State of Utah

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SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Amanda Smith
Executive Director

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
Director

Water Quality Board
Myron E. Bateman, *Chair*
Shane E. Pace, *Vice Chair*
Clyde L. Bunker
Merritt K. Frey
Gregg A. Galecki
Jennifer M. Grant
Leland J. Myers
Hugo E. Rodier
Amanda Smith
Walter L. Baker
Executive Secretary

Utah Water Quality Board Meeting
Dixie Center
1835 S Convention Center Dr.
St. George UT 84790
April 29, 2015

Board Meeting Begins @ 9:00 a.m.
AGENDA

A. **Water Quality Board Meeting – Roll Call**

B. (Tab 1) **Minutes:**
Approval of Minutes for February 25, 2015 WQ Board Meeting .....Myron Bateman

C. **Recognition Award to Leland Myers & Merritt Frey for their service on the Water Quality Board** .....Myron Bateman

Recognition Awards for Terral Dunn & Cliff Specht for their service on the Utah Wastewater Operator Certification Council ..... Myron Bateman

Presentation of the Utah Wastewater Operator Certification Council 2014 Annual Report ..... Mike McFarland

D. **Executive Secretary's Report**.....Walt Baker

E. (Tab 2) **Funding Requests:**
1. Financial Report ..... Emily Cantón

2. San Juan Spanish Valley Request for Planning Advance..... John Mackey

3. North Summit Irrigation Company Request NPS Hardship Grant .....
..... Kari Lundeen

4. Hildale Request for Planning Advance ..... Lisa Nelson

5. TriCounty Health Department Hardship Planning Grant ..... Lisa Nelson

F. (Tab 3) **Request for approval of Moroni Settlement Agreement**.....Jennifer Robinson

G. (Tab 4) **Rulemaking**:
1. **Request to Adopt the Amendment for Section R317-10-8:** *Utah Wastewater Operator Certification Council* ..... Judy Etherington

2. **Request to proceed to Rulemaking R317-2:** *Standards of Quality for Waters of the State* ..... Christopher Bittner

195 North 1950 West • Salt Lake City, UT
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H. (Tab 5) **Other Business:**

1. Sudweeks Committee ..... Walt Baker

2. Legislative Update ..... Walt Baker

I. (Tab 6) **News Articles:**

Next Meeting May 27, 2015
DEQ Building Board Room 1015
195 North 1950 West
Salt Lake City, Utah 84116

Revised 04/15/15

In compliance with the American Disabilities Act, individuals with special needs (including auxiliary communicative aids and services) should contact Dana Powers, Office of Human Resources, at (801) 536-4412, TDD (801) 536-4414, at least five working days prior to the scheduled meeting

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MINUTES
UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY
UTAH WATER QUALITY BOARD

DEQ Building Board Room 1015
195 North 1950 West
Salt Lake City, Utah 84116
February 25, 2015

UTAH WATER QUALITY BOARD MEMBERS PRESENT

Clyde Bunker	Leland Myers
Gregg Galecki	Merritt Frey
Jennifer Grant	Hugo Rodier

Excused: Myron Bateman, Shane Pace & Amanda Smith

DIVISION OF WATER QUALITY STAFF MEMBERS PRESENT

Walter Baker, Leah Ann Lamb, Erica Gaddis, Jenny Potter, Nicole Froula, Marsha Case, Emily Cantón, John Mackey, Lisa Nelson, Carl Adams, and John Cook.

OTHERS PRESENT

Name	Organization Representing
Mayor Bruce Densley	Virgin Town
Theron Miller	Jordan River/Farmington Bay
Nathan Hall	Division of Drinking Water
Rod Mills	Virgin Town
Eric Johnson	Bond Counsel
Lee Snelgrove	Francis City
Scott Kettle	Francis City
Jake Baer	Francis City
Steve Jackson	Jackson Engineering
Krista Klein	South Eden Ranch

Leland Myers called the Board meeting to order at 9:06 AM and took roll call for the members of the Board and audience.

APPROVAL OF MINUTES OF THE JANUARY 28, 2015 MEETING

Motion: **It was moved by Mr. Galecki and seconded by Ms. Grant to approve the minutes of the January 28, 2015 Water Quality Board meeting. The motion was approved. Clyde Bunker abstained from the vote.**

EXECUTIVE SECRETARY REPORT

- Public comment period closed on 401 Certification for the bridge that will be constructed across the Union Pacific causeway. Because of the effect this will have on the eco-system, there were several comments and the certification has been changed. The Division of Forestry, Fire and State lands owns the lake, so there were some concerns on who has the right-of-way, and also who would be responsible for the long-term changes which may be necessary. Completion of construction should be 2015. (http://www.deq.utah.gov/locations/G/greatsaltlake/railroadcauseway/index.htm)
- DWQ has been quiet on the hill this year, however SB200 by Margaret Dayton (http://le.utah.gov/~2015/bills/static/SB0200.html) affects the make-up of the board, by requiring a member representing local services districts. DWQ is supportive of this bill.
- SB244 would combine two divisions within DEQ (http://le.utah.gov/~2015/bills/static/SB0244.html), the Division of Radiation Control and the Division of Solid and Hazardous Waste. It would also reduce by one the number of DEQ Boards.
- Update on Logan: Staff last met with the six communities in November 2014. Shortly after that meeting the six communities hired an attorney to represent them. We have not seen any revisions to the draft agreement since then. We are meeting with them on Friday February 27, 2015 to discuss what decisions have been made. We are hopeful the draft agreement hasn't been completely rewritten as this will set us back several months. The goals for the meeting are to determine: 1) Who would have voting rights? 2) The extent of the land transfer fees. 3) The equity of the user fee charged. We will have another update for the Board as soon as possible.

FUNDING REQUESTS

Financial Reports: Ms. Cantón updated the Board on the Loan Funds, and Hardship Grant Funds, as seen in the Board Packet on pages D-1 & D-2.

Francis City Loan Re-Authorization: In August 2012, the Water Quality Board authorized funding for the construction of an additional lagoon cell and an additional winter storage cell. The original construction cost estimate was $2,285,000 with $848,508 contingency fund. During the site investigation, it became apparent the design and construction costs would increase from the initial planning estimate. The reasons can be seen on page D-4 in the Board packet. With these estimates the lowest bid for the project was $6,114,830, which required an additional $2,441,322 for construction funding.

Staff recommended the Board authorize Francis city a $5,500,000, loan for 25 years at 0% and a $2,275,000 grant for a total of $7,775,000 with the following special conditions: 1) The bond must include an early principal repayment clause that requires an additional payment of $378 per ERU per year when the system has more than 500 ERUs, and, Francis City must agree to participate annually in the Municipal Wastewater Planning Program (MWPP).

Motion: **Following a discussion Mr. Galecki made the motion to approve the reauthorization of the loan for $5,500,000 and a $2,275,000 grant, for a total of $7,775,000, with the noted special conditions. The Board stipulated as a condition that user charges remain, as a minimum, at 1.2% of MAGI. Ms. Frey seconded the motion. The motion passed, with Mr. Bunker voting against the motion.**

Planning Advance, Virgin Town: Virgin Town requested financial assistance in the amount of a $36,000 Hardship Planning Advance to update the wastewater study the Town performed in 2000. This study would be a planning study to determine if the Town should consider transitioning from septic systems to a sewer collection and treatment system.

Motion: **Following a discussion Mr. Bunker made the motion to approve the Hardship Grant for $36,000, Mr. Galecki seconded the motion. The motion unanimously passed.**

Grant Request, Utah Open Lands: Utah Open Lands, a non-profit land trust conservation association, requested $100,000 in grant funds to establish a conservation easement on 50 acres of shore land on the east side of Bear Lake. This grant will be leveraged by a grant from NRCS and other private sources already secured as well as donation in value from the family owning the 50 acres and the donation in full of a conservation easement on 50 adjacent acres, resulting in the preservation of 100 acres of Bear Lake shoreline property.

Motion: **Following a discussion Ms. Frey made the motion to approve the grant for $100,000, Ms. Grant seconded the motion. The motion unanimously passed.**

Next Meeting – March 25, 2015
DEQ Building Board Room – 1015
195 North 1950 West
Salt Lake City, UT 84116

_____
Myron Bateman, Chair
Utah Water Quality Board

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MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker, P.E.
Director

FROM: Judy Etherington
Wastewater Certification Program Coordinator

DATE: April 2, 2014

SUBJECT: Presentation of the 2014 Annual Report of the Utah Wastewater Operator Certification Council to the Water Quality Board

The Utah Water Quality Board has requested a yearly report of the wastewater operator certification program activities. The 2014 Annual Report of the Wastewater Operator Certification Council is being presented by Dr. Mike McFarland, who served as Vice-Chair of the Council during 2014. The information contained within the attached report is for the 2014 calendar year.

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FILE: WWOCC/ANNUAL REPORT 2014

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UTAH WASTEWATER OPERATOR CERTIFICATION PROGRAM

2014 Annual Report

Presented to the Water Quality Board on April 29, 2015 by the Utah Wastewater Operator Certification Council

Utah Wastewater Operator Certification Program

2014 ANNUAL REPORT

Introduction

In March of 1991, following over 20 years of a voluntary certification program, certification of wastewater works operators became mandatory. This program is administered through the Division of Water Quality under rules adopted by the Utah Water Quality Board. The Board established the Utah Wastewater Operator Certification Council to provide guidance and stakeholder involvement in the program. During 2014, the Board adopted revisions to Rule R317-10 that incorporated changes required by Senate Bill 21 (2012 General Session) which changed the duties and responsibilities of the environmental boards, their executive secretaries, and division directors. The Utah Wastewater Operator Certification Council is appointed by the board and established in an advisory capacity to the director of the Division of Water Quality for the certification program.

The Utah Wastewater Operator Certification Council

On January 31, 2014, the terms of two council members expired. During the January 2014 Utah Water Quality Board meeting, the board appointed Dr. Michael McFarland to represent universities in Utah and reappointed Dr. James Callison to represent vocational training for the next 3-year term. The Council members during 2014 were:

Clifton Specht, Chair: represented wastewater collection system operators. He is the Collection System Manager at North Davis Sewer District and is certified as a Grade IV Wastewater Collection System Operator and Grade II Wastewater Treatment Operator. His term expires January 31, 2015.

Dr. Michael McFarland, Vice-Chair: represented Utah universities. He is an Associate Professor in the Department of Civil and Environmental Engineering at Utah State University. His term expires January 31, 2017.

Dr. James Callison: represented vocational training. He is the Coordinator/Advisor for the Environmental Technology Program at Utah Valley State College. His term expires January 31, 2017.

Terral Dunn: represented operators. He is a Wastewater Technician for the Rural Water Association of Utah and is a certified Grade II Wastewater Treatment Operator. His term expires January 31, 2015.

Kerry Eppich: represented the management of municipal wastewater systems. He is the General Manager for Mt. Olympus Improvement District which has at least 15 certified operators. His term expires January 31, 2016.

Dan James: represented certified wastewater operators. He is Maintenance Manager at Central Valley Water Reclamation Facility and is certified as a Grade IV Wastewater Treatment Operator. His term expires January 31, 2016.

Richard F. Jex: represented the private sector wastewater industry. He is employed by SCG Enterprises in the private sector and is certified as a Grade II Wastewater Treatment Operator. His term expires January 31, 2016.

Ed Macauley: represented the Division of Water Quality during the first two months of the year. He was the Engineering Section Manager appointed as the non-voting member of the Council until his departure from the Division in early March.

John Mackey: represented the Division of Water Quality for the balance of the year until the position was eliminated with the adoption of the amendment to Rule R317-10. He is the new Engineering Section Manager, and appointed as the non-voting member of the Council.

Examinations

The Council continued to maintain membership as a certifying authority with the Association of Boards of Certification (ABC), an environmental control testing service headquartered in Ankeny, Iowa. The role of ABC is to provide examination services to the certification program, which includes exam development, scoring, and compilation of exam results. A three-year contract between ABC and the Division of Water Quality is in effect for state fiscal years 2014-2016. Exams were offered Spring and Fall with an alternate testing date during each session in conjunction with the Rural Water Association of Utah's Annual and Northern Conferences.

The registration and attendance of the 2014 exam sessions are shown in Table 1. These totals include the newer voluntary exams as well as the traditional mandatory ones.

TABLE 1- 2014 EXAM REGISTRATION AND ATTENDANCE

	SPRING EXAM SESSION		FALL EXAM SESSION	
	FEBRUARY	**APRIL**	**AUGUST**	**NOVEMBER**
LOCATIONS	ST. GEORGE (IN CONJUNCTION WITH RWAU CONFERENCE)	UVU, OREM	LAYTON (IN CONJUNCTION WITH RWAU CONFERENCE)	UVU, OREM
		PRICE		RICHFIELD
		OGDEN		ST. GEORGE
				OGDEN
				NORTH SALT LAKE

APPLICATIONS RECEIVED	63	161	51	142
TOTAL SCORED*	63	157	49	138

*Some individuals did not show up to take the exams

Exam sessions were proctored by members of DWQ staff, DEQ District Engineers, current Council members, or other individuals delegated by Council members. All examinations, regardless of grade, are 100-question, multiple-choice formats. Answer sheets are shipped to ABC for scoring and the results are compiled and returned to DWQ by electronic format for recording in the database and dissemination to the examinees. Each examinee is provided an individual statistical report and several variations of summary reports showing the cumulative results for all Utah examinees taking the same test during that session. A score of 70% or above is necessary to pass an exam.

The 2014 exams were compiled from ABC's data bank, with the exception of the Small Lagoon System exam, which is compiled from the Utah data bank maintained by ABC. The wastewater treatment and collection exams are "ABC standardized" exams which meet ISO 17024 standard in order to ensure the validity, reliability, and legal defensibility of the certification exams. Exam questions are reviewed by ABC's technical committees on a regular basis to ensure applicability to current wastewater technologies and processes. During 2014, DWQ staff Paul Krauth and former Council member Lonn Rasmussen served on ABC committees.

Three voluntary classifications of wastewater related certifications were again offered in 2014. They include Biosolids Land Applier Grades I - II, Wastewater Laboratory Analyst Grades I - IV, and Plant Maintenance Technologist Grades I - III. Mandatory exams include Collections Grades I - IV, Wastewater Treatment Grade I - IV, and Small Lagoons System Grade I. Cumulative Totals for the 2014 mandatory wastewater exam classifications are shown in Table 2.

TABLE 2 - CUMULATIVE 2014 EXAM SCORES (MANDATORY)

GRADE EXAM	TOTAL EXAMINEES		HIGH SCORE	LOW SCORE	# PASS (≥70%)	# FAIL (<70%)	PASS %
C-I	23		92	66	20	3	87
C-II	47		97	52	31	16	66
C-III	27		85	50	11	16	41
C-IV	75		93	41	37	38	49
SLS-I	12		84	65	10	2	83
T-I	57		88	34	22	35	39
T-II	53		91	38	16	37	30
T-III	40		95	40	16	24	40
T-IV	60		92	34	14	46	23

GRADE EXAM	TOTAL EXAMINEES		HIGH SCORE	LOW SCORE	# PASS (≥70%)	# FAIL (<70%)	PASS %
TOTAL	394		NA	NA	177	217	45

Training

During 2014, Division of Water Quality staff and Certification Council members participated as instructors and presenters at conferences, seminars, and training sessions which provided training to wastewater personnel. The objective of these training opportunities was to facilitate compliance with UPDES permits, review subject matter in preparation for operator examinations, and earn required continuing education credits for renewals. Prior to the change in the certification rule that went into effect August 27, 2014, operators were required to obtain at least half of their required training for renewals from wastewater related educational opportunities other than attendance at major association conferences. Many of the training classes were offered through cooperative efforts with the Rural Water Association of Utah or the Water Environment Association of Utah.

Some council members and staff also participated with the Utah Water and Wastewater Training Coalition to provide a centralized calendar of seminars and training to make it easier for water and wastewater professionals to obtain needed training and continuing education for their respective fields. The council continued to support participation in the "on-line" calendar format that was developed and implemented beginning with the 2006 calendar year. This calendar has greatly improved the communication and coordination between the members of the Coalition as well as the operators. Division of Water Quality staff and representatives of the member organizations maintain the calendar under the direction of the Coalition. Members of the Coalition are: Division of Drinking Water, Division of Water Quality, AWWA Small Water Systems, Water Environment Association of Utah, Rural Water Association of Utah, American Backflow Prevention Association, and Utah Valley University.

