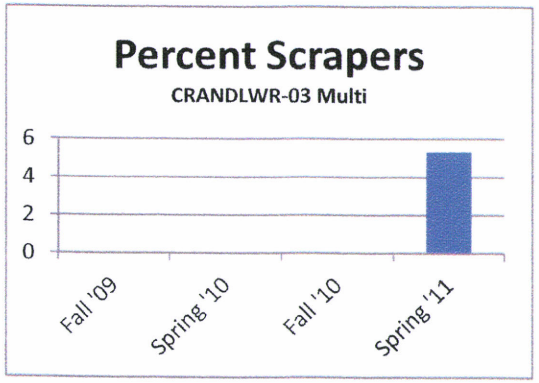

# of Intolerant Taxa
CRANDMD-02 Multi
10
8
6
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

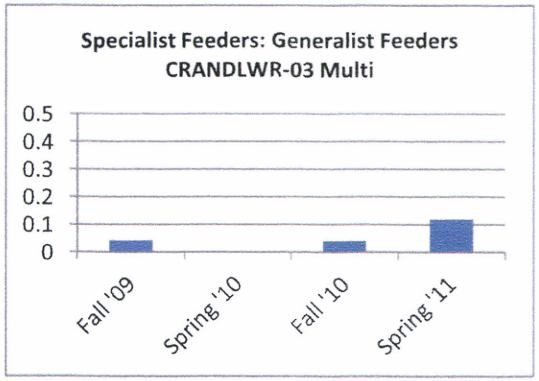

Richness
CRANDLWR-03 Multi
50
40
30
20
10
0
Fall '09
Spring '10
Fall '10
Spring '11

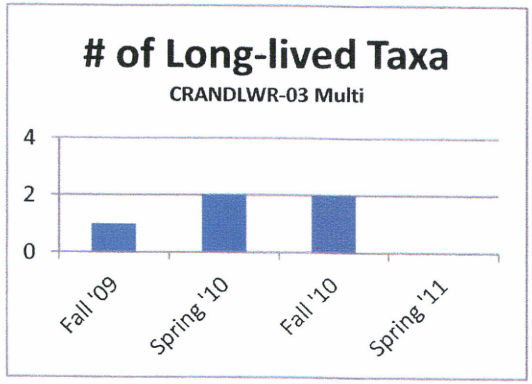

Evenness
CRANDLWR-03 Multi
0.8
0.7
0.6
0.5
Fall '09
Spring '10
Fall '10
Spring '11

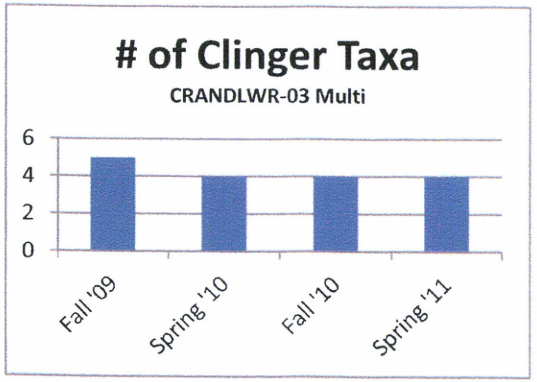

Shannon's Diversity
CRANDLWR-03 Multi
2.6
2.4
2.2
2
Fall '09
Spring '10
Fall '10
Spring '11

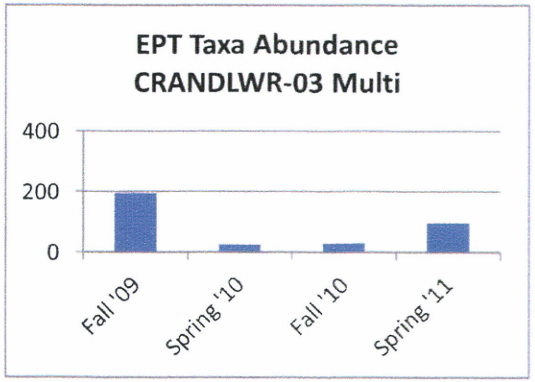

Percent Shredders
CRANDLWR-03 Multi
4
3
2
1
0
Fall '09
Spring '10
Fall '10
Spring '11

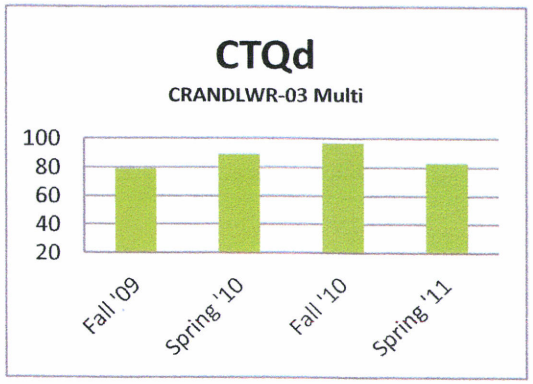

Percent Scrapers
CRANDLWR-03 Multi
6
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

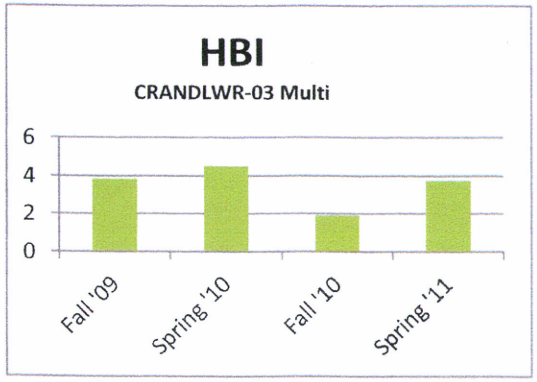

Specialist Feeders: Generalist Feeders
CRANDLWR-03 Multi
0.5
0.4
0.3
0.2
0.1
0
Fall '09
Spring '10
Fall '10
Spring '11

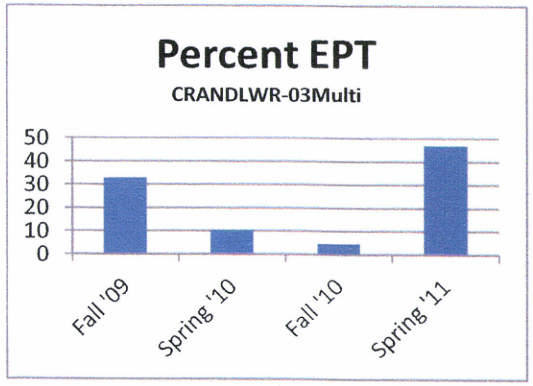

# of Long-lived Taxa
CRANDLWR-03 Multi
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

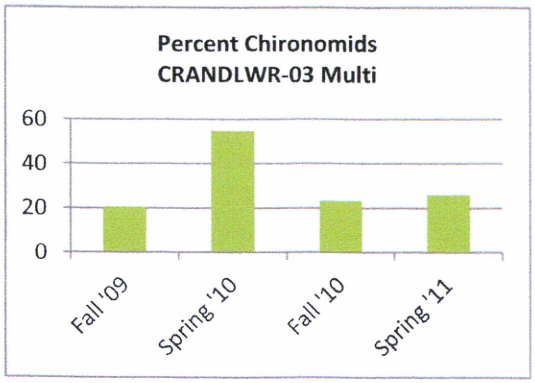

# of Clinger Taxa
CRANDLWR-03 Multi
6
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

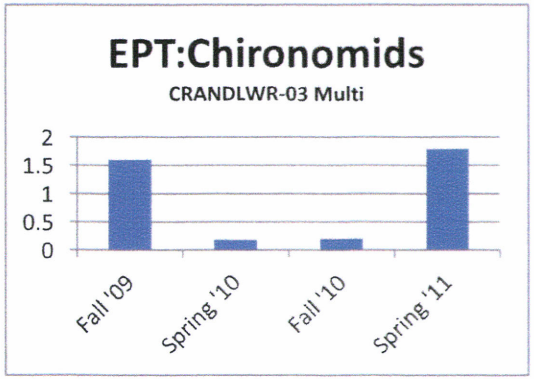

EPT Taxa Abundance
CRANDLWR-03 Multi
400
200
0
Fall '09
Spring '10
Fall '10
Spring '11

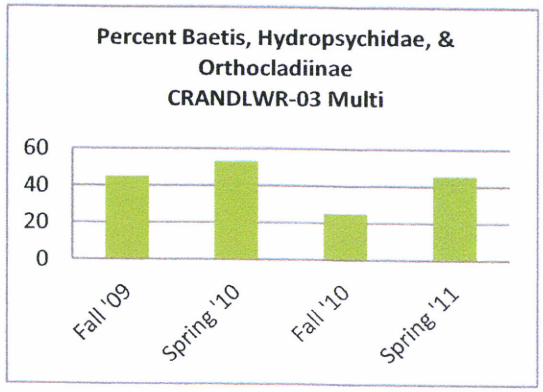

CTQd
CRANDLWR-03 Multi
100
80
60
40
20
Fall '09
Spring '10
Fall '10
Spring '11

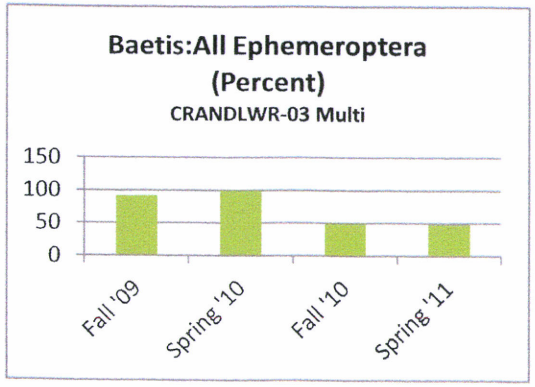

HBI
CRANDLWR-03 Multi
6
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

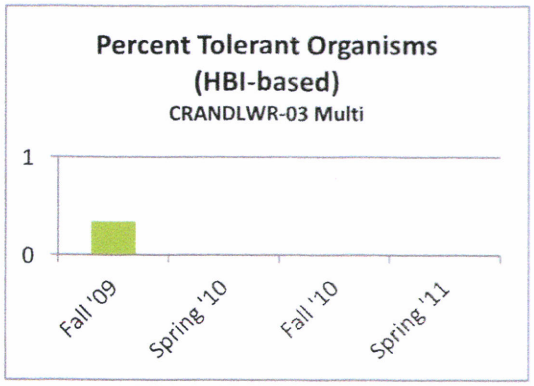

Percent EPT
CRANDLWR-03Multi
50
40
30
20
10
0
Fall '09
Spring '10
Fall '10
Spring '11

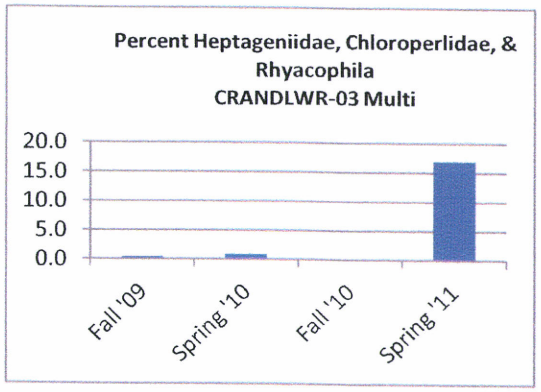

Percent Chironomids
CRANDLWR-03 Multi
60
40
20
0
Fall '09
Spring '10
Fall '10
Spring '11

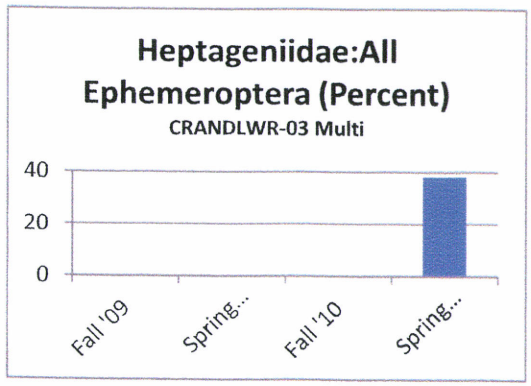

EPT:Chironomids
CRANDLWR-03 Multi
2
1.5
1
0.5
0
Fall '09
Spring '10
Fall '10
Spring '11

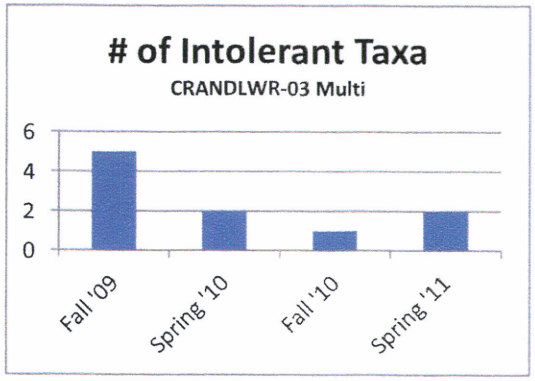

Percent Baetis, Hydropsychidae, & Orthocladiinae
CRANDLWR-03 Multi
60
40
20
0
Fall '09
Spring '10
Fall '10
Spring '11

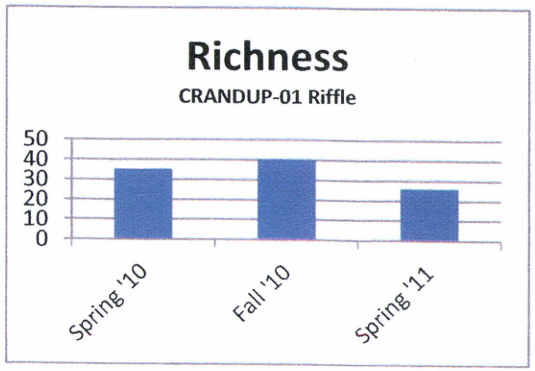

Baetis:All Ephemeroptera (Percent)
CRANDLWR-03 Multi
150
100
50
0
Fall '09
Spring '10
Fall '10
Spring '11

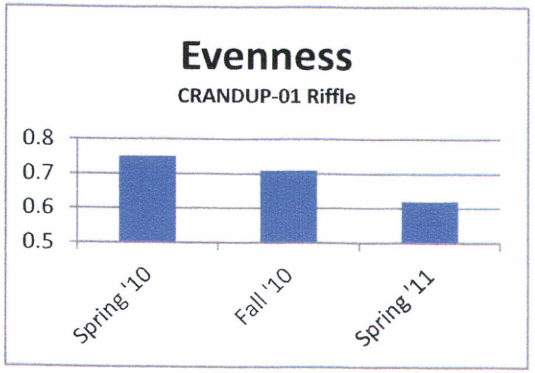

Percent Tolerant Organisms (HBI-based)
CRANDLWR-03 Multi
1
0
Fall '09
Spring '10
Fall '10
Spring '11

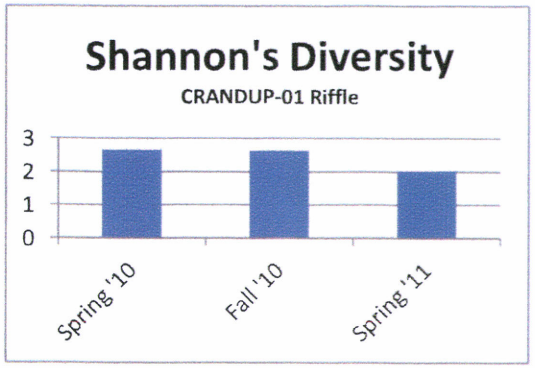

Percent Heptageniidae, Chloroperlidae, & Rhyacophila
CRANDLWR-03 Multi
20.0
15.0
10.0
5.0
0.0
Fall '09
Spring '10
Fall '10
Spring '11

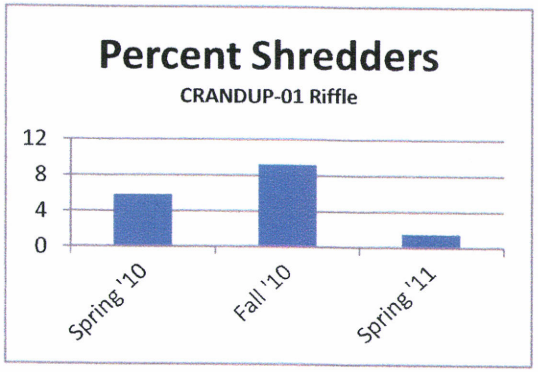

Heptageniidae:All Ephemeroptera (Percent)
CRANDLWR-03 Multi
40
20
0
Fall '09
Spring...
Fall '10
Spring...