Renewal and Compliance

The following statistics represent the certification actions taken during the year 2014:

TABLE 3 - CERTIFICATION ACTIONS FOR 2014

Action	Number
Number of "new operators" added to wastewater certification database during 2014	108
Certificates expired December 31, 2013 – final notices mailed December 2014	70
Certificates expired 2013, reinstated prior to December 31, 2014 deadline	30
Certificates expired 2013, reinstated with "Change in Status" prior to December 31, 2014 deadline	4
"Change in Status" certificates issued for current certifications	23
Certificates expiring December 31, 2014 – notices mailed January 2014	541
Certificates expiring December 31, 2014 – notices mailed September 2014	366
Certificates expiring 2014, renewals received prior to December 31, 2014	388

Action	Number
Certificates expiring 2014, renewed along with "Change in Status" requests	29
Early renewals for certificates expiring after 2014	3
Early renewal with "Change in Status" for certificates expiring after 2014	6
Certificates issued by "reciprocity" (equivalent certification from another state)	0
Issued Letter-of-Intent to issue certificate by "reciprocity" (not employed in Utah)	1
Number of "reciprocity" requests denied in 2014 (no equivalent certificate)	1
Number of "active" individuals in database (participated in certification within last 3 years)	1,409
Number of certified wastewater operators as of January 1, 2015 (all categories)	1,213
Number of certified "treatment" operators	503
WW Treatment Grade I	122
WW Treatment Grade II	139
WW Treatment Grade III	51
WW Treatment Grade IV	239
Number of certified "collection" operators	804
Collection Grade I	103
Collection Grade II	271
Collection Grade III	89
Collection Grade IV	391
Number of certified "small lagoon system" operators	126
Total number of current wastewater operator certifications as of January 1, 2015	1,568
Number of operators holding two classes of certifications, but not more than two	288
Number of operators holding three classes of certifications	46
Total number of publicly owned wastewater collection systems	187
Municipal Collection Class I systems	97
Municipal Collection Class II systems	43
Municipal Collection Class III systems	29
Municipal Collection Class IV systems	18
Total number of current voluntary certifications (Biosolids Land Applier, WW Laboratory, Plant Maintenance)	37
Total number of publicly owned wastewater treatment facilities	115
Municipal Treatment Class I facilities	68
Municipal Treatment Class II facilities	10
Municipal Treatment Class III facilities	21
Municipal Treatment Class IV facilities	16
Municipal Small Lagoon System I facilities (combination Treatment I & Collection I included in the above numbers)	61

The wastewater exams were taken predominantly by individuals from Utah. However, some exams were administered to people who applied from Nevada, California, and Arizona when they met the same U. S. citizenship or resident alien requirement that is required of Utah operators.

New facility classification notices were sent to Hideout, Woodland Hills, and Elwood. Also, two collection systems submitted updated census information for re-evaluation after the previous notifications. Both systems were reclassified to more accurately reflect their "population equivalent served" and were notified of those changes.

Systems with no certified DRC operator of record as of January 1, 2015 are Canyon Land Improvement District (Cloaca Maxima Sewer Co.), East Zion Special Service District, Hinckley Town, Manila Town, Mexican Hat Special Service District #1, North Village Special Service District, Twin Creeks Special Service District, Vineyard Town, and White Hills Special Service District. All of these systems, except Vineyard and White Hills SSD, are within the one-year transition period following the loss of the DRC, such as when a contract expired, the operator's certification expired, termination of employment, or the death of the operator. However, Vineyard has a certified operator under contract for water services, but not for wastewater services; and Eagle Mountain City is still in the process of evaluating the condition of White Hills SSD's system in preparation for assimilating it into its own system according to the annexation agreement. The Water Quality Board provided funding to facilitate the evaluation of the White Hills system, but the situation is still being resolved.

Certification Council Meetings

There were two Council meetings held in 2014. The following items are of particular note:

- The Council invited the additional representatives from the wastewater industry who had participated in the rule revision workgroup in 2013 to continue with the revisions to Rule R317-10 prompted by the Senate Bill 21 legislation from 2012. A final draft of the amendment was presented to the Water Quality Board at the April board meeting. After the comment period, the amendment to the rule was adopted at the August board meeting and made effective immediately.

- Following adoption of the amendment to Rule R317-10, there were a few minor inconsistencies in the language concerning the re-composed Council. Discussions began to resolve those inconsistencies in the near future by proposing new language for Section R317-10-8. The revision will be finalized by the Council and submitted to the Board in 2015.

- The Council continues to offer the ABC exams for Wastewater Laboratory Analyst, Biosolids Land Applier, and Plant Maintenance Specialist during the regular testing dates. The Council agreed to offer them on a voluntary basis since there is no foundation in legislation for them to be included in the mandatory program. There were 13 total voluntary exams of various classifications administered during the year.

- Utah was represented at the Association of Boards of Certification Annual Conference by five individuals from Utah. Judy Etherington, Paul Krauth, Lonn Rasmussen, and Dan James represented wastewater, and Kim Dyches from the Division of Drinking Water represented drinking water.

- The Council continued to support ABC's efforts to accomplish on-going review of the item bank by supporting Paul Krauth's and Lonn Rasmussen's participation on technical committees and review workshops.
- The Council reviewed all "Question Comment Forms" and corresponding questions submitted by examinees following the exams. Requests for improvements to a couple of questions were submitted to ABC for consideration by the exam committees.
- The Council continued to cooperate with the Rural Water Association of Utah offering wastewater training and exams at its Annual and Northern Conferences in 2014. Some Council members and DWQ staff provided presentations and instruction in the associated training sessions.
- The Council continued to support maintaining the On-Line Training Calendar that was implemented at the end of 2005 for all members of the Water and Wastewater Operator Training Coalition in Utah.
- Council members continue to evaluate training requests submitted for continuing education credit (CEUs) to determine whether the training is relevant to the work of the wastewater operators. The change in the rule that allows unlimited hours of conference attendance to count towards renewal of certifications is a major stepping stone to encourage professional development of the operators by attending conferences and learning about the new technologies that are available.
- Council reaffirmed that with the change in the rule allowing more credit from attending wastewater conferences, other training such as in-house safety training, should be relevant to wastewater operator duties, and not just general "employee training" in order to be counted towards CEUs.

LOAN FUNDS
FINANCIAL PROJECTIONS

STATE REVOLVING FUND (SRF)	4th Qtr FY2015 Apr - June 2015	1st Qtr FY 2016 July - Sept 2015	2nd Qtr FY 2016 Oct - Dec 2015	3rd Qtr FY 2016 Jan - Mar 2016	4th Qtr FY 2016 Apr - June 2016	1st Qtr FY 2017 July - Sept 2016	2nd Qtr FY 2017 Oct - Dec 2016	3rd Qtr FY 2017 Jan - Mar 2017	4th Qtr FY 2017 Apr - June 2017	1st Qtr FY 2018 July - Sept 2017	2nd Qtr FY 2018 Oct - Dec 2017	3rd Qtr FY 2018 Jan - Mar 2018
Funds Available												
SRF - 1st Round (LOC) 2014 Cap Grant	5,665,381	-	-	-	-	-	-	-	-	-	-	-
Less: 2014 Principal Forgiveness Amount	(600,934)	-	-	-	-	-	-	-	-	-	-	-
SRF - 1st Round (LOC) 2015 Cap Grant	7,067,520	-	-	-	-	-	-	-	-	-	-	-
State Match	1,472,400	-	-	-	-	-	-	-	-	-	-	-
SRF - 2nd Round	76,351,211	90,895,745	89,196,388	90,911,460	(4,150,115)	(578,602)	(621,526)	1,000,876	4,737,984	8,472,127	10,462,671	11,671,082
Interest Earnings at 0.6%	114,527	113,620	111,495	113,639	-	-	-	1,251	5,922	10,590	13,078	14,589
Loan Repayments	2,192,640	1,925,024	1,603,576	4,724,786	3,571,513	1,957,076	1,622,402	4,685,856	3,728,221	1,979,954	1,195,332	4,711,189
Total Funds Available	92,262,745	92,934,388	90,911,460	95,749,885	(578,602)	1,378,474	1,000,876	5,687,984	8,472,127	10,462,671	11,671,082	16,396,859
Project Obligations												
Eureka City	-	(400,000)	-	-	-	-	-	-	-	-	-	-
Francis City	-	(3,338,000)	-	-	-	-	-	-	-	-	-	-
Granger-Hunter Improvement District	(702,000)	-	-	-	-	-	-	-	-	-	-	-
Kearns Improvement District (2011)	(665,000)	-	-	-	-	-	-	-	-	-	-	-
Loan Authorizations												
Logan City	-	-	-	(70,000,000)	-	-	-	-	-	-	-	-
Anticipated Projects												
Ammonia Projects	-	-	-	-	-	-	-	-	-	-	-	(13,647,000)
Phosphorus Projects	-	-	-	-	-	-	-	-	-	-	-	(23,377,500)
Bear Lake SSD	-	-	-	-	-	(2,000,000)	-	-	-	-	-	-
Moab City	-	-	-	(10,000,000)	-	-	-	-	-	-	-	-
Payson City	-	-	-	(6,900,000)	-	-	-	-	-	-	-	-
Salem City	-	-	-	(13,000,000)	-	-	-	-	-	-	-	-
Wellington City	-	-	-	-	-	-	-	(950,000)	-	-	-	-
Total Obligations	(1,367,000)	(3,738,000)	-	(99,900,000)	-	(2,000,000)	-	(950,000)	-	-	-	(37,024,500)
SRF Unobligated Funds	$ 90,895,745	$ 89,196,388	$ 90,911,460	$ (4,150,115)	$ (578,602)	$ (621,526)	$ 1,000,876	$ 4,737,984	$ 8,472,127	$ 10,462,671	$ 11,671,082	$ (20,627,641)

UTAH WASTEWATER LOAN FUND (UWLF)	4th Qtr FY 2015 Apr - June 2015	1st Qtr FY 2016 July - Sept 2015	2nd Qtr FY 2016 Oct - Dec 2015	3rd Qtr FY 2016 Jan - Mar 2016	4th Qtr FY 2016 Apr - June 2016	1st Qtr FY 2017 July - Sept 2016	2nd Qtr FY 2017 Oct - Dec 2016	3rd Qtr FY 2017 Jan - Mar 2017	4th Qtr FY 2017 Apr - June 2017	1st Qtr FY 2018 July - Sept 2017	2nd Qtr FY 2018 Oct - Dec 2017	3rd Qtr FY 2018 Jan - Mar 2018
Funds Available												
UWLF	$ 13,772,771	$ 11,508,606	$ 12,045,156	$ 12,854,506	$ 14,201,241	$ 15,979,604	$ 17,006,287	$ 17,815,637	$ 19,109,067	$ 21,041,821	$ 22,105,604	$ 22,914,954
Sales Tax Revenue	-	896,875	896,875	896,875	896,875	896,875	896,875	896,875	896,875	896,875	896,875	896,875
Loan Repayments	657,760	469,200	252,000	789,385	1,221,012	469,333	252,000	736,080	1,375,404	506,433	252,000	704,080
Total Funds Available	14,430,531	12,874,681	13,194,031	14,540,766	16,319,129	17,345,812	18,155,162	19,448,592	21,381,346	22,445,129	23,254,479	24,515,909
General Obligations												
State Match Transfer	(1,472,400)	-	-	-	-	-	-	-	-	-	-	-
DWQ Administrative Expenses	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)
Project Obligations												
Murray City	(1,110,000)	-	-	-	-	-	-	-	-	-	-	-
Loan Authorizations												
Eagle Mountain City - White Hills	-	(490,000)	-	-	-	-	-	-	-	-	-	-
Planned Projects												
None at this time	-	-	-	-	-	-	-	-	-	-	-	-
Total Obligations	(2,921,925)	(829,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)	(339,525)
UWLF Unobligated Funds	$ 11,508,606	$ 12,045,156	$ 12,854,506	$ 14,201,241	$ 15,979,604	$ 17,006,287	$ 17,815,637	$ 19,109,067	$ 21,041,821	$ 22,105,604	$ 22,914,954	$ 24,176,384

*Projects being presented to the WQB
Date Printed: 4/24/2015

HARDSHIP GRANT FUNDS
FINANCIAL PROJECTIONS

HARDSHIP GRANT FUNDS (HGF)	4th Qtr FY 2015 Apr - June 2015	1st Qtr FY 2016 July - Sept 2015	2nd Qtr FY 2016 Oct - Dec 2015	3rd Qtr FY 2016 Jan - Mar 2016	4th Qtr FY 2016 Apr - June 2016	1st Qtr FY 2017 July - Sept 2016	2nd Qtr FY 2017 Oct - Dec 2016	3rd Qtr FY 2017 Jan - Mar 2017	4th Qtr FY 2017 Apr - June 2017	1st Qtr FY 2018 July - Sept 2017	2nd Qtr FY 2018 Oct - Dec 2017	3rd Qtr FY 2018 Jan - Mar 2018
Funds Available												
Beginning Balance	$ -	$ 3,282,271	$ 1,557,202	$ (298,345)	$ (125,142)	$ 1,039,070	$ 515,879	$ 539,952	$ 807,851	$ 1,890,766	$ 1,347,552	$ 1,378,759
Federal HGF Beginning Balance	5,482,157	-	-	-	-	-	-	-	-	-	-	-
State HGF Beginning Balance	368,797	-	-	-	-	-	-	-	-	-	-	-
2014 Principal Forgiveness Amount	600,934	-	-	-	-	-	-	-	-	-	-	-
Interest Earnings at 0.6%	8,776	4,103	1,947	(373)	(156)	1,299	645	675	1,010	2,363	1,684	1,723
UWLF Interest Earnings at 0.6%	20,659	14,386	15,056	16,068	17,752	19,975	21,258	22,270	23,886	26,302	27,632	28,644
Hardship Grant Assessments	972,065	424,442	-	104,451	930,197	402,201	-	201,698	860,685	379,454	-	180,346
Interest Payments	183,449	58,000	2,450	53,057	216,420	53,335	2,170	43,257	197,334	48,667	1,890	33,132
Advance Repayments	1,613,500	-	-	-	-	-	-	-	-	-	-	-
Total Funds Available	**9,250,338**	**3,783,202**	**1,576,655**	**(125,142)**	**1,039,070**	**1,515,879**	**539,952**	**807,851**	**1,890,766**	**2,347,552**	**1,378,759**	**1,622,603**
Project Obligations												
Blanding City - Planning Advance	(39,900)	-	-	-	-	-	-	-	-	-	-	-
Eagle Mountain City - White Hills - Construction Grant	-	(580,000)	-	-	-	-	-	-	-	-	-	-
Echo Sewer SSD - Construction Grant	(251,000)	-	-	-	-	-	-	-	-	-	-	-
Eureka City - Construction Grant	-	(646,000)	-	-	-	-	-	-	-	-	-	-
Francis City - Construction Grant	-	-	(1,875,000)	-	-	-	-	-	-	-	-	-
Long Valley SID - Construction Grant	(1,150,000)	-	-	-	-	-	-	-	-	-	-	-
Payson City - Planning Advance	(88,000)	-	-	-	-	-	-	-	-	-	-	-
Salem City - Planning Advance	(112,300)	-	-	-	-	-	-	-	-	-	-	-
Virgin Town - Planning Advance	(36,000)	-	-	-	-	-	-	-	-	-	-	-
Wellington - Planning Advance	(32,000)	-	-	-	-	-	-	-	-	-	-	-
Planned Projects												
*Hildale - Planning Advance	(40,000)	-	-	-	-	-	-	-	-	-	-	-
*San Juan Spanish Valley - Planning Advance	(75,000)	-	-	-	-	-	-	-	-	-	-	-
*Tri County Health Dept. - Planning Advance	(45,000)	-	-	-	-	-	-	-	-	-	-	-
Non-Point Source Project Obligations												
(FY11) Gunnison Irrigation Company	(48,587)	-	-	-	-	-	-	-	-	-	-	-
(FY11) DEQ - Willard Spur Study	(285,778)	-	-	-	-	-	-	-	-	-	-	-
(FY12) UDAF	(947,714)	-	-	-	-	-	-	-	-	-	-	-
(FY13) DEQ - Great Salt Lake Advisory Council	(400,000)	-	-	-	-	-	-	-	-	-	-	-
(FY14) UACD	(56,524)	-	-	-	-	-	-	-	-	-	-	-
(FY15) DEQ - Nitrogen Transformation Study	(150,000)											
(FY15) Utah Open Lands	(100,000)	-	-	-	-	-	-	-	-	-	-	-
FY 2011 - Remaining Payments	(32,178)	-	-	-	-	-	-	-	-	-	-	-
FY 2012 - Remaining Payments	(59,713)	-	-	-	-	-	-	-	-	-	-	-
FY 2013 - Remaining Payments	(241,809)	-	-	-	-	-	-	-	-	-	-	-
FY 2014 - Remaining Payments	(651,405)	-	-	-	-	-	-	-	-	-	-	-
FY 2015 - Remaining Payments	(775,159)	-	-	-	-	-	-	-	-	-	-	-
FY 2016 Allocation	-	(1,000,000)	-	-	-	-	-	-	-	-	-	-
FY 2017 Allocation	-	-	-	-	-	(1,000,000)	-	-	-	-	-	-
FY 2018 Allocation	-	-	-	-	-	-	-	-	-	(1,000,000)	-	-
Non-Point Source Projects in Planning												
*North Summit Irrigation Company	(350,000)	-	-	-	-	-	-	-	-	-	-	-
Total Obligations	**(5,968,067)**	**(2,226,000)**	**(1,875,000)**	**-**	**-**	**(1,000,000)**	**-**	**-**	**-**	**(1,000,000)**	**-**	**-**
HGF Unobligated Funds	**$ 3,282,271**	**$ 1,557,202**	**$ (298,345)**	**$ (125,142)**	**$ 1,039,070**	**$ 515,879**	**$ 539,952**	**$ 807,851**	**$ 1,890,766**	**$ 1,347,552**	**$ 1,378,759**	**$ 1,622,603**