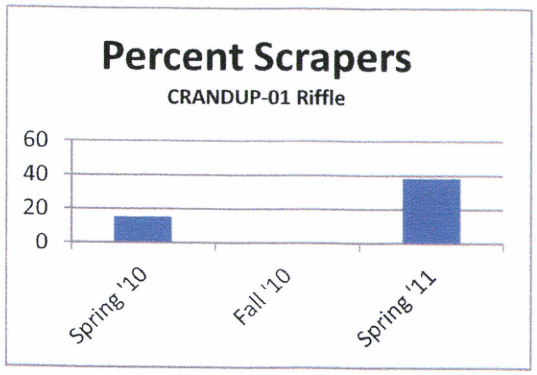

# of Intolerant Taxa
CRANDLWR-03 Multi
6
4
2
0
Fall '09
Spring '10
Fall '10
Spring '11

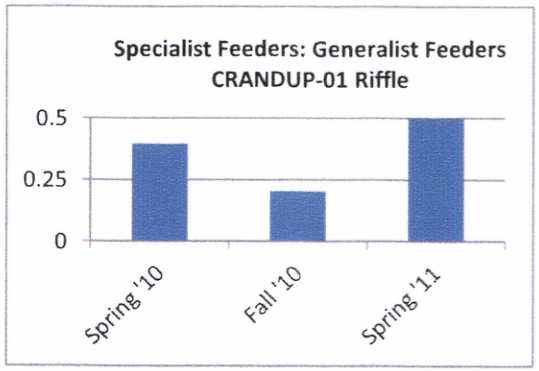

Richness
CRANDUP-01 Riffle
50
40
30
20
10
0
Spring '10
Fall '10
Spring '11

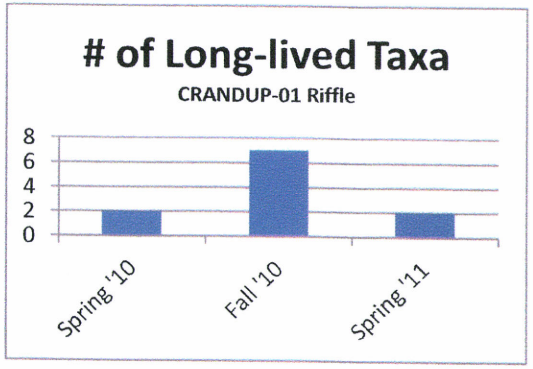

Evenness
CRANDUP-01 Riffle
0.8
0.7
0.6
0.5
Spring '10
Fall '10
Spring '11

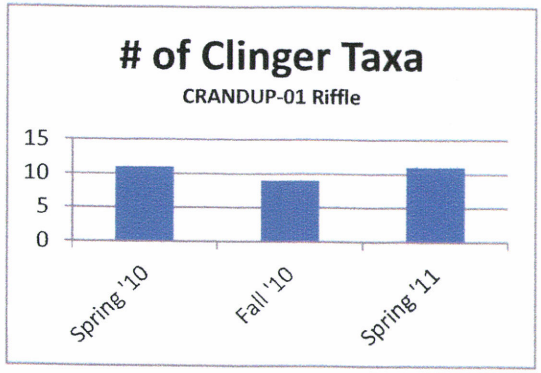

Shannon's Diversity
CRANDUP-01 Riffle
3
2
1
0
Spring '10
Fall '10
Spring '11

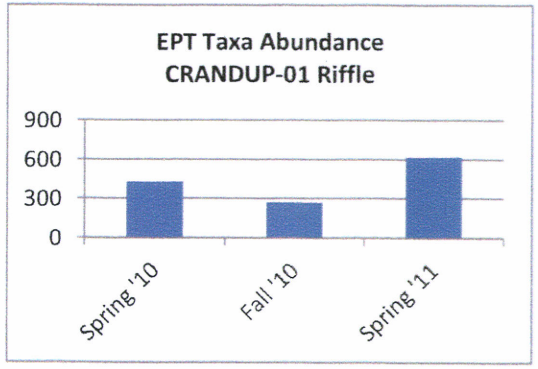

Percent Shredders
CRANDUP-01 Riffle
12
8
4
0
Spring '10
Fall '10
Spring '11

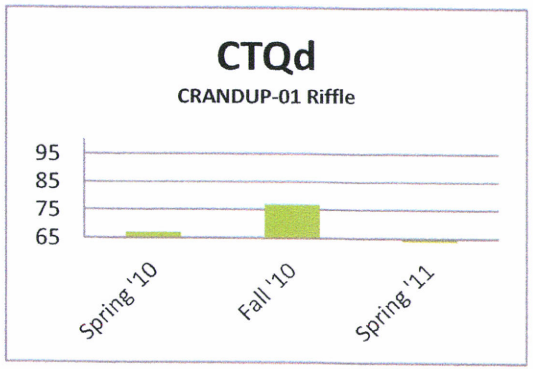

Percent Scrapers
CRANDUP-01 Riffle
60
40
20
0
Spring '10
Fall '10
Spring '11

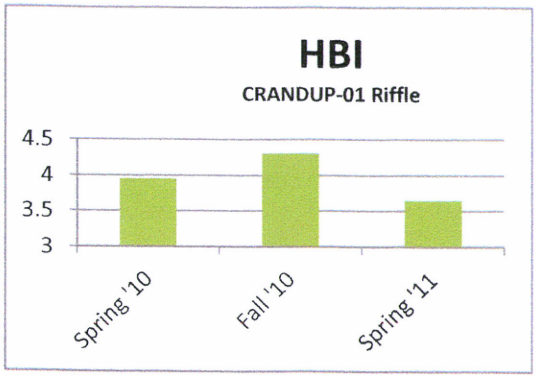

Specialist Feeders: Generalist Feeders
CRANDUP-01 Riffle
0.5
0.25
0
Spring '10
Fall '10
Spring '11

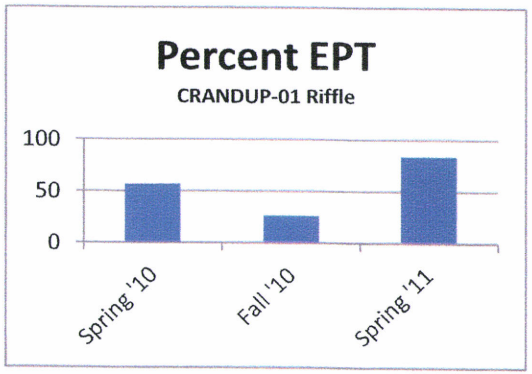

# of Long-lived Taxa
CRANDUP-01 Riffle
8
6
4
2
0
Spring '10
Fall '10
Spring '11

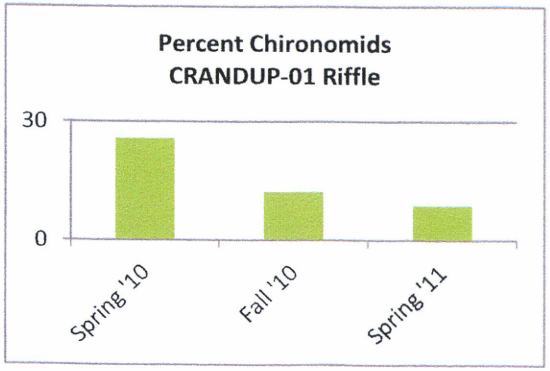

# of Clinger Taxa
CRANDUP-01 Riffle
15
10
5
0
Spring '10
Fall '10
Spring '11

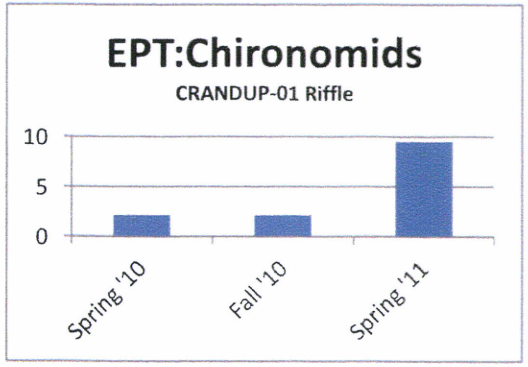

EPT Taxa Abundance
CRANDUP-01 Riffle
900
600
300
0
Spring '10
Fall '10
Spring '11

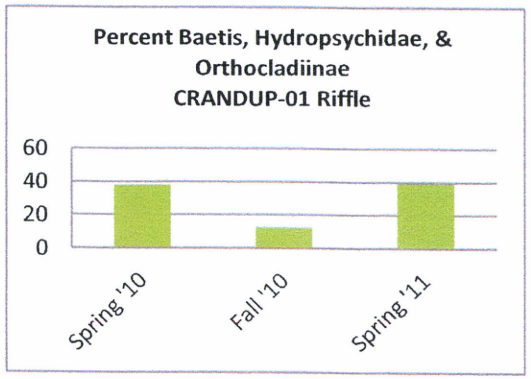

CTQd
CRANDUP-01 Riffle
95
85
75
65
Spring '10
Fall '10
Spring '11

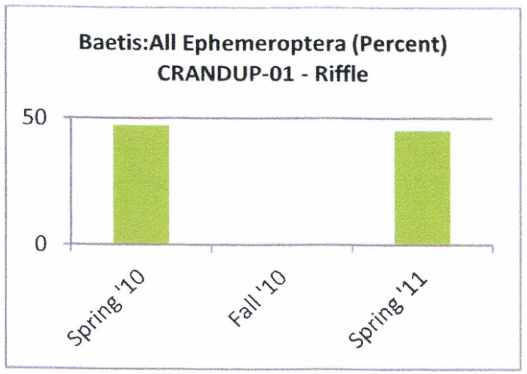

HBI
CRANDUP-01 Riffle
4.5
4
3.5
3
Spring '10
Fall '10
Spring '11

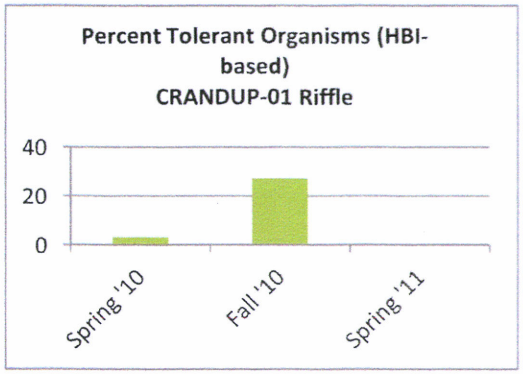

Percent EPT
CRANDUP-01 Riffle
100
50
0
Spring '10
Fall '10
Spring '11

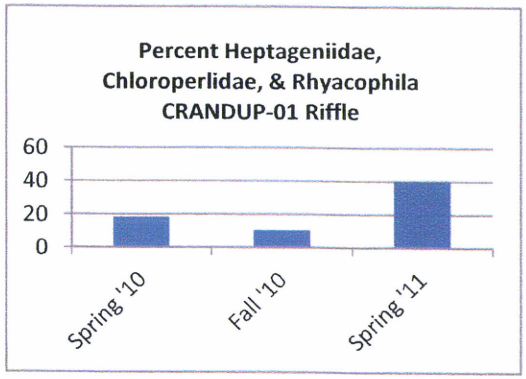

Percent Chironomids
CRANDUP-01 Riffle
30
0
Spring '10
Fall '10
Spring '11

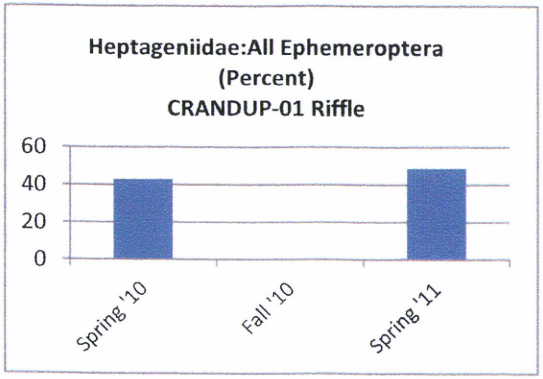

EPT:Chironomids
CRANDUP-01 Riffle
10
5
0
Spring '10
Fall '10
Spring '11

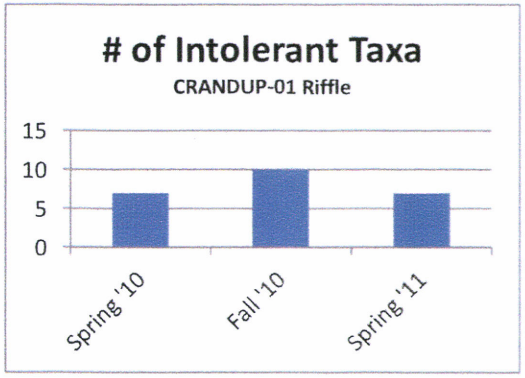

Percent Baetis, Hydropsychidae, & Orthocladiinae
CRANDUP-01 Riffle
60
40
20
0
Spring '10
Fall '10
Spring '11

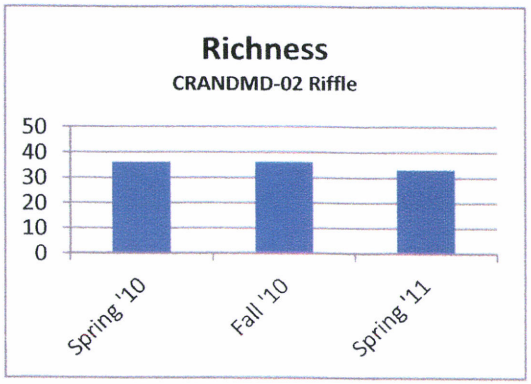

Baetis:All Ephemeroptera (Percent)
CRANDUP-01 - Riffle
50
0
Spring '10
Fall '10
Spring '11

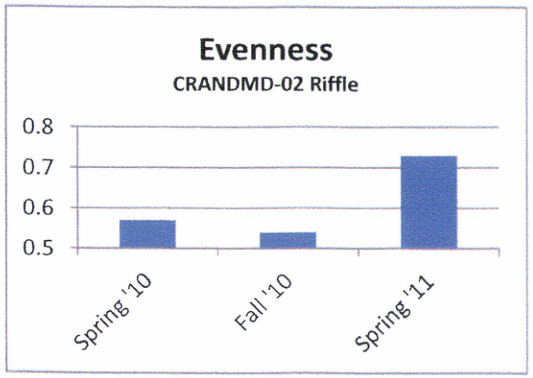

Percent Tolerant Organisms (HBI-based)
CRANDUP-01 Riffle
40
20
0
Spring '10
Fall '10
Spring '11

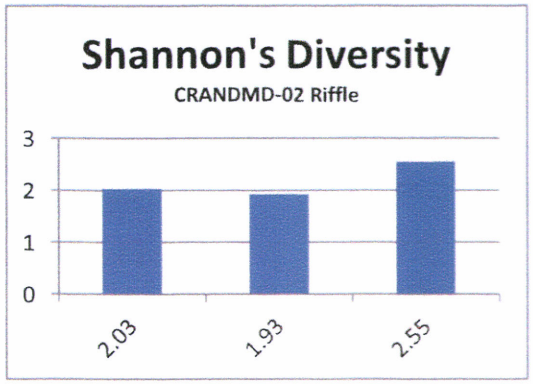

Percent Heptageniidae, Chloroperlidae, & Rhyacophila
CRANDUP-01 Riffle
60
40
20
0
Spring '10
Fall '10
Spring '11

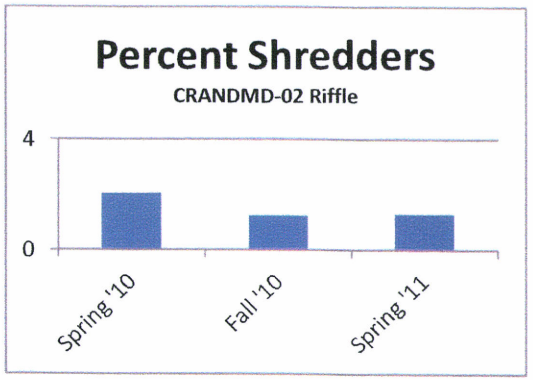

Heptageniidae:All Ephemeroptera (Percent)
CRANDUP-01 Riffle
60
40
20
0
Spring '10
Fall '10
Spring '11