*Projects being presented to the WQB
Date Printed: 4/24/2015

State of Utah
Wastewater Project Assistance Program
Project Priority List

FY15 Rank	Project Name	Funding Authorized	Total Points	Point Categories				Description of Project Status
				Project Need	Potential Improvement	Population Affected	Special Consideration	
1	Logan City	x	159	50	39	10	60	Planning
2	Price River Water Improvement District	x	145	70	48	7	20	Design
3	Coalville City	x	142	40	40	2	60	Construction
4	Eureka City	x	118	50	0	8	60	Construction
5	Echo City	x	112	70	41	1	0	Construction
6	Snyderville Basin WRD	x	107	10	29	8	60	Design
7	White Hills - Eagle Mountain	x	106	40	5	1	60	Design
8 (Tie)	Kearns Improvement District	x	105	40	16	9	40	Construction
	Granger-Hunter Improvement District	x	105	35	0	10	60	Construction
10	Ephraim	x	102	40	16	6	40	Construction
11	Salem City	x	94	50	18	6	20	Planning
12	Long Valley Sewer Improvement District	x	79	10	7	2	60	Construction
13 (Tie)	Murray City	x	78	10	0	8	60	Construction
	Wellington City	x	78	35	1	2	40	Planning
15	Francis City	x	72	10	0	2	60	Design
16	Payson City	x	70	10	13	7	40	Planning
17	Midvalley Improvement District	x	68	40	0	8	20	Design/Construction
18 (Tie)	San Juan Spanish Valley SSD		6	5	0	1	0	Planning
	Virgin Town		6	5	0	1	0	Planning

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Leland J. Myers
Amanda Smith
Walter L. Baker
Executive Secretary

Application Number: _____
Date Received: March 5, 2015
Date to be presented to the WQB: April 29, 2015

WATER QUALITY BOARD
FEASIBILITY REPORT FOR PLANNING ADVANCE
AUTHORIZATION

APPLICANT:	San Juan Spanish Valley SSD P.O. Box 9 Monticello, UT 84535 Telephone: (435) 587-3225
PRESIDING OFFICIAL:	Frank Darcy
TREASURER/RECORDER:	Louis Jones, Recorder
CONSULTING ENGINEER:	Ryan Jolley Jones & DeMille Engineering Telephone: (435) 896-8266
BOND COUNSEL:	Richard Chamberlain & Associates 225 North 100 East Richfield, UT 84701 (435) 896-4461

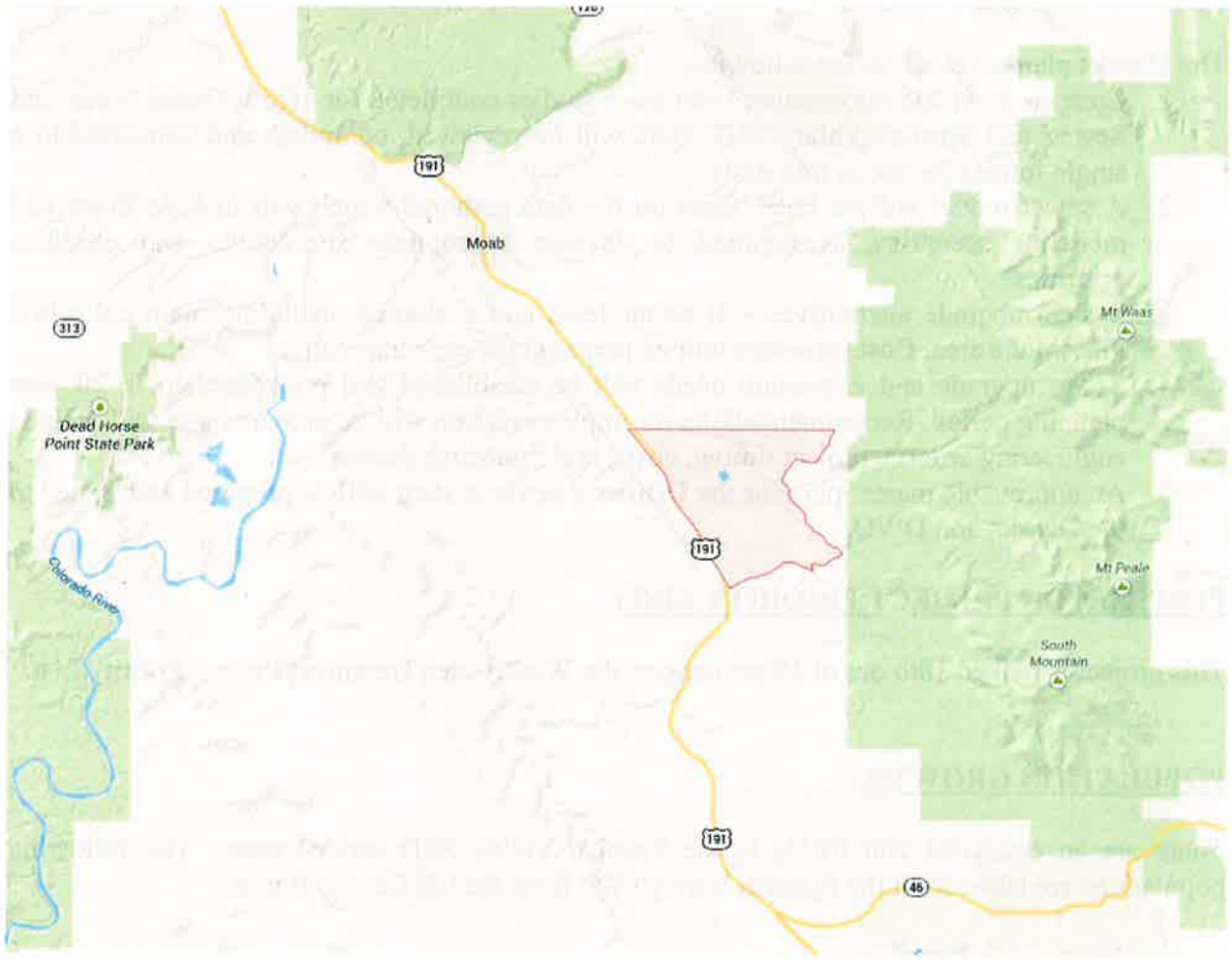
APPLICANT'S REQUEST:

San Juan Spanish Valley Special Service District is requesting a planning grant in the amount of $75,000 to evaluate the District's wastewater collection and treatment system needs and prepare master plan.

APPLICANT'S LOCATION:

San Juan Spanish Valley SSD is located along Highway 191, in the southern portion of the Spanish Valley, south of the San Juan County line, south of Moab City, Utah.

MAP OF APPLICANT'S LOCATION



BACKGROUND AND PROJECT NEED:

Preliminary evaluations have been completed for a possible sewer and treatment system in the San Juan Spanish Valley SSD service area. A master plan for the District has not been developed.

Several meetings have been recently held to discuss a region wide sewer master plan which would assist local government leaders in planning and protection water resources in the area. This plan would identify needed collection system upgrades and costs associated with sewering the District and connecting with the planned Moab regional treatment plant through Grand Water and Sewer District's interceptor system.

ITEMS TO BE EVALUATED:

The District plans to evaluate the following:

1. Compile available information from other studies completed for Moab, Grand Water and Sewer, and Spanish Valley SSD. Data will be reviewed, compiled, and converted to a single format for use in this study.
2. A sewer model will be built based on the data gathered which will include flows and modeling scenarios, as required to develop appropriate alternatives and establish priorities.
3. System upgrade alternatives will be modeled and evaluated, including main collection lines in the area. Cost estimates will be prepared for each alternative.
4. Sewer upgrade and expansion needs will be established and prioritized for a 20 year planning period. Recommendations for implementation will be prepared and will include engineering criteria, project timing, costs, and financing alternatives.
5. An approvable master plan for the District's sewer system will be prepared and issued to the District and DWQ.

POSITION ON PROJECT PRIORITY LIST:

This project is ranked 18th out of 19 projects on the Wastewater Treatment Project Priority List.

POPULATION GROWTH:

There are an estimated 200 ERUs in the Spanish Valley SSD service area. The following populations are taken from the Spanish Valley CDP from the US Census Bureau.

Year	Population
2000	181
2010	491

The Governor's Office for Planning and Budget does not project population growth for San Juan Spanish Valley SSD. However, it does predict between 0.1% and 0.6% growth over the next 25 years for San Juan County

PLANNING SCHEDULE:

Apply to WQB for Planning Advance:	April 29, 2015
Planning Completion	October 2015

COST ESTIMATE:

	Total Project	Sewer Related
Consulting Engineer	$125,000	$100,000
Total Planning Cost:	$125,000	$100,000

FUNDING SOURCES:

	Total Project	Sewer Related
Local Contribution	$12,500	$0
SITLA	$12,500	$12,500
CIB	$25,000	$12,500
DWQ	$75,000	$75,000
Total Planning Cost:	$125,000	$100,000

STAFF RECOMMENDATION:

Staff recommends that the Water Quality Board authorize a $75,000 Planning Grant to the San Juan Spanish Valley SSD for master planning.

SPECIAL COSIDERATIONS:

1. The Division of Water Quality must approve the engineering agreement and plan of study before the advance is executed.

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File: San Juan Spanish Valley, Admin, Section 1

State of Utah

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Walter L. Baker
Executive Secretary

MEMORANDUM

TO: Water Quality Board

THROUGH: Walter L. Baker
Director

FROM: Kari Lundeen
Watershed Protection Section

DATE: April 29, 2015

SUBJECT: North Summit Pressurized Irrigation System Project

NSPIC is a consortium of irrigation companies, water providers, and individual water right holders between Wanship Dam and Echo Reservoir. NSPIC was formed in order to install and operate a pressurized irrigation system that will reduce water diversion from the Weber River by approximately 3,800 acre-feet and improve efficiency on approximately 2,000 acres. Because this project demonstrated a water quality benefit consistent with load reductions called for in the Echo Reservoir TMDL, NSPIC received a $500,000 Hardship Grant from the Water Quality Board in April, 2013. NSPIC obtained funding from additional sources as outlined in Table 1.

Table 1. Funding – 2013, 2015	***As of March 2013***	***Anticipated Change***	***Current Estimates - April 2015***
Source			
Utah Division of Water Resources Loan	$3,910,000	$340,000	$4,250,000
Bureau of Reclamation WaterSMART Grant	$1,000,000	$0	$1,000,000
Contributions by NSPIC	$690,000	$63,000	$753,000
Weber Basin Water Conservancy District	$600,000	($300,000)(1)	$300,000
DWQ Hardship Grant	$500,000	$350,000	$850,000
Total	$6,700,000	$453,000	$7,153,000

(1) The $716,000 spent by WBWCD on the project is being split. 58% ($416,000) is part of the cost share for NSPIC and 42% ($300,000) is being considered as a grant by the Utah Division of Water Resources.

195 North 1950 West • Salt Lake City, UT
Mailing Address: P.O. Box 144870 • Salt Lake City, UT 84114-4870
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CHANGES SINCE THE PREVIOUS FUNDING REQUEST

When the project had been bid and NSPIC was in the process of awarding the construction contract, East Wanship Irrigation Company (EWIC) withdrew from the project. EWIC represented 300 acres: 15% of the project and a critical geographic piece in terms of connecting the pipeline to Wanship Dam. EWIC's withdrawal resulted in an 18 month delay while NSPIC tried to negotiate, and additional costs were incurred due to attorney fees, additional engineering, bridge loan interest, appraisal fees, easements, surveying fees, and redesign/rebid due to the new alignment. The cost of the connection to the dam also increased dramatically as a result of the delay (Table 2). Weber Basin Water Conservancy District's contribution to the connection to the dam was also changed from a cash match to an in-kind match, further increasing NSPIC's cash outlay requirements on the project.

Table 2. Cost Increases Related to EW Non-participation and the Associated Delay

Item	Increased Cost	Notes
East Wanship Road restoration	$97,000	To construct the pipeline, the pipe had to be realigned and placed in East Wanship Road, which resulted in repaving costs.
Increased cost of dam connection	$116,000	Less competitive bidding environment and increased material costs.
Legal fees	$40,000	Costs related to efforts to obtain the necessary easements.
Additional surveying	$4,000	Surveying for potential condemnation and redesign.
Appraisal costs	$12,000	Appraisal cost when trying to purchase/condemn the necessary easement.
Bridge loan interest	$30,000	Accrued during the delay.
Project recovery engineering	$57,000	Legal support, explore alternatives, funding agency coordination, etc.
Redesign and rebid	$91,000	Cost to modify drawings to address changed conditions and reduce costs. Conduct bidding process again.
Redesign and rebid dam connection	$21,000	Address changed conditions and rebid the work.
Subtotal	**$468,000**	
Less competitive bidding environment and increased material costs	?	Difficult to quantify since many changes were made to reduce construction costs.

NSPIC is seeking a $350,000 hardship grant from the WQB in order to cover the increased costs of the project. Table 1 shows the additional funding they are seeking, including an increased loan amount from the Division of Water Resources (obtained). NSPIC has contributed additional funding to the project, has made cost saving efforts, and has shifted approximately $260,000 in increased costs to the shareholders. The cost for each landowner is now $53/acre, and secondary water will be $20/month.

Substantial completion of the project and delivery of water to most project areas is planned for May 2015. Additional work will continue throughout the summer to fix fences, pave, re-vegetate, and complete as-built surveys.

The next pay request from the contractor will be submitted mid-April, and current funding and cash from NSPIC assessments will cover this request. The May pay request will not be due until mid-June, when additional funding should be available to make the payment.

Staff recommends providing funding to complete the project in the form of hardship grant. Staff explored the possibility of a loan for this project but due to other loan obligations associated with this project, NSPIC does not meet the minimum requirements for collateral. This project will reduce pollutant loading to the Weber River and Echo Reservoir and will help to resolve the impairment in Echo Reservoir.

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Leland J. Myers
Amanda Smith
Walter L. Baker
Executive Secretary

Project Number: _____
Date Received: April 3, 2015
Date to be presented to the WQB: April 29, 2015

WATER QUALITY BOARD
REQUEST FOR HARDSHIP PLANNING ADVANCE TO
PREPARE WASTEWATER COLLECTION/TREATMENT FEASIBILITY STUDY
AUTHORIZATION

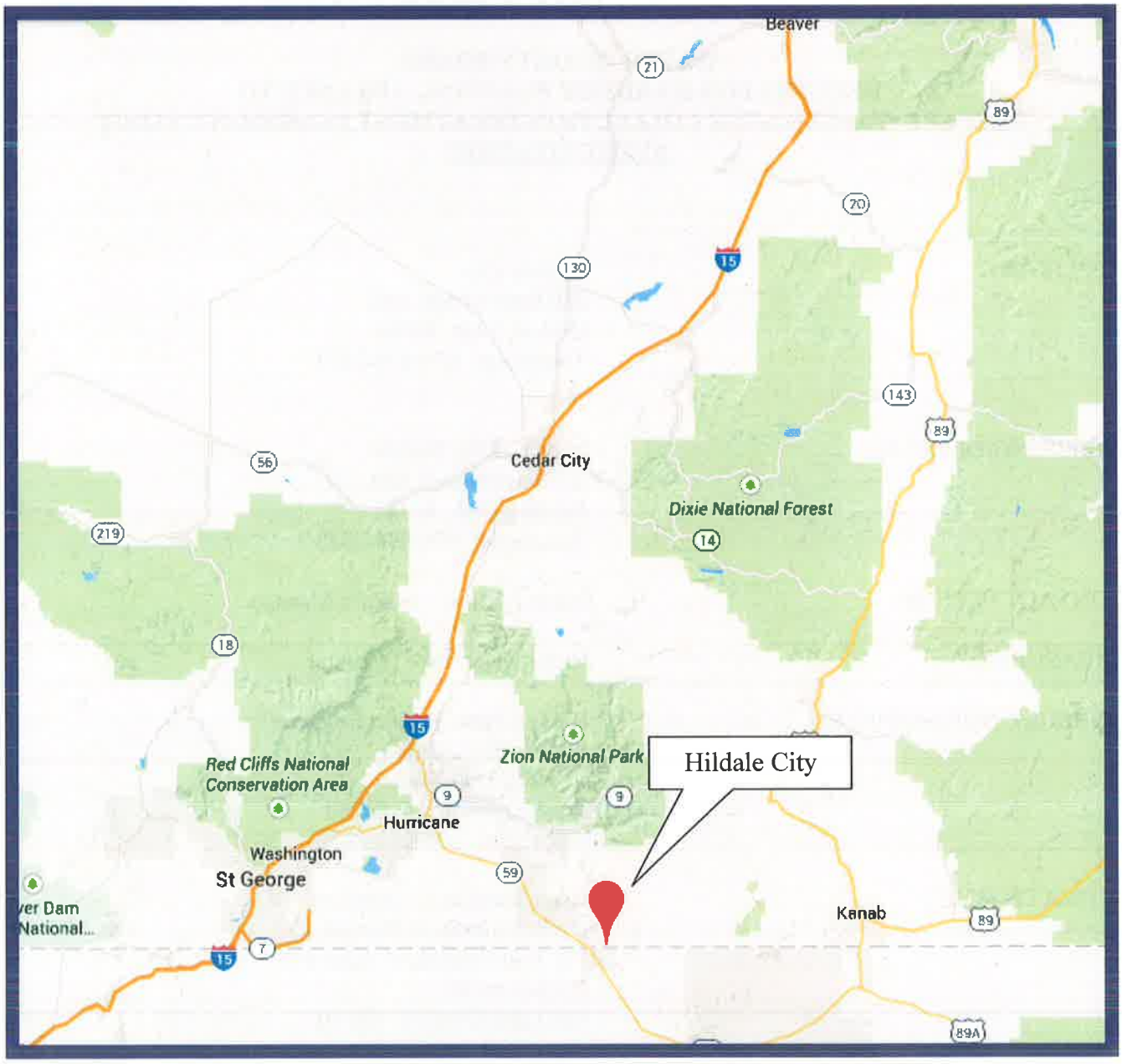
APPLICANT:	Hildale City 320 East Newell Ave Hildale, Utah 84784 Telephone: 435-874-2323
PRESIDING OFFICIAL:	Mayor Philip Barlow 320 East Newell Ave Hildale, Utah 84784 Telephone: 435-874-2323
CONTACT PERSON:	Justin Barlow – Utilities Manager
TREASURER:	Richard Barlow - Treasurer
CONSULTING ENGINEER:	Russell Funk, Project Engineer Sunrise Engineering 11 North 300 West Washington, Utah 84780 Telephone: 435-652-8450
CITY ATTORNEY:	Blake Hamilton – Attorney Durham, Jones & Pinegar, P.C. 111 East Broadway, Suite 900 PO Box 4050 Salt Lake City, UT 84110

APPLICANT'S REQUEST:

Hildale City requests a **hardship planning advance in the amount of $40,000** to complete a wastewater treatment and collection system master plan to evaluate alternatives to address problems with their existing collection system and lagoon treatment facility.