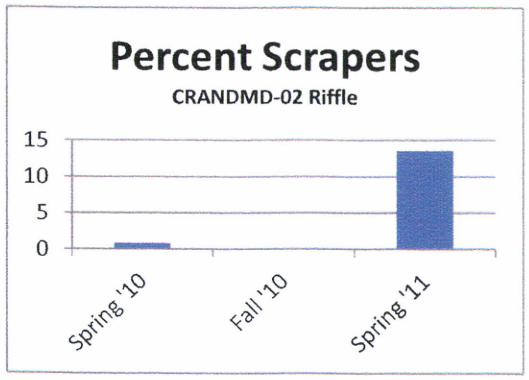

# of Intolerant Taxa
CRANDUP-01 Riffle
15
10
5
0
Spring '10
Fall '10
Spring '11

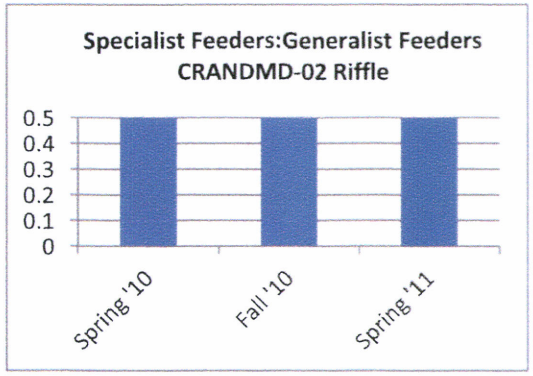

Richness
CRANDMD-02 Riffle
50
40
30
20
10
0
Spring '10
Fall '10
Spring '11

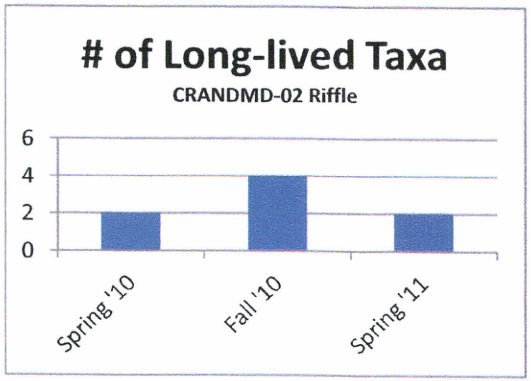

Evenness
CRANDMD-02 Riffle
0.8
0.7
0.6
0.5
Spring '10
Fall '10
Spring '11

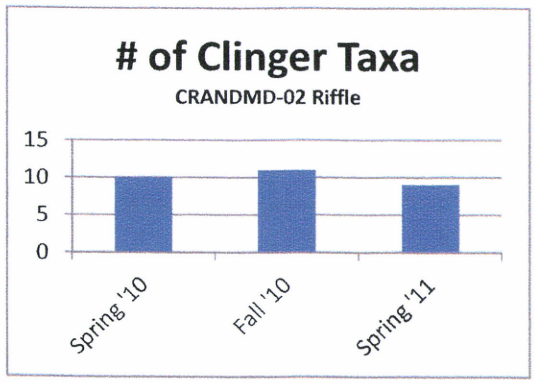

Shannon's Diversity
CRANDMD-02 Riffle
3
2
1
0
2.03
1.93
2.55

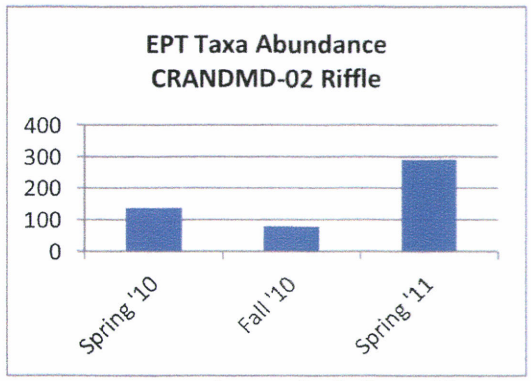

Percent Shredders
CRANDMD-02 Riffle
4
0
Spring '10
Fall '10
Spring '11

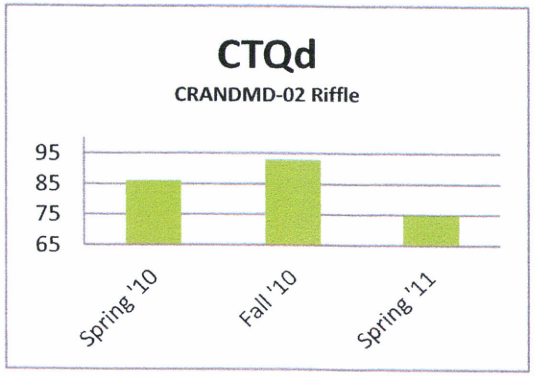

Percent Scrapers
CRANDMD-02 Riffle
15
10
5
0
Spring '10
Fall '10
Spring '11

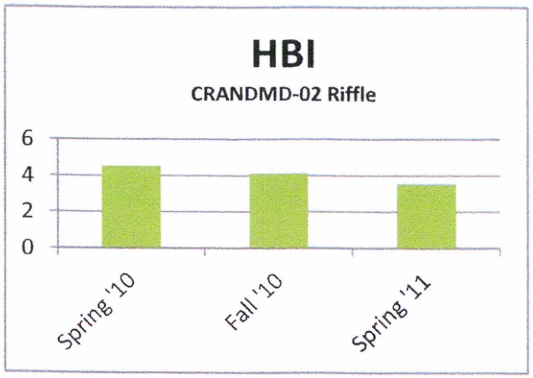

Specialist Feeders:Generalist Feeders
CRANDMD-02 Riffle
0.5
0.4
0.3
0.2
0.1
0
Spring '10
Fall '10
Spring '11

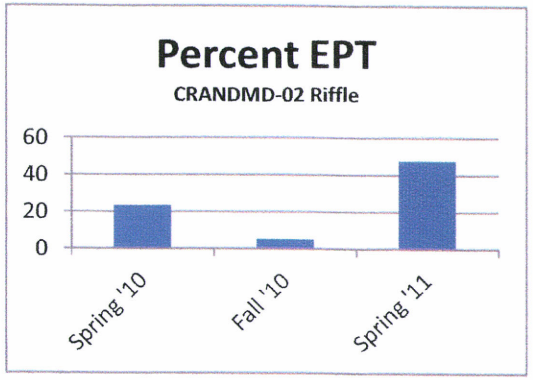

# of Long-lived Taxa
CRANDMD-02 Riffle
6
4
2
0
Spring '10
Fall '10
Spring '11

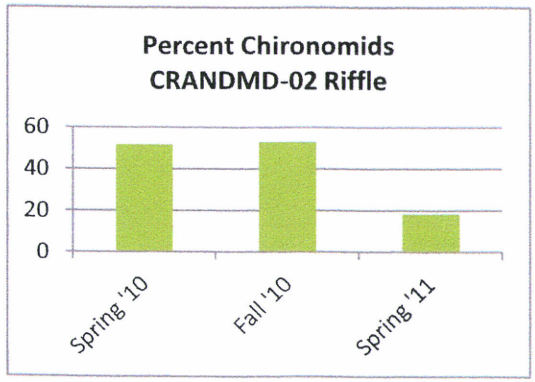

# of Clinger Taxa
CRANDMD-02 Riffle
15
10
5
0
Spring '10
Fall '10
Spring '11

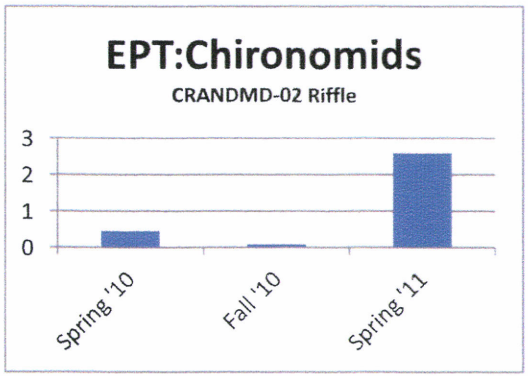

EPT Taxa Abundance
CRANDMD-02 Riffle
400
300
200
100
0
Spring '10
Fall '10
Spring '11