APPLICANT'S LOCATION

Hildale City is located in Washington County approximately 45 miles east of St. George.



BACKGROUND

Hildale City owns and operates a five cell facultative lagoon that was constructed in 2000, designed for an average flow of 1.0 mgd. The facility was designed to utilize land application as a method of disposal but due to the high salinity content in the effluent they have not had success getting anything to grow. In addition, the influent BOD is nearly twice what the system was designed for.

PROJECT DESCRIPTION:

The wastewater Facilities Plan will provide an analysis of the current system and provide detailed alternatives analysis along with full lifecycle costs of those alternatives:

The study will include:

- Mapping of the collection system, piping, treatment plant and manholes as the basis for a computer model.
- Modelling analysis of average and maximum flows.
- Review and analysis of past wastewater flow, customer data and biological loading data.
- Develop wastewater flow rates by analyzing population growth rates and projected future growth rates and review of existing land use.
- Prepare a recommended infrastructure plan including improvements to the existing wastewater collection and treatment system for a planning period of 20 years.
- Prepare life cycle costs for proposed recommendations and an Impact Fee analysis meeting Utah requirements.
- Environmental documentation.

IMPLEMENTATION SCHEDULE:

The facility plan is estimated to be complete by January 1st, 2016.

PROJECT PRIORITY LIST

This project will be ranked when a project has been identified.

COST ESTIMATE:

The base planning effort will cost $40,000.

Administrative	$	2,400
Master Plan	$	29,600
Environmental	$	8,000
Total	**$**	**40,000**

STAFF COMMENTS AND RECOMMENDATION:

This project is being presented as an authorization to the Water Quality Board. Staff recommends the Board authorize the entire amount requested for hardship planning advance to assist Hildale City in completing the alternatives analysis to meet the water quality standards.

SPECIAL CONDITIONS:

1. The Division of Water Quality must approve the engineering agreement and plan of study before the advance will be executed.
2. This Planning Advance must be repaid expeditiously repaid no later than January 1. 2019. If this study leads to a project that receives funding from the Water Quality Board, this advance can be repaid from the project funding.

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File: SRF-Hildale/Planning/Section 1
DWQ-2015-005149

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Walter L. Baker
Executive Secretary

Project Number: _____
Date Received: April 3, 2015
Date to be presented to the WQB: April 29, 2015

WATER QUALITY BOARD
REQUEST FOR HARDSHIP PLANNING ADVANCE TO PREPARE WASTEWATER COLLECTION/TREATMENT FEASIBILITY STUDY
AUTHORIZATION

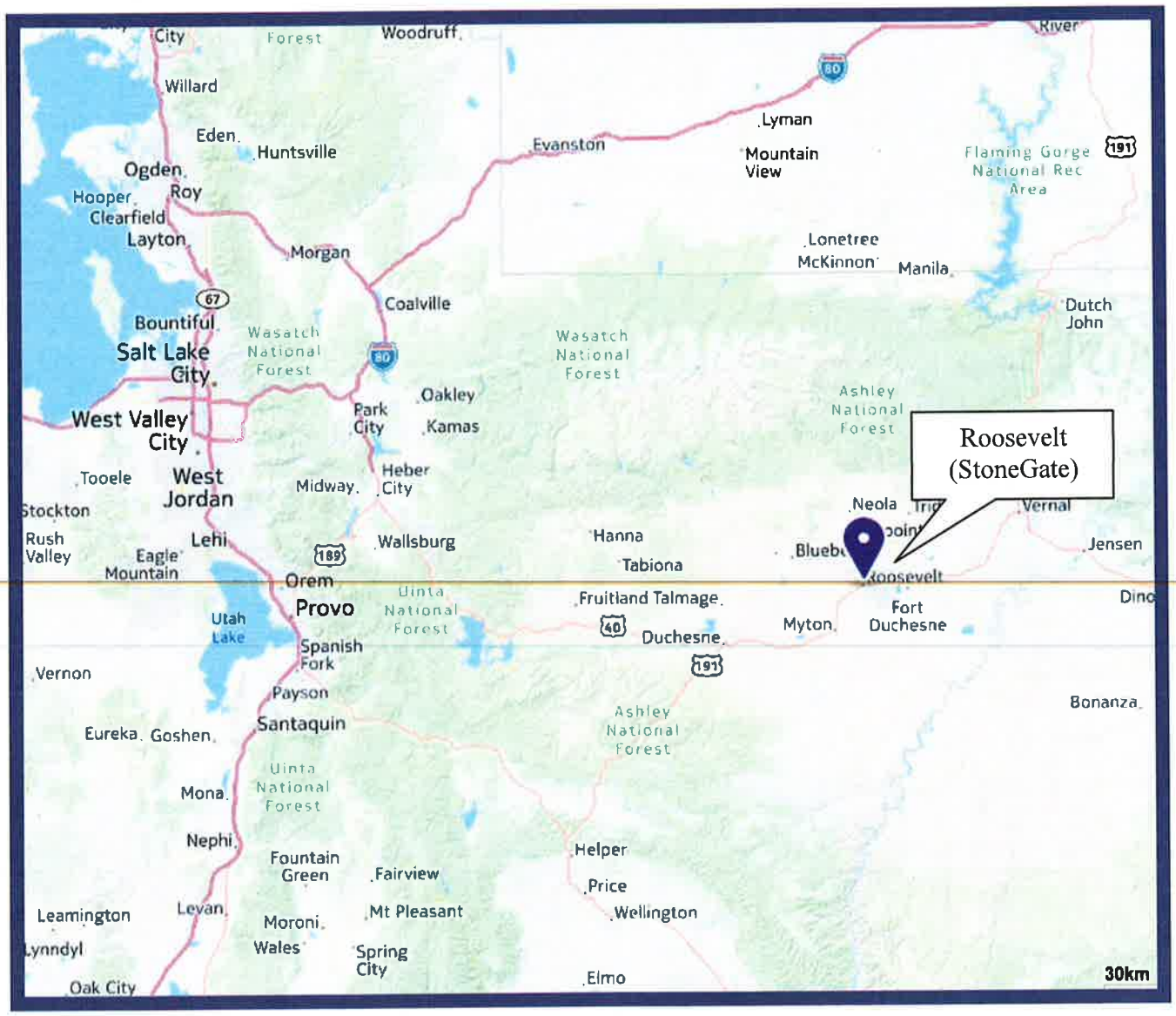
APPLICANT:	TriCounty Health Department 133 S 500 E Vernal Zip Code: 84078 435-247-1172
PRESIDING OFFICIAL:	Jordan D. Mathis - Health Officer
CONTACT PERSON:	Jordan D. Mathis - Health Officer
TREASURER:	N/A
CONSULTING ENGINEER:	Aaron Averett 363 East Main Street Sunrise Engineering Inc. Vernal, UT 84078 435-789-7364
CITY ATTORNEY:	Jared Tingey Duchesne County Attorney PO Box 206 Duchesne, UT 84021 435-738-1236

APPLICANT'S REQUEST:

TriCounty Health Department requests a **hardship planning grant in the amount of $45,000** to complete a facility plan to evaluate alternatives that address failing onsite systems in the StoneGate subdivision.

APPLICANT'S LOCATION

The StoneGate subdivision is located in unincorporated Duchesne County approximately one mile west of Roosevelt City.

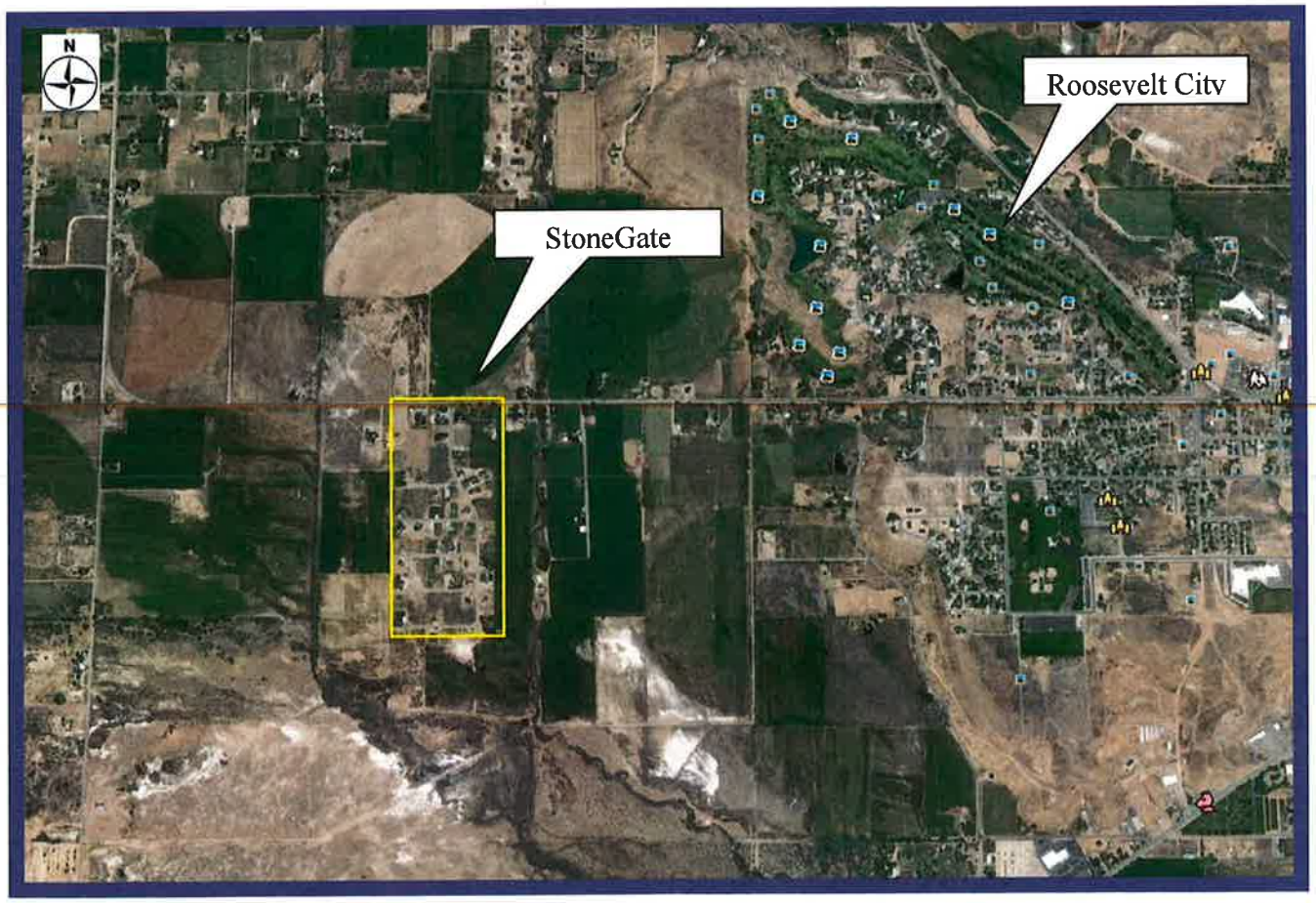


BACKGROUND

The Hancock Cove area, and in particular, the StoneGate subdivision (comprised of ~ 49 residences) has

experienced multiple failed septic tanks because of issues with high groundwater and it is suspected that many more are not functioning as intended. Undeveloped farmland west of Roosevelt City was given approval to be developed (what is now known as Hancock Cove) and was subdivided into 700 lots, of which 300 have been built on. Site assessments conducted for the StoneGate subdivision indicated shallow groundwater was present but within acceptable separation distances for use of onsite (septic) systems. Groundwater monitoring was required for some of the lots due to shallow groundwater. Ultimately, onsite system construction permits were allowed for all of the StoneGate lots; in most cases, maximum drainfield depths needed to be quite shallow at less than 36 inches below original grade.

In the past year, high groundwater has occurred in the subdivision. Several onsite systems have failed and other property damage has been reported. It is unclear why the groundwater conditions have changed so much. Excessive irrigation may be contributing to the problem. These failed onsite systems and the surfacing of sewage are a public health hazard. One homeowner has moved his family from his home but has not been required to vacate. Shallow groundwater also prevents wastewater from being properly treated in the soil even when evidence of system failure is not apparent.



PROJECT DESCRIPTION:

The proposed project will develop a wastewater Facilities Plan that will develop alternatives for correcting the problems in StoneGate and ensuring the long-term solution will be effectively managed under a subdivision of the state (e.g., a district or Roosevelt City). The plan will analyze alternatives for effectiveness, suitability, and

lifecycle costs:

Principal tasks that will be completed in this project are:

- Detailed alternatives analysis including the no action alternative, cluster systems, small diameter sewer and full gravity sewer.
- Lifecycle cost analysis of proposed alternatives.
- Potential funding options
- Public support coordination, and coordination with Roosevelt City and Duchesne County.
- Preliminary groundwater analysis (three initial wells, slug test, piezometric surface modelling)

IMPLEMENTATION SCHEDULE:

This plan is estimated to be complete by September 1st, 2015.

PROJECT PRIORITY LIST

This project will be ranked on the project priority list when a project has been identified.

COST ESTIMATE:

The base planning effort will cost $45,000.

Master Plan (lump sum)	$	22,500
Groundwater monitoring - optional (T&M NTE)	$	17,500
Environmental (T&M NTE)	$	5,000
Total	**$**	**45,000**

STAFF COMMENTS AND RECOMMENDATION:

This project is being presented as an authorization to the Water Quality Board. Staff recommends the Board authorize the entire amount requested for hardship planning advance to assist TriCounty Health Department in completing the alternatives analysis.

SPECIAL CONDITIONS:

1. The Division of Water Quality must approve the engineering agreement and plan of study before the advance will be executed.

U:\ENG_WQ\Lcnelson\0-Projects\StoneGate,\StoneGate Feasibility Report Planning Advance 2015-04-29.doc
File: SRF-StoneGate/Planning/Section 1

State of Utah

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Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Amanda Smith
Executive Director

DIVISION OF WATER QUALITY
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Walter L. Baker
Executive Secretary

MEMORANDUM

TO: Water Quality Board

THROUGH: Walter L. Baker
Director

FROM: Jennifer Robinson
Environmental Scientist III

DATE: April 20, 2015

SUBJECT: Request for Approval of Settlement Agreement for Moroni Feed Company
UPDES Permit # UT0020222

The Utah Water Quality Act (UCA 19-5-104 (3) (h) (i, ii)) requires that any Settlement Agreement (SA) negotiated by the Director, in excess of $25,000, must be reviewed and approved or disapproved by the Water Quality Board.

From April 11, 2014 to April 26, 2014, the Moroni Feed Company (MFC) overflowed its equalization basin (EQ Basin) 10 times. These overflows were not reported by MFC to the Division of Water Quality (DWQ) as required by their permit. Rather, they were found by a District Engineer, during a site visit to Moroni's POTW. DWQ subsequently issued a Notice of Violation for these overflows and negotiated the attached SA. Attached for your reference are the following documents for your review: the penalty calculations, penalty justification and proposed SA.

The gravity penalty is $36,875 and was based on the following: the ten overflows of the EQ Basin, the failure to maintain the EQ Basin and the failure to report the overflows to the DWQ. Due to the maintenance failure of the EQ Basin, an economic benefit was included of $128, totaling $37,003.

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The terms of the financial settlement in the SA:

Monetary Penalty paid to DEQ	$2,003
Mitigation Projects (future)	$35,000
Total Settlement	**$37,003**

The public comment period for the proposed SA ran from March 27, 2015 through April 26, 2015 (copy attached). At this time, no comments have been received. If comments are received, then copies of the comments will be provided to the Board at the Board Meeting on April 27, 2015.

The proposed SA represents a fair and reasonable settlement. It is the Division of Water Quality's recommendation to approve this settlement.

Attachments:

1. Settlement Agreement (DWQ-2014-016446)
2. Penalty Calculations (DWQ-2014-016447)
3. Penalty Justification (DWQ-2014-016445)
4. Public Notice (DWQ-2015-004252)

State of Utah

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Department of
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Amanda Smith
Executive Director

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
Director

March 26, 2015

UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY

PUBLIC NOTICE OF SETTLEMENT AGREEMENT, DOCKET NO. I14-05SA

PURPOSE OF PUBLIC NOTICE

This notice is to declare that the State of Utah has reached a settlement agreement with Moroni Feed Company. This Public Notice is issued pursuant to Utah Administrative Code R317-8-1.9, to provide opportunity for public comment on the proposed settlement of an enforcement action. The proposed settlement agreement is for the purpose of resolving alleged violations of Utah Code Annotated 19-5 (Water Quality Act), and is a resolution of enforcement proceedings brought against Moroni Feed Company.

PUBLIC COMMENTS

Public comments are invited any time prior to close of business April 27, 2015. Comments may be directed to the Department of Environmental Quality, Division of Water Quality, 195 North 1950 West, P.O. Box 144870, Salt Lake City, Utah 84114-4870.

FURTHER INFORMATION

The settlement agreement is available for public review under "Public Participation" at www.waterquality.utah.gov/PublicNotices. If internet access is not available, a copy may be obtained by calling Jennifer Robinson at 801-536-4383. Written public comments can be submitted to: Jennifer Robinson, P.O. Box 144870, Salt Lake City, Utah 84114-4870 or by email at: jenrobinson@utah.gov. The deadline to receive comments is close of business April 27, 2015. After considering public comment the Director of the Division of Water Quality may execute the settlement agreement, revise it, or abandon it.

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UPDES PENALTY CALCULATION SHEET

LEGAL NAME AND MAILING ADDRESS OF OPERATOR		UPDES Permit Number	UT0020222	FACILITY DESCRIPTION / CONTACT NAMES	
Moroni Feed Company		Date of Analysis	2/18/2015	Name of Site Contact:	Matt Cook
PO BOX 308		Site Name:	Moroni Feed Company	Name of Authorized Official:	Matt Cook
Moroni, Utah 84646		NOV/SA Docket No.	I14-05	Telephone Number	
		DEQ Analyst Name	Jennifer Robinson		

PERMIT COVERAGE	Category of Violation Enter Max $ Per Day	Credit for Degree of Negligence	Credit for History of Compliance	Credit for Good Faith Efforts	Total Penalty Per Day	No. of Violation Days	Dollar Amount	Total
Category A	$7,000-$10,000	0%	0%	0%	$10,000	0	$0	$0
	Reduction	$0	$0	$0				
Category B	$2,000-$7,000	0%	0%	0%	$7,000	0	$0	$0
	Reduction	$0	$0	$0				
Category C	$500-$2,000	0%	50%	25%	$1,625	15	$24,375	$24,375
EQ Basin Overflows	Reduction	$0	-$250	-$125				
Category D	$0-$500	0%	100%	0%	$333	15	$5,000	$5,000
Maintanence of EQ Basin	Reduction	$0	-$167	$0				
Category D	$0-$500	0%	0%	0%	$500	15	$7,500	$7,500
Failure to Notify DWQ	Reduction	$0	$0	$0				
							Total Gravity:	$36,875
Economic Benefit								
BEN worksheets are attached							Total BEN:	$128
							Total Penalty:	$37,003

DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF MORONI FEED COMPANY 350 SOUTH 300 WEST MORONI, UTAH 84646	DOCKET NUMBER I14-05 SETTLEMENT AGREEMENT

This **SETTLEMENT AGREEMENT** (hereinafter "**AGREEMENT**") is **MORONI FEED COMPANY** (hereinafter "**OPERATOR**") and the **DIRECTOR OF THE DIVISION OF WATER QUALITY** (hereinafter the "**DIRECTOR**"), concerning violations of the *Utah Water Quality Act* (the *Act*), *Utah Code Annotated*, and the *Utah Administrative Code*.

1. The **DIRECTOR** has authority to administer the *Utah Water Quality Act, as amended 1953*, (hereinafter the "*ACT*").

2. The **UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)** has been delegated authority by the U.S. Environmental Protection Agency (EPA) to administer the *National Pollutant Discharge Elimination System (NPDES)* permit program under the *Federal Clean Water Act* (CWA).

3. The parties now desire to resolve this matter fully without further administrative proceedings except to the extent provided herein by entering into this **AGREEMENT**. Entering into this **AGREEMENT** is not an admission of liability or factual allegation set out in the **NOTICE**, nor is it an admission of or an agreement to any disputed facts or disputed legal theories, nor is it an admission of any violation of any law, rule, regulation or permit by the **OPERATOR**.

4. The **DIRECTOR** will administer the terms and provisions of this **AGREEMENT**.

5. This **AGREEMENT** resolves the **NOTICE OF VIOLATION** and **ORDER**, Docket Number **I14-05** (hereinafter the "**NOTICE**"), between the **OPERATOR** and the **DIRECTOR,** issued to the **OPERATOR** on June 11, 2014, by the **DIRECTOR**. It does not in any way relieve the **OPERATOR** from any other obligation imposed under the Act or any other State or Federal laws.

6. The **OPERATOR** agrees to the following settlement terms:

   A. The **OPERATOR** agrees to pay a penalty in the amount of $2,003.00 within thirty (30) days of the effective date of this **AGREEMENT** by check made payable to the State of Utah delivered or mailed to:

      Department of Environmental Quality
      Division of Water Quality
      P. O. Box 144870
      Salt Lake City, Utah 84114-4870

B. The **OPERATOR** further agrees to fund mitigation projects, in the amount of $35,000 as a part of the penalty assessment pursuant to *UAC R317-1-9.4*. The mitigation project funds must be utilized by no later than two years from the effective date of this **AGREEMENT**, unless the **DIRECTOR** grants an extension.

   1. The **OPERATOR** must submit within ninety (90) days of the effective date of this **AGREEMENT** for the **DIRECTOR** approval, a project implementation plan for each project that includes a detailed description of the mitigation project, a cost breakdown showing how the funds will be used, and a plan for implementation of the project, which shall include a time frame for implementation and completion of the project and submission of final document(s) indicating completion of the project. The implementation plan should also include a funding schedule which specifies who receives the mitigation funds and when.

   2. The **OPERATOR** participation in the mitigation projects must fully adhere to *UAC R317-1-9.4.* The **OPERATOR** agrees not to attempt to gain or generate any positive publicity, and further agrees not to deduct or otherwise attempt to obtain a tax benefit from the foregoing funding of the mitigation projects.

   3. Once a mitigation project is approved by the **DIRECTOR**, the **OPERATOR** will provide an update on the mitigation project every 90 days.

C. If the **OPERATOR** fails to fund the mitigation projects or fails to submit the outline as described in Paragraph 6.B. above, or if the mitigation projects will not utilize the full funds allotted, the **OPERATOR** shall remit the remaining unspent funds as per the method and address in Paragraph 6.A. within thirty (30) days of demand to do so by the **DIRECTOR**.

D. The **OPERATOR** must submit all documentation to the **DIRECTOR** including receipts, once the funds have been spent for the approved mitigation project. This information must include who was paid, what the payment was for, and the dates of when the payment was made.

The penalty has been determined using the *Penalty Criteria for Civil Settlement Negotiations, Utah Administrative Code ("UAC") R317-1-9* which considers such factors as the nature, severity and extent of the violations, history of noncompliance, degree of willfulness and/or negligence, good faith efforts to comply, and economic benefit. Submittals required under this **AGREEMENT** shall be delivered or mailed to the Division of Water Quality, Department of Environmental Quality, 195 North 1950 West, P.O. Box 144870, Salt Lake City, Utah 84114-4870.

7. Nothing contained in this **AGREEMENT** shall preclude the **DIRECTOR** from taking additional actions to include additional penalties against the **OPERATOR** for permit violations not resolved by this **AGREEMENT**.

8. If an agreement between the **OPERATOR** and the **DIRECTOR** cannot be reached in a dispute arising under any provision of this **AGREEMENT,** then the **OPERATOR** or the **DIRECTOR** may commence a proceeding with the **DEQ** under the *Administrative Procedures Act* to resolve the dispute. A final decision in any adjudicative proceeding shall be subject to judicial review under applicable state law.

9. Nothing in this **AGREEMENT** shall constitute a waiver by the **OPERATOR** to raise in defense any legal or factual contention for future allegations of noncompliance.

10. Nothing in this **AGREEMENT** shall constitute or be considered as a release from any claims, to include natural resource damage claims, cause of action, or demand in law or equity which the **STATE** may have against the **OPERATOR**, or any other person, firm, partnership or corporation for any liability arising out of or relating in any way to the release of pollutants to waters of the State.

AGREED to this _____ day of _____, 2015.

MORONI FEED	**UTAH DIVISION of WATER QUALITY**
By_____	By_____
Authorized Agent	Director

ADMINISTRATIVE PENALTY DISCUSSION PURSUANT TO THE NOV ISSUED FOR, MORONI FEED SETTLEMENT AGREEMENT DOCKET NO. I14-05

Infractions of the Utah Water Quality Act are penalized up to $10,000/day/violation for civil penalties ($25,000/day/violation for criminal) according to guidelines established in the penalty policy (*Utah Administrative Code R317-1-9*).

The principles that apply in the penalty policy are:

1) Penalties should be based on the nature and extent of the violation
2) Penalties should at a minimum, recover the economic benefit of noncompliance;
3) Penalties should be large enough to deter noncompliance;
4) Penalties should be consistent in an effort to provide fair and equitable treatment of the regulated community.

To determine a civil penalty the State will consider:

1) the magnitude of the violations;
2) the degree of actual environmental harm or the potential for such harm created by the violations;
3) response and/or investigative costs incurred by the State or others;
4) any economic advantage the violator may have gained through noncompliance;
5) recidivism of the violator;
6) good faith efforts of the violator;
7) ability of the violator to pay;
8) the possible deterrent effect of a penalty to prevent future violations.

In the case of negotiated adjustments to penalties, arguments must be based on the considerations above.

Civil penalties for settlement purposes should be calculated based on the following formula:

CIVIL PENALTY = PENALTY + ADJUSTMENTS - ECONOMIC AND LEGAL CONSIDERATIONS

Penalties are grouped in four main categories:

A. $7,000 to $10,000 per day. Violations with high impact on public health and the environment.
B. $2,000 to $7,000 per day. Major violations of the Utah Water Quality Act, associated regulations, permits or orders.
C. $500 to $2,000 per day. Significant violations of the Utah Water Quality Act, associated regulations, permits or orders.
D. Up to $500 per day. Minor violations of the Utah Water Quality Act, regulations, permits or orders.

Penalties are established within the penalty ranges shown above, based on the following criteria:

- History of compliance or non-compliance,
- Degree of willfulness or negligence, and
- Good faith efforts to comply.

Adjustments to the civil penalty include:

- The economic benefit gained as a result of non-compliance,
- Investigative costs incurred by the State and/or other governmental level,
- Documented monetary costs associated with environmental damage.

PENALTY - The penalty for FACILITY has been calculated as follows:

Gravity Component:

The gravity component of the penalty is based on the following:

- Moroni Feed's failure to prevent overflows from the equalization basin,
- Failure to notify the Division of Water Quality of the overflows and
- Failure to operate the equalization basin properly.

Moroni Feed stated in their response to the NOV that overflows had occurred from April 11, 2014 to April 26, 2014. The overflows lasted from 3 to 4 hours each and it was estimated that no more than 36,000 gallons overflowed from the equalization tank during each overflow. Based on the information provided in this paragraph a Category B penalty was used to calculate the gravity penalty.

No credit was given for degree of negligence. Moroni Feed made no effort to resolve issues prior to an inspection conducted by the Department of Environmental Quality. Credit was given for history of compliance at only 50% because Moroni Feed has had compliance issues in the past but none recently. Credit was given for good faith efforts to comply at only 25% since Moroni Feed did not resolve the issue until after the equalization basin had overflowed 10 times over 15 days. Based on this information, 15 violations were assessed at $1,625 each for a gravity penalty of $24,375.

A category D penalty was used to calculate the gravity penalty for failing to notify the DWQ of the overflow. Credit was not given for the failure to notify DWQ of the overflows, since Moroni Feed did not notify the DWQ and has in the past failed to notify DWQ of permit violations. Based on this information, 15 violations were assessed at $500 each for a gravity penalty of $7,500.

A category D penalty was used to calculate the gravity penalty for the failure to operate the equalization basin properly. Credit was given, at 100%, for history of compliance since there isn't any history of failures of the basin in the past. No credit was given for good faith efforts to comply and degree of negligence. Moroni Feed failed to properly operate and maintain the basin which could have prevented the overflows

from occurring. Based on this information, 15 violations were assessed at $333 each for a gravity penalty of $5,000.

Economic Benefit Justification:

BEN is a program developed by EPA to determine the economic benefit a violator has gained by not complying with regulations. A BEN was done for this SA based on the actions taken by Moroni Feed. The BEN calculation was generated using information provided by Moroni Feed. The one time expenditures of $34,171 are based on the removal of the fat from the equalization basin and the repair of a pump. The calculated penalty using the BEN model was $128. The calculation sheets for BEN are attached.

State of Utah

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Executive Secretary

MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker, P.E.
Director

FROM: Judy Etherington
Wastewater Certification Program Coordinator

DATE: April 2, 2015

SUBJECT: Request to Adopt Amendment to Section R317-10-8, Utah Wastewater Operator Certification Council

Following the adoption of the recent changes to *Rule R317-10, Certification of Wastewater Works Operators* in 2014, it was discovered that some corrections were needed to clarify the recommended composition of the Utah Wastewater Operator Certification Council (the Council) as found in Section R317-10-8. Both staff and the former workgroup members considered the final language and it is being recommended by the Council that these revisions be made to better reflect the intent of the previously approved changes.

The Water Quality Board approved initiation of rulemaking at its January 2015 meeting. The amendment was published in the State Bulletin on February 15, 2015, and comments solicited through March 17, 2015. Notification of this action was also sent out via the division's Water Quality Actions listserv. Copies of the information presented to the board were available at the division's booth during the Rural Water Annual Conference and on the division's web site. Due to the minimal effect of the changes on wastewater operators, no individual notifications were mailed to them. No comments were received during the public comment period.

It is recommended that the Water Quality Board adopt the proposed amendment to *Section R317-10-8, Utah Wastewater Operator Certification Council,* as detailed in the attached marked text, with the understanding that it will go into effect immediately.

Attachments: Summary of Proposed Revisions to R317-10 &
Text of Revisions to *Rule R317-10, "Certification of Wastewater Works Operators"*

DWQ-2015-004550.DOC File: Administrative Rules /Wastewater Operator Certification/Revisions 2015

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SUMMARY OF PROPOSED REVISIONS TO SECTION R317-10-8

The following changes are reflected in the recommended revised rule language:

- Revise the suggested composition of Council representation to match the number of voting members.
- Allow for flexibility in representation by having two members who may provide representation from any combination of educational institutions, vocational training, or certified operators in the private sector.
- Reorganize the verbiage to better indicate that Division of Water Quality staff in attendance at meetings are not voting members of the Council.

R317. Environmental Quality, Water Quality.
R317-10. Certification of Wastewater Works Operators.
R317-10-8. Utah Wastewater Operator Certification Council.

A. Membership.

1. Members of the council shall be appointed by the board.

a. Recommendations for appointments may be made by interested individuals or organizations, including the Department of Environmental Quality, Utah League of Cities and Towns, Water Environment Association of Utah, the Rural Water Association of Utah, and the Civil and Environmental Engineering Departments of universities in Utah.

b. The council shall serve at the discretion of the board to oversee the certification program in an advisory capacity to the director as provided in this rule.

2. The council shall consist of seven voting members and should include representation from interest groups as follows:

a. four members who are operators holding valid certificates, with at least two members being wastewater collection system operators and two members being wastewater treatment system operators;

b. one member with at least three years of management experience in either wastewater treatment, collection, or both, who represents municipal wastewater management;

c. [~~one~~]two members who [~~is~~]are at large and may represent:

(1) an educational institution in Utah;

[~~d.~~](2) [~~one member from~~]those who are currently certified as wastewater operators in the private sector[~~ who is currently certified as a wastewater operator~~]; or

[~~e.~~](3) [~~one member representing~~]vocational training. [~~; and~~]

[~~f~~]3. [~~a~~]At least two non-voting division staff [~~members~~]should be in attendance at any council meeting.

[~~3~~]4. Voting council members shall serve as follows:

a. terms of office shall be for three years with two members retiring each year, except for the third year when three shall retire;

b. any member who does not attend at least 50 percent of the meetings during a year of service may be replaced at the discretion of the board;

c. appointments to succeed a council member who is unable to serve his full term shall be for the remainder of the unexpired term; and

d. council members may be reappointed, but they do not automatically succeed themselves.