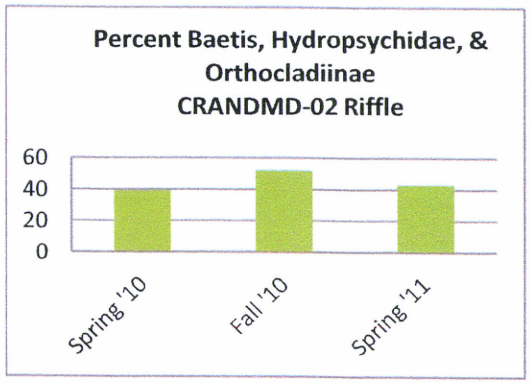

CTQd
CRANDMD-02 Riffle
95
85
75
65
Spring '10
Fall '10
Spring '11

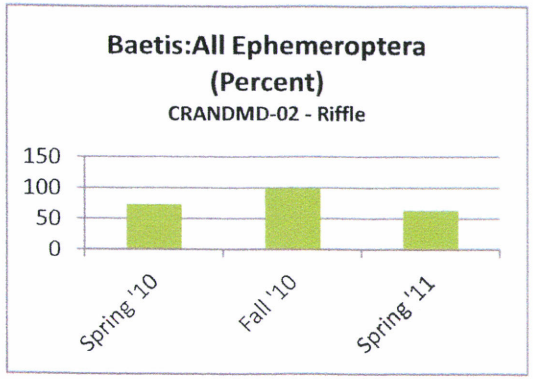

HBI
CRANDMD-02 Riffle
6
4
2
0
Spring '10
Fall '10
Spring '11

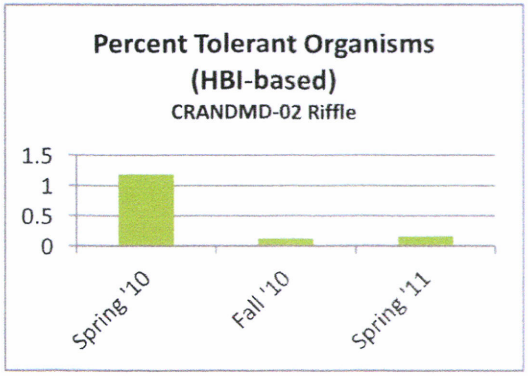

Percent EPT
CRANDMD-02 Riffle
60
40
20
0
Spring '10
Fall '10
Spring '11

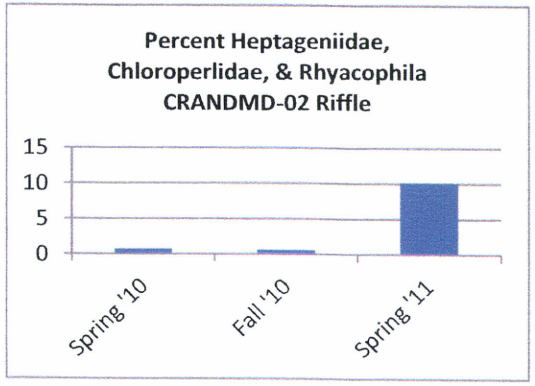

Percent Chironomids
CRANDMD-02 Riffle
60
40
20
0
Spring '10
Fall '10
Spring '11

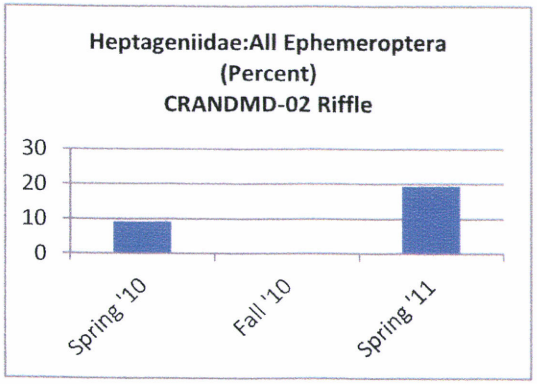

EPT:Chironomids
CRANDMD-02 Riffle
3
2
1
0
Spring '10
Fall '10
Spring '11

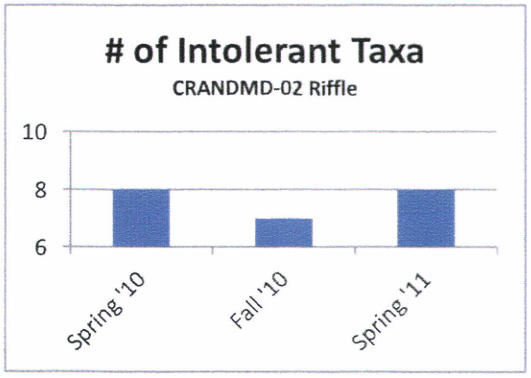

Percent Baetis, Hydropsychidae, & Orthocladiinae
CRANDMD-02 Riffle
60
40
20
0
Spring '10
Fall '10
Spring '11

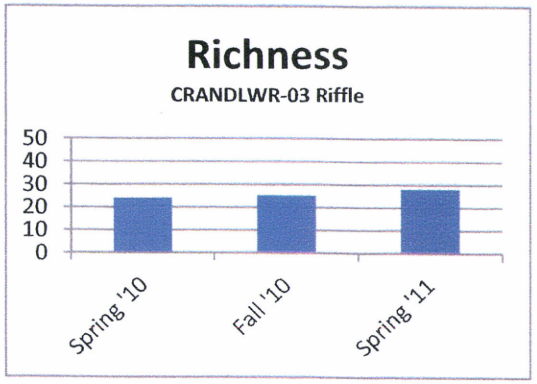

Baetis:All Ephemeroptera (Percent)
CRANDMD-02 - Riffle
150
100
50
0
Spring '10
Fall '10
Spring '11

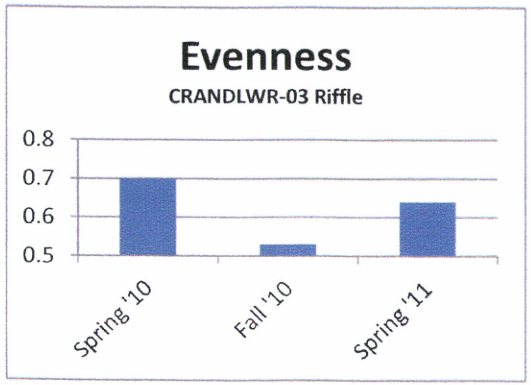

Percent Tolerant Organisms (HBI-based)
CRANDMD-02 Riffle
1.5
1
0.5
0
Spring '10
Fall '10
Spring '11

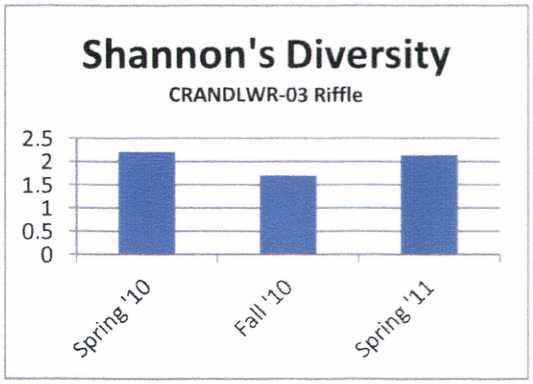

Percent Heptageniidae, Chloroperlidae, & Rhyacophila
CRANDMD-02 Riffle
15
10
5
0
Spring '10
Fall '10
Spring '11

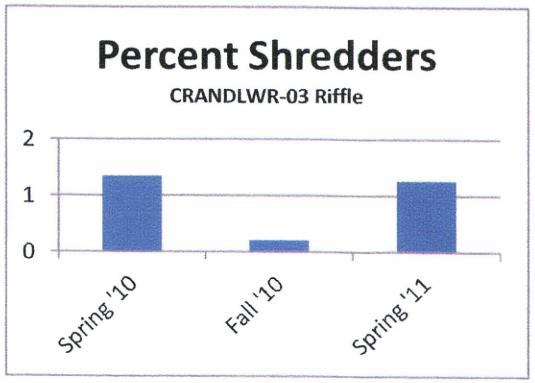

Heptageniidae:All Ephemeroptera (Percent)
CRANDMD-02 Riffle
30
20
10
0
Spring '10
Fall '10
Spring '11