[4]5. A majority of voting members shall constitute a quorum for the purpose of transacting council business.

[~~5~~]6. Each year the Council shall elect from its membership a Chair and Vice Chair.

B. Duties of the council shall include:

1. evaluating examinations to ensure compatibility with operator responsibilities, accuracy of content, and composition of individual exam databank items;

2. evaluating certification applications, as requested by the director, and making recommendations for approval or disapproval;

3. assisting in administering examinations at various locations;

4. providing a forum for ongoing evaluation of the certification

program and recommending changes to the director;

5. providing advice and recommendations for CEU approval; and

6. preparing an annual report of certification program activities for distribution to the board and other interested parties.

KEY: water pollution, operator certification, wastewater treatment, renewals
Date of Enactment or Last Substantive Amendment: [~~August 27, 2014~~]2015
Notice of Continuation: July 11, 2012
Authorizing, and Implemented or Interpreted Law: 19-5

State of Utah

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Walter L. Baker
Executive Secretary

MEMORANDUM

TO: Water Quality Board Members

THROUGH: Walter L. Baker
Director

FROM: Chris Bittner
Standards Coordinator

DATE: April 2, 2015

SUBJECT: Request for Water Quality Board permission to initiate rulemaking, R317-2 Standards of Quality for Waters of the State

Staff requests permission from the Board to initiate rulemaking for the proposed revisions to R317-2 shown in the table below and on following redline/strikeout version of R317-2. The proposed site-specific criteria for total dissolved solids (TDS) for Blue Creek in Box Elder County are based on the report for Blue Creek provided as Attachment 1. These proposed revisions were vetted with the Water Quality Standards Workgroup at the March 23, 2015 meeting and no concerns were noted.

If the Board grants permission, staff will file the proposed changes with the Utah Division of Administrative Rules. In accordance with the Utah Administrative Procedures Act and the Title 19, Chapter 5 Utah Water Quality Act, staff will conduct the required public notifications and hearings. If comments are received, staff will prepare responses and present these to the Board along with any proposed revisions to the rule language at a future meeting. Any revisions to the rules must then be adopted by the Board. If the Board adopts revisions to the standards, then staff will submit the revisions to USEPA Region 8 for approval. USEPA Region 8 must approve all changes to Utah's standards.

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Proposed Changes to R317-2 Standards of Quality for Waters of the State	
Rule Number	**Description of Change**
R317-2-7.1	A new explicit condition was added that when background concentration of a pollutant is higher than the applicable water quality criterion, the criterion will be the background concentration. This change is per USEPA Guidance and is intended to allow Utah to delist or not list waters where the exceedance of criteria is determined to be caused by natural conditions. From USEPA's 2014 Integrated Report memorandum: "States may have natural background provisions in EPA approved water quality standards that specify the applicable aquatic life water quality criterion will be equal to the natural background level of a pollutant if it is determined that the natural background level is less stringent than the otherwise applicable criteria. In the absence of a natural background provision in an EPA approved water quality standard or a site-specific criterion based on natural background, the otherwise applicable criterion is the basis for determining whether a waterbody is impaired." The rule was also reformatted into 3 sections for easier reading and based on intent.
Table 2.14.1 Footnote 4	The site-specific TDS criteria for Blue Creek were revised in accordance with the recommendations of the 2015 DWQ report for Blue Creek. The previous site-specific criteria were too low and would likely result in false-positive impairment conclusions. The criteria were recalculated into 2 seasonal criteria, each having both maximum and average criteria. Comparison values for assessing against the average criteria are also included. The location of Blue Creek is corrected from Gunnison to Bear River Bay.
Table 2.14.2	The aquatic life criteria for gross alpha were changed to indicators. Footnote 10 that applies to the other pollutant indicators also previously applied to gross alpha. Gross alpha is a non-specific measurement and the source of the radioactivity should be determined if the gross alpha (or beta) indicators are exceeded. Criteria for gross alpha and beta remain for Class 1C and Class 4 waters. USEPA does not have aquatic life use criteria for gross alpha or beta.

Proposed Changes to R317-2 Standards of Quality for Waters of the State	
Rule Number	**Description of Change**
Table 2.14.2 Footnote 13	The formula for calculating hydrogen sulfide concentrations was deleted because this formula cannot be verified in Standard or U.S. EPA Methods. The resulting hydrogen sulfide concentrations are incorrect for some pH ranges. If this formula is deleted, hydrogen sulfide concentrations will be calculated by the laboratory in accordance with the Standard Methods or U.S. EPA analytical methods.
Table 2.14.3b	Missing parentheses were added to correct formulas for the calculating acute aquatic life criteria for nickel, silver, and zinc.

Supporting Documents

Attachment 1: Proposed Site Specific Standard for Total Dissolved Solids, Blue Creek, Box Elder County, Utah. March 3, 2015 Draft

REDLINE/STRIKEOUT of PROPOSED REVISIONS TO STANDARDS
APRIL, 2015

R317. Environmental Quality, Water Quality.
R317-2. Standards of Quality for Waters of the State.

-----BREAK----

R317-2-7. Water Quality Standards.

7.1 Application of Standards

a. The numeric criteria listed in R317-2-14 shall apply to each of the classes assigned to waters of the State as specified in R317-2-6. It shall be unlawful and a violation of these rules for any person to discharge or place any wastes or other substances in such manner as may interfere with designated uses protected by assigned classes or to cause any of the applicable standards to be violated, except as provided in R317-1-3.1.

b. At a minimum, assessment of the beneficial use support for waters of the state will be conducted biennially and available for a 30-day period of public comment and review. Monitoring locations and target indicators of water quality standards shall be prioritized and published yearly. For water quality assessment purposes, up to 10 percent of the representative samples may exceed the minimum or maximum criteria for dissolved oxygen, pH, E. coli, total dissolved solids, and temperature, including situations where such criteria have been adopted on a site-specific basis.

c. Site-specific standards may be adopted by rulemaking where biomonitoring data, bioassays, or other scientific analyses indicate that the statewide criterion is over or under protective of the designated uses or where natural or un-alterable conditions or other factors as defined in 40 CFR 131.10(g) prevent the attainment of the statewide criteria as prescribed in Subsections R317-2-7.2, and R317-2-7.3, and Section R317-2-14. When it is determined that the natural background level of a pollutant is less stringent than the otherwise applicable criterion, the water quality criterion will be equal to the natural background concentration.

7.2 Narrative Standards

It shall be unlawful, and a violation of these rules, for any person to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural

deposits, floating debris, oil, scum or other nuisances such as color, odor or taste; or cause conditions which produce undesirable aquatic life or which produce objectionable tastes in edible aquatic organisms; or result in concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish, or other desirable aquatic life, or undesirable human health effects, as determined by bioassay or other tests performed in accordance with standard procedures; or determined by biological assessments in Subsection R317-2-7.3.

7.3 Biological Water Quality Assessment and Criteria

Waters of the State shall be free from human-induced stressors which will degrade the beneficial uses as prescribed by the biological assessment processes and biological criteria set forth below:

a. Quantitative biological assessments may be used to assess whether the purposes and designated uses identified in R317-2-6 are supported.

b. The results of the quantitative biological assessments may be used for purposes of water quality assessment, including, but not limited to, those assessments required by 303(d) and 305(b) of the federal Clean Water Act (33 U.S.C. 1313(d) and 1315(b)).

c. Quantitative biological assessments shall use documented methods that have been subject to technical review and produce consistent, objective and repeatable results that account for methodological uncertainty and natural environmental variability.

d. If biological assessments reveal a biologically degraded water body, specific pollutants responsible for the degradation will not be formally published (i.e., Biennial Integrated Report, TMDL) until a thorough evaluation of potential causes, including nonchemical stressors (e.g., habitat degradation or hydrological modification or criteria described in 40 CFR 131.10 (g)(1 - 6) as defined by the Use Attainability Analysis process), has been conducted.

-----BREAK----

R317-2-14. Numeric Criteria.

TABLE 2.14.1
NUMERIC CRITERIA FOR DOMESTIC,
RECREATION, AND AGRICULTURAL USES

Parameter	Domestic Source	Recreation and Aesthetics		Agri-culture
	1C	2A	2B	4
BACTERIOLOGICAL (30-DAY GEOMETRIC MEAN) (NO.)/100 ML) (7)				
E. coli	206	126	206	
MAXIMUM (NO.)/100 ML) (7)				
E. coli	668	409	668	
PHYSICAL				
pH (RANGE)	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0
Turbidity Increase (NTU)		10	10	
METALS (DISSOLVED, MAXIMUM MG/L) (2)				
Arsenic	0.01			0.1
Barium	1.0			
Beryllium	<0.004			
Cadmium	0.01			0.01
Chromium	0.05			0.10
Copper				0.2
Lead	0.015			0.1
Mercury	0.002			
Selenium	0.05			0.05
Silver	0.05			
INORGANICS (MAXIMUM MG/L)				
Bromate	0.01			
Boron				0.75

Chlorite	<1.0		
Fluoride (3)	1.4-2.4		
Nitrates as N	10		
Total Dissolved Solids (4)			1200
	RADIOLOGICAL		
(MAXIMUM pCi/L)			
Gross Alpha	15		15
Gross Beta	4 mrem/yr	Radium 226, 228	
(Combined)	5		
Strontium 90	8		
Tritium	20000		
Uranium	30		
ORGANICS (MAXIMUM UG/L)			
Chlorophenoxy Herbicides			
2,4-D	70		
2,4,5-TP	10	Methoxychlor	40
POLLUTION INDICATORS (5)			
BOD (MG/L)	5	5	5
Nitrate as N (MG/L)	4	4	
Total Phosphorus as P (MG/L)(6)	0.05	0.05	

FOOTNOTES:

(1) Reserved

(2) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by approved laboratory methods for the required detection levels.

(3) Maximum concentration varies according to the daily maximum mean air temperature.

TEMP (C)	MG/L
12.0	2.4
12.1-14.6	2.2
14.7-17.6	2.0
17.7-21.4	1.8

21.5-26.2	1.6
26.3-32.5	1.4

(4) SITE SPECIFIC STANDARDS FOR TOTAL DISSOLVED SOLIDS (TDS)

Blue Creek and tributaries, Box Elder County, from ~~Gunnison~~ Bear River Bay. Great Salt Lake
to Blue Creek Reservoir: ~~maximum 6,300 mg/l and an average of 3,900 mg/l~~March through October daily maximum 7,200 mg/l and an average of 3,800 mg/l; November through February daily maximum 7,500 mg/l and an average of 4,700 mg/l. Assessments will be based on TDS concentrations measured at the location of STORET 4960740. At least 10 samples are required to assess compliance with the average criterion. If the sample average for samples collected from March through October is equal to or less than 4,100 mg/l and the sample average for samples collected from November through February is equal to or less than 5,300 mg/l, the average criteria are met. Alternative scientifically defensible assessment methods may be applied for assessing the average criteria.

Blue Creek Reservoir and tributaries, Box Elder County,
maximum 2,200 mg/l

Castle Creek from confluence with the Colorado River to Seventh Day Adventist Diversion: 1,800 mg/l;

Cottonwood Creek from the confluence with Huntington Creek to I-57:
3,500 mg/l;

Ferron Creek from the confluence with San Rafael River to Highway 10: 3,500 mg/l;

Huntington Creek and tributaries from the confluence with Cottonwood Creek to U-10: 4,800 mg/l;

Ivie Creek and its tributaries from the confluence with Muddy Creek
to the confluence with Quitchupah Creek:
3,800 mg/l provided that total sulfate not exceed 2,000 mg/l to protect the livestock watering agricultural existing use;

Ivie Creek and its tributaries from the confluence with Quitchupah Creek to U10: 2,600 mg/l;

Lost Creek from the confluence with Sevier River to U.S. Forest Service Boundary: 4,600 mg/l;

Muddy Creek and tributaries from the confluence with Ivie Creek toU-10: 2,600 mg/l;

Muddy Creek from confluence with Fremont River to confluence with Ivie Creek: 5,800 mg/l;

North Creek from the confluence with Virgin River to headwaters: 2,035 mg/l;

Onion Creek from the confluence with Colorado River to road crossing above Stinking Springs: 3000 mg/l;

Brine Creek-Petersen Creek, from the confluence with the Sevier River to U-119 Crossing: 9,700 mg/l;

Price River and tributaries from confluence with Green River to confluence with Soldier Creek: 3,000 mg/l;

Price River and tributaries from the confluence with Soldier Creek to Carbon Canal Diversion: 1,700 mg/l

Quitchupah Creek from the confluence with Ivie Creek to U-10: 3,800 mg/l provided that total sulfate not exceed 2,000 mg/l to protect the livestock watering agricultural existing use;
Rock Canyon Creek from the confluence with Cottonwood Creek to headwaters: 3,500 mg/l;

San Pitch River from below Gunnison Reservoir to the Sevier River: 2,400 mg/l;

San Rafael River from the confluence with the Green River to Buckhorn Crossing: 4,100 mg/l;

San Rafael River from the Buckhorn Crossing to the confluence with Huntington Creek and Cottonwood Creek: 3,500 mg/l;

Sevier River between Gunnison Bend Reservoir and DMAD Reservoir: 1,725 mg/l;

Sevier River from Gunnison Bend Reservoir to Clear Lake: 3,370

mg/l;

South Fork Spring Creek from confluence with Pelican Pond Slough Stream to US 89 1,450 mg/l (Apr.-Sept.)
1,950 mg/l (Oct.-March)

Virgin River from the Utah/Arizona border to Pah Tempe Springs: 2,360 mg/l

(5) Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

(6) Total Phosphorus as P (mg/l) indicator for lakes and reservoirs shall be 0.025.

(7) Where the criteria are exceeded and there is a reasonable basis for concluding that the indicator bacteria E. coli are primarily from natural sources (wildlife), e.g., in National Wildlife Refuges and State Waterfowl Management Areas, the criteria may be considered attained provided the density attributable to non-wildlife sources is less than the criteria. Exceedences of E. coli from nonhuman nonpoint sources will generally be addressed through appropriate Federal, State, and local nonpoint source programs.

Measurement of E. coli using the "Quanti-Tray 2000" procedure is approved as a field analysis. Other EPA approved methods may also be used.

For water quality assessment purposes, up to 10% of representative samples may exceed the 668 per 100 ml criterion(for 1C and 2B waters) and 409 per 100 ml (for 2A waters). For small datasets, where exceedences of these criteria are observed, follow-up ambient monitoring should be conducted to better characterize water quality.

TABLE 2.14.2
NUMERIC CRITERIA FOR AQUATIC WILDLIFE(8)

Parameter	Aquatic Wildlife 3A	3B	3C	3D	5
PHYSICAL					
Total Dissolved Gases	(1)	(1)			
Minimum Dissolved Oxygen (MG/L) (2)(2a)					
30 Day Average	6.5	5.5	5.0	5.0	
7 Day Average	9.5/5.0	6.0/4.0			
Minimum	8.0/4.0	5.0/3.0	3.0	3.0	
Max. Temperature(C)(3)	20	27	27		
Max. Temperature Change (C)(3)	2	4	4		
pH (Range)(2a)	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	
Turbidity Increase (NTU)	10	10	15	15	
METALS (4) (DISSOLVED, UG/L)(5)					
Aluminum					
4 Day Average (6)	87	87	87	87	
1 Hour Average	750	750	750	750	
Arsenic (Trivalent)					
4 Day Average	150	150	150	150	
1 Hour Average	340	340	340	340	
Cadmium (7)					
4 Day Average	0.25	0.25	0.25	0.25	
1 Hour Average	2.0	2.0	2.0	2.0	
Chromium (Hexavalent)					
4 Day Average	11	11	11	11	
1 Hour Average	16	16	16	16	
Chromium					

(Trivalent) (7)					
4 Day Average	74	74	74	74	
1 Hour Average	570	570	570	570	
Copper (7)					
4 Day Average	9	9	9	9	
1 Hour Average	13	13	13	13	
Cyanide (Free)					
4 Day Average	5.2	5.2	5.2		
1 Hour Average	22	22	22	22	
Iron (Maximum)	1000	1000	1000	1000	
Lead (7)					
4 Day Average	2.5	2.5	2.5	2.5	
1 Hour Average	65	65	65	65	
Mercury					
4 Day Average	0.012	0.012	0.012	0.012	
Nickel (7)					
4 Day Average	52	52	52	52	
1 Hour Average	468	468	468	468	
Selenium					
4 Day Average	4.6	4.6	4.6	4.6	
1 Hour Average	18.4	18.4	18.4	18.4	
Selenium (14) Gilbert Bay (Class 5A) Great Salt Lake Geometric Mean over Nesting Season (mg/kg dry wt)					12.5
Silver					
1 Hour Average (7)	1.6	1.6	1.6	1.6	
Tributyltin					
4 Day Average	0.072	0.072	0.072	0.072	
1 Hour Average	0.46	0.46	0.46	0.46	
Zinc (7)					
4 Day Average	120	120	120	120	
1 Hour Average	120	120	120	120	