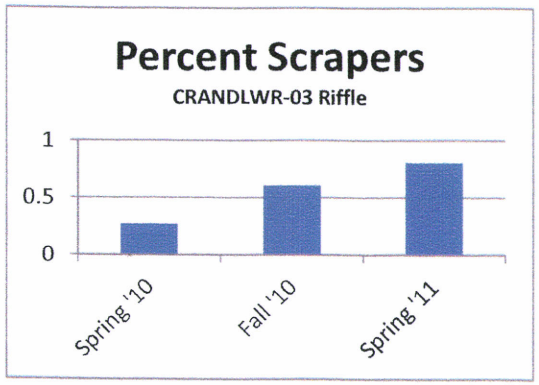

# of Intolerant Taxa
CRANDMD-02 Riffle
10
8
6
Spring '10
Fall '10
Spring '11

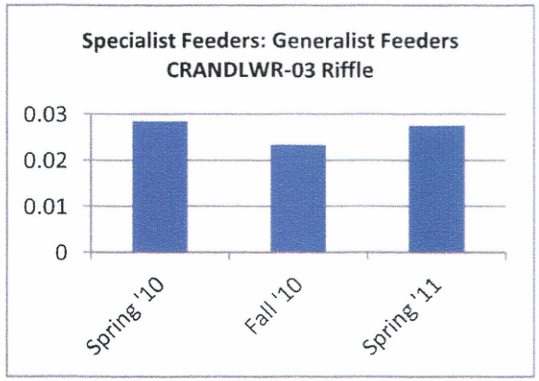

Richness
CRANDLWR-03 Riffle
50
40
30
20
10
0
Spring '10
Fall '10
Spring '11

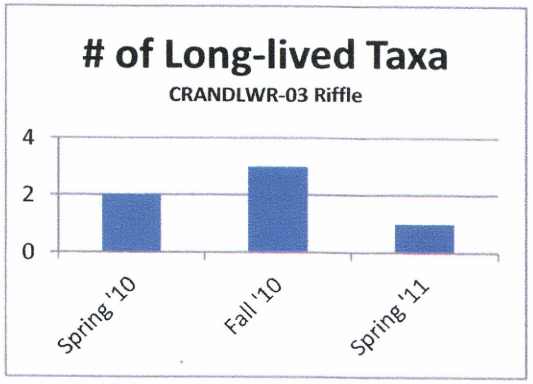

Evenness
CRANDLWR-03 Riffle
0.8
0.7
0.6
0.5
Spring '10
Fall '10
Spring '11

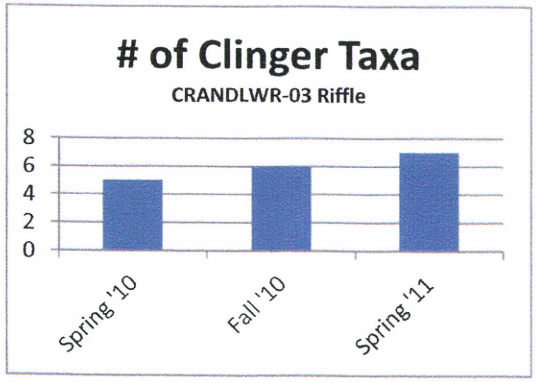

Shannon's Diversity
CRANDLWR-03 Riffle
2.5
2
1.5
1
0.5
0
Spring '10
Fall '10
Spring '11

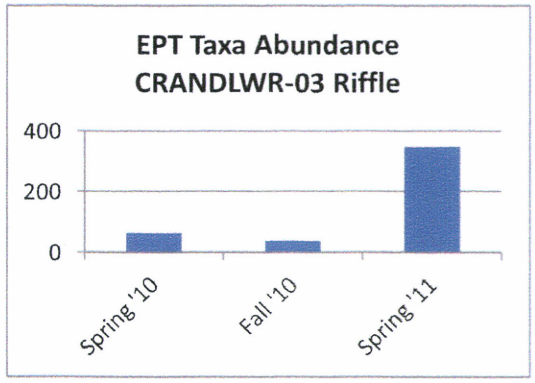

Percent Shredders
CRANDLWR-03 Riffle
2
1
0
Spring '10
Fall '10
Spring '11

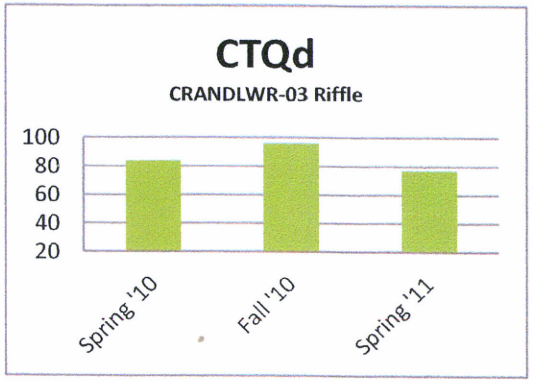

Percent Scrapers
CRANDLWR-03 Riffle
1
0.5
0
Spring '10
Fall '10
Spring '11

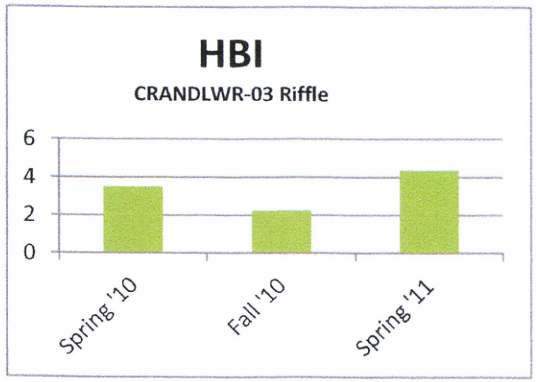

Specialist Feeders: Generalist Feeders
CRANDLWR-03 Riffle
0.03
0.02
0.01
0
Spring '10
Fall '10
Spring '11