INORGANICS (MG/L) (4)				
Total Ammonia as N (9)				
30 Day Average	(9a)	(9a)	(9a)	(9a)
1 Hour Average	(9b)	(9b)	(9b)	(9b)
Chlorine (Total Residual)				
4 Day Average	0.011	0.011	0.011	0.011
1 Hour Average	0.019	0.019	0.019	0.019
Hydrogen Sulfide ~~(13)~~ (Undissociated, Max. UG/L)	2.0	2.0	2.0	2.0
Phenol (Maximum)	0.01	0.01	0.01	0.01
RADIOLOGICAL	(MAXIMUM pCi/L)			
~~Gross Alpha (10)~~	~~15~~	~~15~~	~~15~~	~~15~~
ORGANICS (UG/L) (4)				
Acrolein				
4 Day Average	3.0	3.0	3.0	3.0
1 Hour Average	3.0	3.0	3.0	3.0
Aldrin				
1 Hour Average	1.5	1.5	1.5	1.5
Chlordane				
4 Day Average	0.0043	0.0043	0.0043	0.0043
1 Hour Average	1.2	1.2	1.2	1.2
Chlorpyrifos				
4 Day Average	0.041	0.041	0.041	0.041
1 Hour Average	0.083	0.083	0.083	0.083
4,4' -DDT				
4 Day Average	0.0010	0.0010	0.0010	0.0010
1 Hour Average	0.55	0.55	0.55	0.55
Diazinon				
4 Day Average	0.17	0.17	0.17	0.17
1 Hour Average	0.17	0.17	0.17	0.17
Dieldrin				
4 Day Average	0.056	0.056	0.056	0.056
1 Hour Average	0.24	0.24	0.24	0.24

Alpha-Endosulfan				
4 Day Average	0.056	0.056	0.056	0.056
1 Hour Average	0.11	0.11	0.11	0.11
beta-Endosulfan				
4 Day Average	0.056	0.056	0.056	0.056
1 Day Average	0.11	0.11	0.11	0.11
Endrin				
4 Day Average	0.036	0.036	0.036	0.036
1 Hour Average	0.086	0.086	0.086	0.086
Heptachlor				
4 Day Average	0.0038	0.0038	0.0038	0.0038
1 Hour Average	0.26	0.26	0.26	0.26
Heptachlor epoxide				
4 Day Average	0.0038	0.0038	0.0038	0.0038
1 Hour Average	0.26	0.26	0.26	0.26
Hexachlorocyclohexane (Lindane)				
4 Day Average	0.08	0.08	0.08	0.08
1 Hour Average	1.0	1.0	1.0	1.0
Methoxychlor (Maximum)	0.03	0.03	0.03	0.03
Mirex (Maximum)	0.001	0.001	0.001	0.001
Nonylphenol				
4 Day Average	6.6	6.6	6.6	6.6
1 Hour Average	28.0	28.0	28.0	28.0
Parathion				
4 Day Average	0.013	0.013	0.013	0.013
1 Hour Average	0.066	0.066	0.066	0.066
PCB's				
4 Day Average	0.014	0.014	0.014	0.014
Pentachlorophenol (11)				
4 Day Average	15	15	15	15
1 Hour Average	19	19	19	19
Toxaphene				

4 Day Average	0.0002	0.0002	0.0002	0.0002
1 Hour Average	0.73	0.73	0.73	0.73

POLLUTION
INDICATORS (~~11~~10)

Gross Alpha (pCi/L)	15	15	15	15
Gross Beta (pCi/L)	50	50	50	50
BOD (MG/L)	5	5	5	5
Nitrate as N (MG/L)	4	4	4	
Total Phosphorus as P(MG/L) (12)	0.05	0.05		

FOOTNOTES:

(1) Not to exceed 110% of saturation.

(2) These limits are not applicable to lower water levels in deep impoundments. First number in column is for when early life stages are present, second number is for when all other life stages present.

(2a) These criteria are not applicable to Great Salt Lake impounded wetlands. Surface water in these wetlands shall be protected from changes in pH and dissolved oxygen that create significant adverse impacts to the existing beneficial uses. To ensure protection of uses, the Director shall develop reasonable protocols and guidelines that quantify the physical, chemical, and biological integrity of these waters. These protocols and guidelines will include input from local governments, the regulated community, and the general public. The Director will inform the Water Quality Board of any protocols or guidelines that are developed.

(3) Site Specific Standards for Temperature
Ken's Lake: From June 1st - September 20th, 27 degrees C.

(4) Where criteria are listed as 4-day average and 1-hour average concentrations, these concentrations should not be exceeded more often than once every three years on the average.

(5) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels.

(6) The criterion for aluminum will be implemented as follows:

Where the pH is equal to or greater than 7.0 and the hardness is equal to or greater than 50 ppm as CaC03 in the

receiving water after mixing, the 87 ug/l chronic criterion (expressed as total recoverable) will not apply, and aluminum will be regulated based on compliance with the 750 ug/l acute aluminum criterion (expressed as total recoverable).

(7) Hardness dependent criteria. 100 mg/l used. Conversion factors for ratio of total recoverable metals to dissolved metals must also be applied. In waters with a hardness greater than 400 mg/l as CaC03, calculations will assume a hardness of 400 mg/l as CaC03. See Table 2.14.3 for complete equations for hardness and conversion factors.

(8) Reserved

(9) The following equations are used to calculate Ammonia criteria concentrations:

(9a) The thirty-day average concentration of total ammonia nitrogen (in mg/l as N) does not exceed, more than once every three years on the average, the chronic criterion calculated using the following equations.

Fish Early Life Stages are Present:

mg/l as N (Chronic) = $((0.0577/(1+10^{7.688-pH})) + (2.487/(1+10^{pH-7.688})))$ * MIN $(2.85, 1.45*10^{0.028*(25-T)})$

Fish Early Life Stages are Absent:

mg/l as N (Chronic) = $((0.0577/(1+10^{7.688-pH})) + (2.487/(1+10^{pH-7.688})))$ * $1.45*10^{0.028*(25-MAX(T,7))})$

(9b) The one-hour average concentration of total ammonia nitrogen (in mg/l as N) does not exceed, more than once every three years on the average the acute criterion calculated using the following equations.

Class 3A:

mg/l as N (Acute) = $(0.275/(1+10^{7.204-pH})) + (39.0/1+10^{pH-7.204}))$

Class 3B, 3C, 3D:

mg/l as N (Acute) = $0.411/(1+10^{7.204-pH})) + (58.4/(1+10^{pH-7.204}))$

In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the chronic criterion. The "Fish Early Life Stages are Present" 30-day average total ammonia criterion will be applied by default unless it is determined by the Director, on a site-specific basis, that it is appropriate to apply the "Fish Early Life Stages are Absent" 30-day average criterion for all or some portion of the year. At a minimum, the "Fish Early Life Stages are Present" criterion will apply from the beginning of spawning through the end of the early life stages. Early life stages include the pre-hatch embryonic stage, the post-hatch free embryo or yolk-sac fry stage, and the larval stage for the species of fish expected to occur at the site. The Director

will consult with the Division of Wildlife Resources in making such determinations. The Division will maintain information regarding the waterbodies and time periods where application of the "Early Life Stages are Absent" criterion is determined to be appropriate.

(10) Investigation should be conducted to develop more information where these levels are exceeded.

(11) pH dependent criteria. pH 7.8 used in table. See Table 2.14.4 for equation.

(12) Total Phosphorus as P (mg/l) as a pollution indicator for lakes and reservoirs shall be 0.025.

(13) ~~Formula to convert dissolved sulfide to un-disassociated hydrogen sulfide is: H_2S = Dissolved Sulfide * $e^{((-1.92 + pH) + 12.05)}$~~ Reserved

(14) The selenium water quality standard of 12.5 (mg/kg dry weight) for Gilbert Bay is a tissue based standard using the complete egg/embryo of aquatic dependent birds using Gilbert Bay based upon a minimum of five samples over the nesting season. Assessment procedures are incorporated as a part of this standard as follows:

Egg Concentration Triggers: DWQ Responses

Below 5.0 mg/kg: Routine monitoring with sufficient intensity to determine if selenium concentrations within the Great Salt Lake ecosystem are increasing.

5.0 mg/kg: Increased monitoring to address data gaps, loadings, and areas of uncertainty identified from initial Great Salt Lake selenium studies.

6.4 mg/kg: Initiation of a Level II Antidegradation review by the State for all discharge permit renewals or new discharge permits to Great Salt Lake. The Level II Antidegradation review may include an analysis of loading reductions.

9.8 mg/kg: Initiation of preliminary TMDL studies to evaluate selenium loading sources.

12.5 mg/kg and above: Declare impairment. Formalize and implement TMDL.

Antidegradation
Level II Review procedures associated with this standard are referenced at R317-2-3.5.C.

TABLE
1-HOUR AVERAGE (ACUTE) CONCENTRATION OF
TOTAL AMMONIA AS N (MG/L)

pH	Class 3A	Class 3B, 3C, 3D
6.5	32.6	48.8
6.6	31.3	46.8
6.7	29.8	44.6
6.8	28.1	42.0
6.9	26.2	39.1
7.0	24.1	36.1
7.1	22.0	32.8
7.2	19.7	29.5
7.3	17.5	26.2
7.4	15.4	23.0
7.5	13.3	19.9
7.6	11.4	17.0
7.7	9.65	14.4
7.8	8.11	12.1
7.9	6.77	10.1
8.0	5.62	8.40
8.1	4.64	6.95
8.2	3.83	5.72
8.3	3.15	4.71
8.4	2.59	3.88
8.5	2.14	3.20
8.6	1.77	2.65
8.7	1.47	2.20
8.8	1.23	1.84
8.9	1.04	1.56
9.0	0.89	1.32

TABLE
30-DAY AVERAGE (CHRONIC) CONCENTRATION OF
TOTAL AMMONIA AS N (MG/l)

Fish Early Life Stages Present
Temperature, C

pH	0	14	16	18	20	22	24	26	28	30
6.5	6.67	6.67	6.06	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	6.57	6.57	5.97	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	6.44	6.44	5.86	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	6.29	6.29	5.72	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	6.12	6.12	5.56	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	5.91	5.91	5.37	4.72	4.15	3.65	3.21	2.82	2.48	2.18
7.1	5.67	5.67	5.15	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	5.39	5.39	4.90	4.31	3.78	3.33	2.92	2.57	2.26	1.99
7.3	5.08	5.08	4.61	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	4.73	4.73	4.30	3.78	3.32	2.92	2.57	2.26	1.98	1.74
7.5	4.36	4.36	3.97	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.98	3.98	3.61	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	3.58	3.58	3.25	2.86	2.51	2.21	1.94	1.71	1.50	1.32
7.8	3.18	3.18	2.89	2.54	2.23	1.96	1.73	1.52	1.33	1.17
7.9	2.80	2.80	2.54	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	2.43	2.43	2.21	1.94	1.71	1.50	1.32	1.16	1.02	0.90
8.1	2.10	2.10	1.91	1.68	1.47	1.29	1.14	1.00	0.88	0.77
8.2	1.79	1.79	1.63	1.43	1.26	1.11	0.97	0.86	0.75	0.66
8.3	1.52	1.52	1.39	1.22	1.07	0.94	0.83	0.73	0.64	0.56
8.4	1.29	1.29	1.17	1.03	0.91	0.80	0.70	0.62	0.54	0.48
8.5	1.09	1.09	0.99	0.87	0.76	0.67	0.59	0.52	0.46	0.40
8.6	0.92	0.92	0.84	0.73	0.65	0.57	0.50	0.44	0.39	0.34
8.7	0.78	0.78	0.71	0.62	0.55	0.48	0.42	0.37	0.33	0.29
8.8	0.66	0.66	0.60	0.53	0.46	0.41	0.36	0.32	0.28	0.24
8.9	0.56	0.56	0.51	0.45	0.40	0.35	0.31	0.27	0.24	0.21
9.0	0.49	0.49	0.44	0.39	0.34	0.30	0.26	0.23	0.20	0.18

TABLE
30-DAY AVERAGE (CHRONIC) CONCENTRATION OF
TOTAL AMMONIA AS N (MG/l)

Fish Early Life Stages Absent
Temperature, C

pH	0-7	8	9	10	11	12	13	14	16
6.5	10.8	10.1	9.51	8.92	8.36	7.84	7.36	6.89	6.06
6.6	10.7	10.1	9.37	9.37	8.79	8.24	7.72	7.24	6.36
6.7	10.5	9.99	9.20	8.62	8.08	7.58	7.11	6.66	5.86
6.8	10.2	9.81	8.98	8.42	7.90	7.40	6.94	6.51	5.72
6.9	9.93	9.31	8.73	8.19	7.68	7.20	6.75	6.33	5.56
7.0	9.60	9.00	8.43	7.91	7.41	6.95	6.52	6.11	5.37
7.1	9.20	8.63	8.09	7.58	7.11	6.67	6.25	5.86	5.15
7.2	8.75	8.20	7.69	7.21	6.76	6.34	5.94	5.57	4.90
7.3	8.24	7.73	7.25	6.79	6.37	5.97	5.60	5.25	4.61
7.4	7.69	7.21	6.76	6.33	5.94	5.57	5.22	4.89	4.30
7.5	7.09	6.64	6.23	5.84	5.48	5.13	4.81	4.51	3.97
7.6	6.46	6.05	5.67	5.32	4.99	4.68	4.38	4.11	3.61
7.7	5.81	5.45	5.11	4.79	4.49	4.21	3.95	3.70	3.25
7.8	5.17	4.84	4.54	4.26	3.99	3.74	3.51	3.29	2.89
7.9	4.54	4.26	3.99	3.74	3.51	3.29	3.09	2.89	2.54
8.0	3.95	3.70	3.47	3.26	3.05	2.86	2.68	2.52	2.21
8.1	3.41	3.19	2.99	2.81	2.63	2.47	2.31	2.17	1.91
8.2	2.91	2.73	2.56	2.40	2.25	2.11	1.98	1.85	1.63
8.3	2.47	2.32	2.18	2.04	1.91	1.79	1.68	1.58	1.39
8.4	2.09	1.96	1.84	1.73	1.62	1.52	1.42	1.33	1.17
8.5	1.77	1.66	1.55	1.46	1.37	1.28	1.20	1.13	0.990
8.6	1.49	1.40	1.31	1.23	1.15	1.08	1.01	0.951	0.836
8.7	1.26	1.18	1.11	1.04	0.976	0.915	0.858	0.805	0.707
8.8	1.07	1.01	0.944	0.885	0.829	0.778	0.729	0.684	0.601
8.9	0.917	0.860	0.806	0.758	0.709	0.664	0.623	0.584	0.513
9.0	0.790	0.740	0.694	0.651	0.610	0.572	0.536	0.503	0.442

pH	18	20	22	24	26	28	30
6.5	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	4.72	4.15	3.65	3.21	2.82	2.48	2.18
7.1	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	4.41	3.78	3.33	2.92	2.57	2.26	1.99
7.3	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	3.78	3.32	2.92	2.57	2.26	1.98	1.74

7.5	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	2.86	2.51	2.21	1.94	1.71	1.50	1.32
7.8	2.54	2.23	1.96	1.73	1.52	1.33	1.17
7.9	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	0.94	1.71	1.50	1.32	1.16	1.02	0.897
8.1	0.68	1.47	1.29	1.14	1.00	0.879	0.733
8.2	0.43	1.26	1.11	0.073	0.855	0.752	0.661
8.3	0.22	1.07	0.941	0.827	0.727	0.639	0.562
8.4	0.03	0.906	0.796	0.700	0.615	0.541	0.475
8.5	0.870	0.765	0.672	0.591	0.520	0.457	0.401
8.6	0.735	0.646	0.568	0.499	0.439	0.396	0.339
8.7	0.622	0.547	0.480	0.422	0.371	0.326	0.287
8.8	0.528	0.464	0.408	0.359	0.315	0.277	0.244
8.9	0.451	0.397	0.349	0.306	0.269	0.237	0.208
9.0	0.389	0.342	0.300	0.264	0.232	0.204	0.179

TABLE 2.14.3a

EQUATIONS TO CONVERT TOTAL RECOVERABLE METALS STANDARD WITH HARDNESS (1) DEPENDENCE TO DISSOLVED METALS STANDARD BY APPLICATION OF A CONVERSION FACTOR (CF).

Parameter	4-Day Average (Chronic) Concentration (UG/L)
CADMIUM	$CF * e^{(0.7409\ (\ln(hardness))\ -4.719}$
	$CF = 1.101672 - \ln(hardness)\ (0.041838)$
CHROMIUM III	
	$CF * e^{(0.8190(\ln(hardness))\ +\ 0.6848}$
	$CF = 0.860$
COPPER	$CF * e^{(0.8545(\ln(hardness))\ -1.702)}$
	$CF = 0.960$
LEAD	$CF * e^{(1.273(\ln(hardness))-4.705)}$
	$CF = 1.46203 - \ln(hardness)(0.145712)$
NICKEL	$CF * e^{(0.8460(\ln(hardness))+0.0584)}$
	$CF = 0.997$
SILVER	N/A
ZINC	$Cf * e^{(0.8473(\ln(hardness))+0.884)}$ $CF = 0.986$

TABLE 2.14.3b

EQUATIONS TO CONVERT TOTAL RECOVERABLE METALS STANDARD WITH HARDNESS (1) DEPENDENCE TO DISSOLVED METALS STANDARD BY APPLICATION OF A CONVERSION FACTOR (CF).