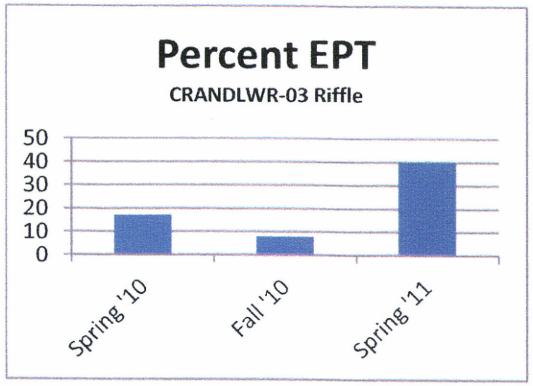

# of Long-lived Taxa
CRANDLWR-03 Riffle
4
2
0
Spring '10
Fall '10
Spring '11

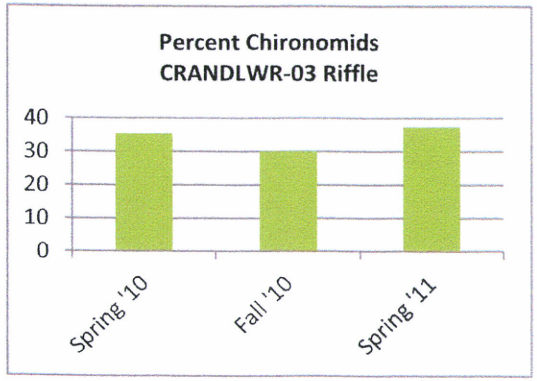

# of Clinger Taxa
CRANDLWR-03 Riffle
8
6
4
2
0
Spring '10
Fall '10
Spring '11

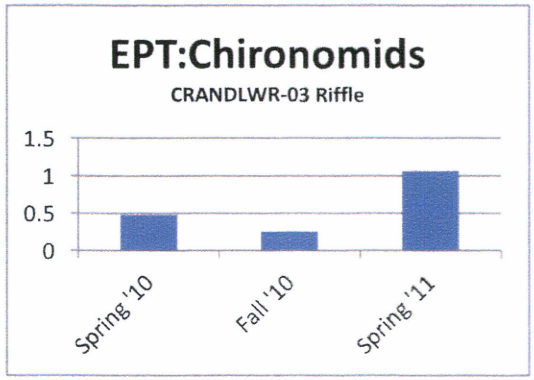

EPT Taxa Abundance
CRANDLWR-03 Riffle
400
200
0
Spring '10
Fall '10
Spring '11

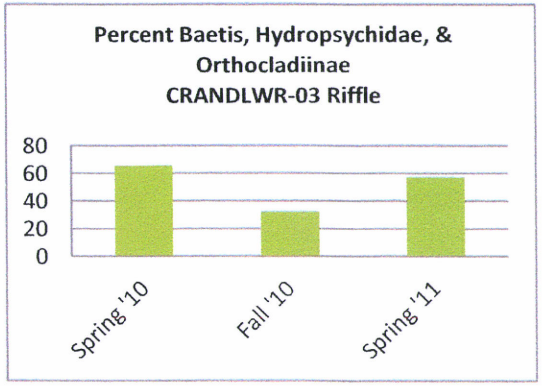

CTQd
CRANDLWR-03 Riffle
100
80
60
40
20
Spring '10
Fall '10
Spring '11

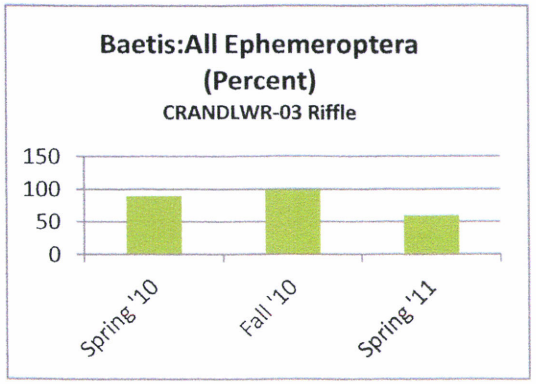

HBI
CRANDLWR-03 Riffle
6
4
2
0
Spring '10
Fall '10
Spring '11

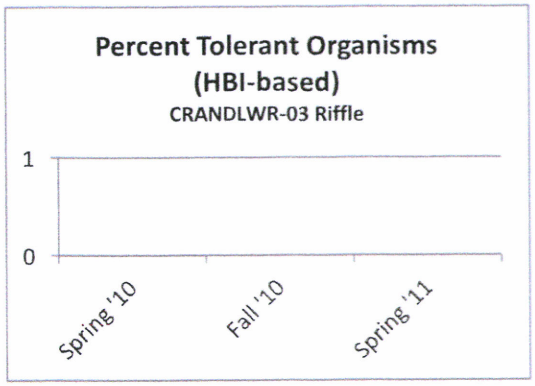

Percent EPT
CRANDLWR-03 Riffle
50
40
30
20
10
0
Spring '10
Fall '10
Spring '11

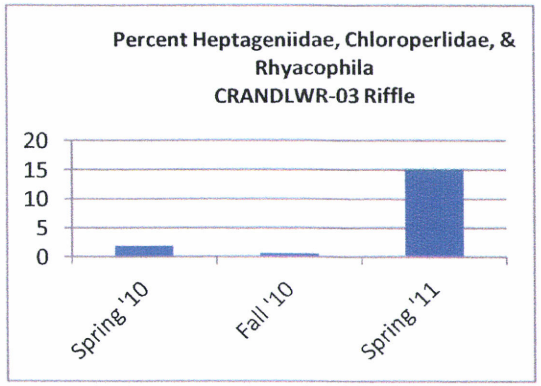

Percent Chironomids
CRANDLWR-03 Riffle
40
30
20
10
0
Spring '10
Fall '10
Spring '11

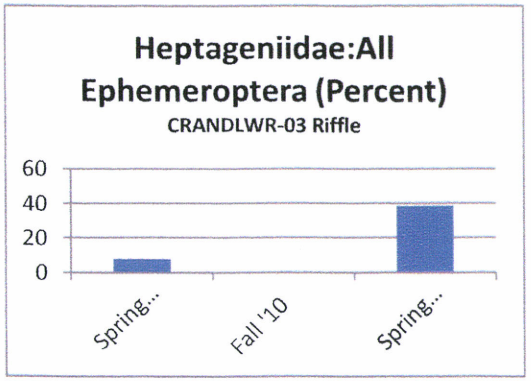

EPT:Chironomids
CRANDLWR-03 Riffle
1.5
1
0.5
0
Spring '10
Fall '10
Spring '11

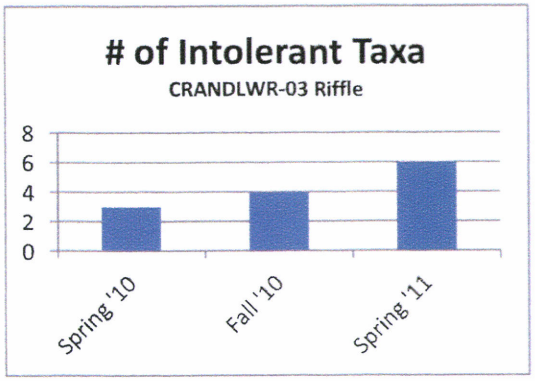

Percent Baetis, Hydropsychidae, & Orthocladiinae
CRANDLWR-03 Riffle
80
60
40
20
0
Spring '10
Fall '10
Spring '11


Baetis:All Ephemeroptera (Percent)
CRANDLWR-03 Riffle
150
100
50
0
Spring '10
Fall '10
Spring '11


Percent Tolerant Organisms (HBI-based)
CRANDLWR-03 Riffle
1
0
Spring '10
Fall '10
Spring '11


Percent Heptageniidae, Chloroperlidae, & Rhyacophila
CRANDLWR-03 Riffle
20
15
10
5
0
Spring '10
Fall '10
Spring '11


Heptageniidae:All Ephemeroptera (Percent)
CRANDLWR-03 Riffle
60
40
20
0
Spring...
Fall '10
Spring...


# of Intolerant Taxa
CRANDLWR-03 Riffle
8
6
4
2
0
Spring '10
Fall '10
Spring '11

Range (Minimum & Maximum) of Values for Each Metric, by Location

(Using data from Fall 2009 through Spring 2011)

Metric Name	CRANDUP-01		CRANDMD-02		CRANDLWR-03	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Richness	21	45	22	36	18	28
Shannon's Diversity	2.03	2.78	1.87	2.59	1.7	2.50
Evenness	0.62	0.76	0.54	0.75	0.53	0.85
EPT Taxa Abundance	56	738	69	291	26	348
# of Intolerant Taxa	3	11	5	8	1	6
HBI	3.53	5.86	3.55	5.01	1.91	4.51
# of Clinger taxa	4	11	6	11	4	7
Long-lived Taxa	0	7	1	4	0	3
CTQd	63	81	75	93	77	97
Percent Shredders	1.5	15.7	0.9	5.4	0.0	3.2
Percent Scrapers	0.0	38.2	0.0	13.5	0.0	5.3
Specialist Feeders: Generalist Feeders	0.1	0.9	0.0	0.3	0.0	0.1
Percent EPT	18.9	83.5	5.0	47.4	4.8	46.9
Percent Chironomids	8.8	66.0	18.2	64.1	20.5	54.7
EPT:Chironomids	0.3	9.5	0.1	2.6	0.2	1.8
Percent Baetis, Hydropsychidae, & Orthocladiinae	9.3	39.2	32.6	55.2	25.0	65.7
Baetis: All Ephemeroptera (Percent)	0.0	72.7	15.0	100.0	48.3	100.0
Percent Tolerant Organisms (HBI-based)	0.0	38.1	0.0	6.7	0.0	0.3
Percent Heptageniidae, Chloroperlidae, & Rhyacophila	0.7	39.9	0.6	10.1	0.0	16.9
Heptageniidae: All Ephemeroptera (Percent)	0.0	48.6	0.0	70.0	0.0	38.3

MINE MAP

FEDERAL LEASE UTU-68082

DH-6 ● 5.0'

Burn (Doelling)

PANEL 7

PANEL 8

PANEL 9

PANEL 10

PANEL 11

PANEL 12

SECTION 35

FEDERAL LEASE UTU-68082

GENWAL STATE LEASE ML-21569

(ALL OF SECTION 36)

SEALED AREA

SECTION 36

PANEL 1

PANEL 2

PANEL 28

SECTION 31

PANEL 13

PANEL 14

PANEL 15

GENWAL STATE LEASE ML-21568

(ALL OF SECTION 2)

PANEL 16

PANEL 17

PANEL 18

PANEL 3

PANEL 4

PANEL 5

PANEL 6

PANEL 19

PANEL 20

PANEL 27

GENWAL LEASE

SL062648

GENWAL LEASE U-34762

EM-179

EM-186

DELLEBACK FEE

PACIFICORP SUBLEASE

RECEIVED
APR 0 3 2012
DIV. OF OIL, GAS & MINING

UTAH REGISTERED PROFESSIONAL ENGINEER
#6449561
David W. Hibbs
5/5/09

2011
~~2010~~
~~2009~~

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

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