Parameter	1-Hour Average (Acute) Concentration (UG/L)
CADMIUM	$CF * e^{(1.0166(\ln(hardness))-3.924)}$ $CF = 1.136672 - \ln(hardness)(0.041838)$
CHROMIUM (III)	$CF * e^{(0.8190(\ln(hardness)) +3.7256)}$ $CF = 0.316$
COPPER	$CF * e^{(0.9422(\ln(hardness))- 1.700)}$ $CF = 0.960$
LEAD	$CF * e^{(1.273(\ln(hardness))-1.460)}$ $CF = 1.46203 - \ln(hardness)(0.145712)$
NICKEL	$CF * e^{(0.8460(\ln(hardness)) +2.255)}$ $CF= 0.998$
SILVER	$CF * e^{(1.72(\ln(hardness))- 6.59)}$ $CF = 0.85$
ZINC	$CF * e^{(0.8473(\ln(hardness)) +0.884)}$ $CF = 0.978$

FOOTNOTE:
(1) Hardness as mg/l $CaCO_3$.

TABLE 2.14.4
EQUATIONS FOR PENTACHLOROPHENOL
(pH DEPENDENT)

4-Day Average (Chronic) Concentration (UG/L)	1-Hour Average (Acute) Concentration (UG/L)
$e^{(1.005(pH))-5.134}$	$e^{(1.005(pH))-4.869}$

TABLE 2.14.5
SITE SPECIFIC CRITERIA FOR
DISSOLVED OXYGEN FOR JORDAN RIVER, SURPLUS CANAL, AND STATE CANAL
(SEE SECTION 2.13)

DISSOLVED OXYGEN:	
May-July	
7-day average	5.5 mg/l
30-day average	5.5 mg/l
Instantaneous minimum	4.5 mg/l
August-April	
30-day average	5.5 mg/l
Instantaneous minimum	4.0 mg/l

TABLE 2.14.6
LIST OF HUMAN HEALTH CRITERIA (CONSUMPTION)

Chemical Parameter	Water and Organism (ug/L) Class 1C	Organism Only (ug/L) Class 3A,3B,3C,3D
Antimony	5.6	640
Arsenic	A	A
Beryllium	C	C
Cadmium	C	C
Chromium III	C	C
Chromium VI	C	C
Copper	1,300	
Lead	C	C
Mercury	A	A
Nickel	100 MCL	4,600
Selenium	A	4,200
Thallium	0.24	0.47
Zinc	7,400	26,000
Cyanide	140	140
Asbestos	7 million Fibers/L	
2,3,7,8-TCDD Dioxin	5.0 E -9 B	5.1 E-9 B
Acrolein	6.0	9.0
Acrylonitrile	0.051 B	0.25 B
Alachlor	2.0	
Atrazine	3.0	
Benzene	2.2 B	51 B
Bromoform	4.3 B	140 B

Carbofuran	40	
Carbon Tetrachloride	0.23 B	1.6 B
Chlorobenzene	100 MCL	1,600
Chlorodibromomethane	0.40 B	13 B
Chloroethane		
2-Chloroethylvinyl Ether		
Chloroform	5.7 B	470 B
Dalapon	200	
Di(2ethylhexl)adipate	400	
Dibromochloropropane	0.2	
Dichlorobromomethane	0.55 B	17 B
1,1-Dichloroethane		
1,2-Dichloroethane	0.38 B	37 B
1,1-Dichloroethylene	7 MCL	7,100
Dichloroethylene (cis-1,2)	70	
Dinoseb	7.0	
Diquat	20	
1,2-Dichloropropane	0.50 B	15 B
1,3-Dichloropropene	0.34	21
Endothall	100	
Ethylbenzene	530	2,100
Ethylene Dibromide	0.05	
Glyphosate	700	
Haloacetic acids	60 E	
Methyl Bromide	47	1,500
Methyl Chloride	F	F
Methylene Chloride	4.6 B	590 B
Ocamyl (vidate)	200	
Picloram	500	
Simazine	4	
Styrene	100	
1,1,2,2-Tetrachloroethane	0.17 B	4.0 B
Tetrachloroethylene	0.69 B	3.3 B
Toluene	1,000	15,000
1,2 -Trans-Dichloroethylene	100 MCL	10,000
1,1,1-Trichloroethane	200 MCL	F
1,1,2-Trichloroethane	0.59 B	16 B
Trichloroethylene	2.5 B	30 B
Vinyl Chloride	0.025	2.4
Xylenes	10,000	
2-Chlorophenol	81	150
2,4-Dichlorophenol	77	290
2,4-Dimethylphenol	380	850
2-Methyl-4,6-Dinitrophenol	13.0	280
2,4-Dinitrophenol	69	5,300

2-Nitrophenol		
4-Nitrophenol		
3-Methyl-4-Chlorophenol		
Penetachlorophenol	0.27 B	3.0 B
Phenol	10,000	860,000
2,4,6-Trichlorophenol	1.4 B	2.4 B
Acenaphthene	670	990
Acenaphthylene		
Anthracene	8,300	40,000
Benzidine	0.000086 B	0.00020 B
BenzoaAnthracene	0.0038 B	0.018 B
BenzoaPyrene	0.0038 B	0.018 B
BenzobFluoranthene	0.0038 B	0.018 B
BenzoghiPerylene		
BenzokFluoranthene	0.0038 B	0.018 B
Bis2-ChloroethoxyMethane		
Bis2-ChloroethylEther	0.030 B	0.53 B
Bis2-ChloroisopropylEther	1,400	65,000
Bis2-EthylhexylPhthalate	1.2 B	2.2 B
4-Bromophenyl Phenyl Ether		
Butylbenzyl Phthalate	1,500	1,900
2-Chloronaphthalene	1,000	1,600
4-Chlorophenyl Phenyl Ether		
Chrysene	0.0038 B	0.018 B
Dibenzoa,hAnthracene	0.0038 B	0.018 B
1,2-Dichlorobenzene	420	1,300
1,3-Dichlorobenzene	320	960
1,4-Dichlorobenzene	63	190
3,3-Dichlorobenzidine	0.021 B	0.028 B
Diethyl Phthalate	17,000	44,000
Dimethyl Phthalate	270,000	1,100,000
Di-n-Butyl Phthalate	2,000	4,500
2,4-Dinitrotoluene	0.11 B	3.4 B
2,6-Dinitrotoluene		
Di-n-Octyl Phthalate		
1,2-Diphenylhydrazine	0.036 B	0.20 B
Fluoranthene	130	140
Fluorene	1,100	5,300
Hexachlorobenzene	0.00028 B	0.00029 B
Hexachlorobutedine	0.44 B	18 B
Hexachloroethane	1.4 B	3.3 B
Hexachlorocyclopentadiene	40	1,100
Ideno 1,2,3-cdPyrene	0.0038 B	0.018 B
Isophorone	35 B	960 B
Naphthalene		

Nitrobenzene	17	690
N-Nitrosodimethylamine	0.00069 B	3.0 B
N-Nitrosodi-n-Propylamine	0.005 B	0.51 B
N-Nitrosodiphenylamine	3.3 B	6.0 B
PhenanthrenePyrene	830	4,000
1,2,4-Trichlorobenzene	35	70
Aldrin	0.000049 B	0.000050 B
alpha-BHC	0.0026 B	0.0049 B
beta-BHC	0.0091 B	0.017 B
gamma-BHC (Lindane)	0.2 MCL	1.8
delta-BHC		
Chlordane	0.00080 B	0.00081 B
4,4-DDT	0.00022 B	0.00022 B
4,4-DDE	0.00022 B	0.00022 B
4,4-DDD	0.00031 B	0.00031 B
Dieldrin	0.000052 B	0.000054 B
alpha-Endosulfan	62	89
beta-Endosulfan	62	89
Endosulfan Sulfate	62	89
Endrin	0.059	0.060
Endrin Aldehyde	0.29	0.30
Heptachlor	0.000079 B	0.000079 B
Heptachlor Epoxide	0.000039 B	0.000039 B
Polychlorinated Biphenyls PCB's	0.000064 B,D	0.000064 B,D
Toxaphene	0.00028 B	0.00028 B

Footnotes:

A. See Table 2.14.2

B. Based on carcinogenicity of 10-6 risk.

C. EPA has not calculated a human criterion for this contaminant. However, permit authorities should address this contaminant in NPDES permit actions using the State's existing narrative criteria for toxics

D. This standard applies to total PCBs.

KEY: water pollution, water quality standards
Date of Enactment or Last Substantive Amendment: July 2, 2014
Notice of Continuation: October 2, 2012
Authorizing, and Implemented or Interpreted Law: 19-5

ATK

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Utah Division of Water Quality

Launch Systems Group

Work Plan For the Development of a New Site-Specific TDS Criterion For Blue Creek

June 2011

G-31

1.0 Introduction

ATK Launch Systems Inc. is submitting this work plan for use in the development of a site-specific criterion for Total Dissolved Solids (TDS) in a stream segment of Blue Creek. The stream segment of Blue Creek begins at 41°43'20.40" N, 112°26'33.58" W a location on the northern boundary of ATK's facility along Highway 83 that ATK identifies as Blue Creek Upper with the stream segment ending at the Great Salt Lake. ATK currently has two wastewater treatment discharges along this stream segment under UPDES Permit #UT0024805. (See Figure 1 & 2, Goggle Earth image)

2.0 Background

Blue Creek originates approximately 8 miles north of the ATK Facility from Blue Springs. Blue Springs is a warm springs that has a TDS concentration of 2000 mg/L. The water that flows from Blue Springs is then stored in the Blue Creek Reservoir Dam.

The Blue Creek Reservoir Dam was constructed in 1904. The Blue Creek Dam was modified, enlarged and repaired in 1949, 1967 and 1986. The current capacity of the reservoir is about 2,185 acre-feet (UDWR, 2001). Water from Blue Springs is stored in the reservoir during the winter months and used for agricultural irrigation during the spring through fall season. The water in the reservoir is distributed by canals owned by the Blue Creek Irrigation Company. The two main canals, the East Canal and the West Canal, are used to irrigate a portion of the valley north of ATK's facility (Bolke and Price, 1972).

Several saline springs feed the main channel of Blue Creek once it leaves the Blue Creek Reservoir. These springs are the major source of flow in Blue Creek during most of the year as it passes through the ATK facility.

Prior to 1975, the stream segment of Blue Creek from the irrigation dam flowing southward was an intermittent stream only flowing significantly after rainfall events and snow melts. As a result of an earthquake in March 1975, Blue Creek became a perennial stream with year round flow resulting from the springs located below the Blue Creek Reservoir Dam.

In May 2010, four irrigation wells used for pivot irrigation that are located west and south within ½ mile of the Blue Creek Reservoir were sampled, reporting TDS concentrations of 2910 mg/L, 2600 mg/L, 2450 mg/L and 2270 mg/L. Some

- Mercury Method 245.1;
- Total Dissolved Solids (TDS), Method 160.1; and
- Anions, Method 300 IC to include, Fluoride, Chloride, Nitrite-N, Bromide, Nitrate-N, Orthophosphate-P, Sulfate.

During each sampling event, a visual investigation will be conducted to verify if water is flowing from the Blue Creek Reservoir Dam into either the west or east irrigation canal. This will assist in validating when the irrigation season is occurring and allow the opportunity to coincide possible irrigation return flows with changing TDS levels at the two most southern monitoring sites (Blue Creek at crossing 14400 N, and Blue Creek Upper (north boundary of ATK property, Hwy 83).

A second visual investigation will be done each sampling event to verify if water is being released from the Blue Creek Reservoir Dam into the main Blue Creek channel. This will observation will be used to verify when lower TDS water that is being released from the reservoir dam is mixing with the higher TDS water below the dam, and thereby lowering the TDS levels at the two most southern monitoring sites (Blue Creek at crossing 14400 N, and Blue Creek Upper (north boundary of ATK property, Hwy 83).
Sampling these sites and conducting the visual investigations will allow the development of three datasets:

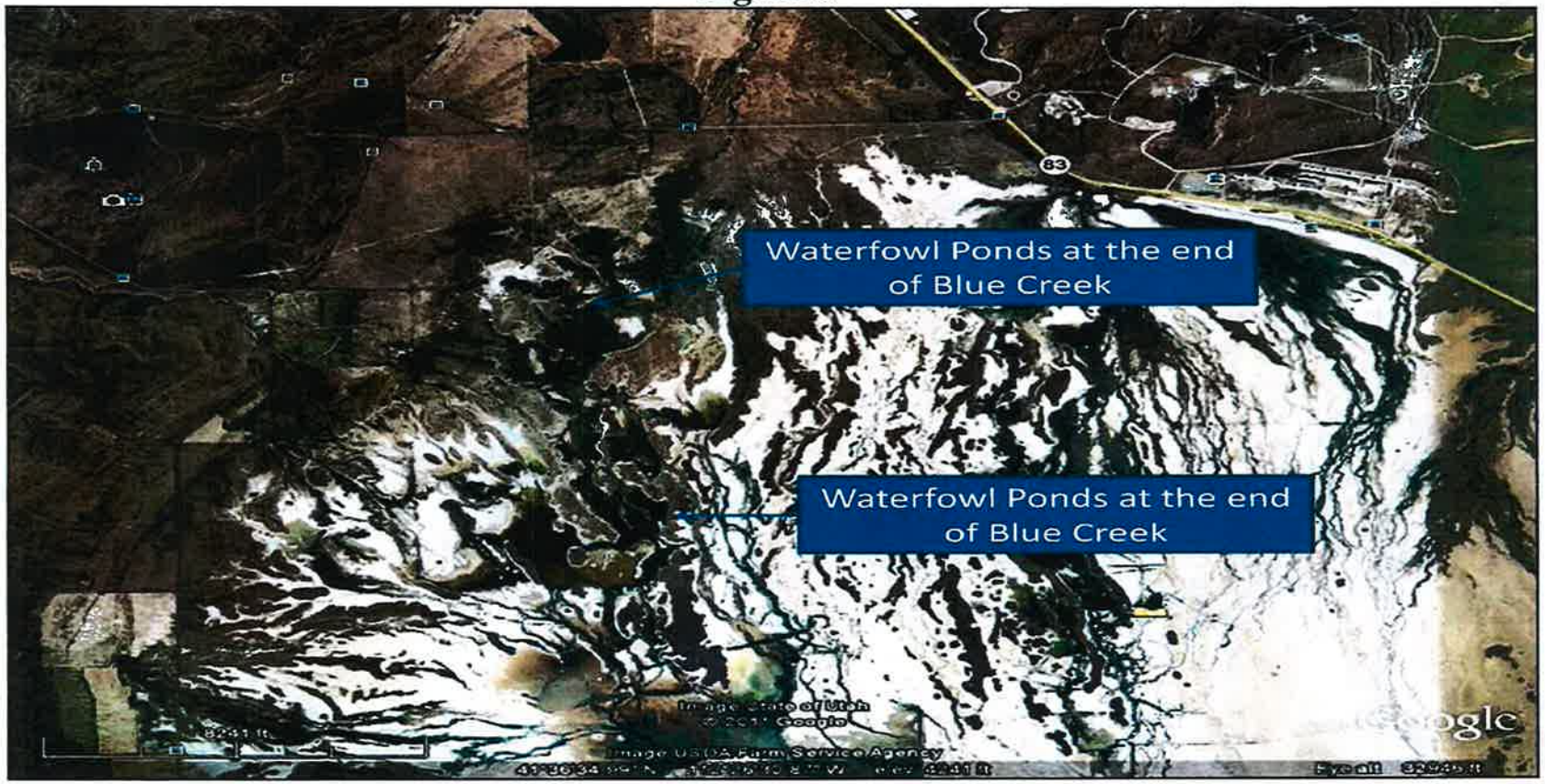
- The existing disturbed conditions, when irrigation is occurring and irrigation return flows are possible;
- When water is being discharged from the Blue Creek Reservoir Dam into the main channel of Blue Creek thereby, lowering the TDS level of Blue Creek by dilution; and
- A dataset for the periods when no irrigation is occurring and no water is being discharged from the Blue Creek Reservoir Dam, which is intended to represent natural conditions that predominate most of the year. This would represent the flow and TDS level in the main channel of Blue Creek that result from springs or seeps that occur below the reservoir dam southward.

The development of these three datasets will help characterize the three different flow conditions, as well as allowing the coordination of the sampling and analytical results with the flow conditions.

Figure 1

Blue Springs,
(Source of Blue
Creek Reservoir)
Blue Creek
Reservoir
Blue Creek
Highway 83
Point of proposed Site
Specific Standard (Highway
83 north boundary of ATK)
following Blue Creek south
to the Great Salt Lake
Image USDA Farm Service Agency
© 2009 Tele Atlas
Google
Imagery Date Aug 19, 2003
41°43'34.79" N 112°21'43.06" W elev 5182 ft
Eye alt 24.49 mi

Figure 3


Waterfowl Ponds at the end of Blue Creek
Waterfowl Ponds at the end of Blue Creek
83

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Bolke, E.L. and Price D. 1972. Hydrologic Reconnaissance of the Blue Creek Valley Area, Box Elder County, Utah. Utah Department of Natural Resources Technical Publication No. 37.

UDWR (Utah Division of Water Resources). 2001. Utah State Water Plan, West Desert Basin, Salt Lake City, Utah. 3-17p.

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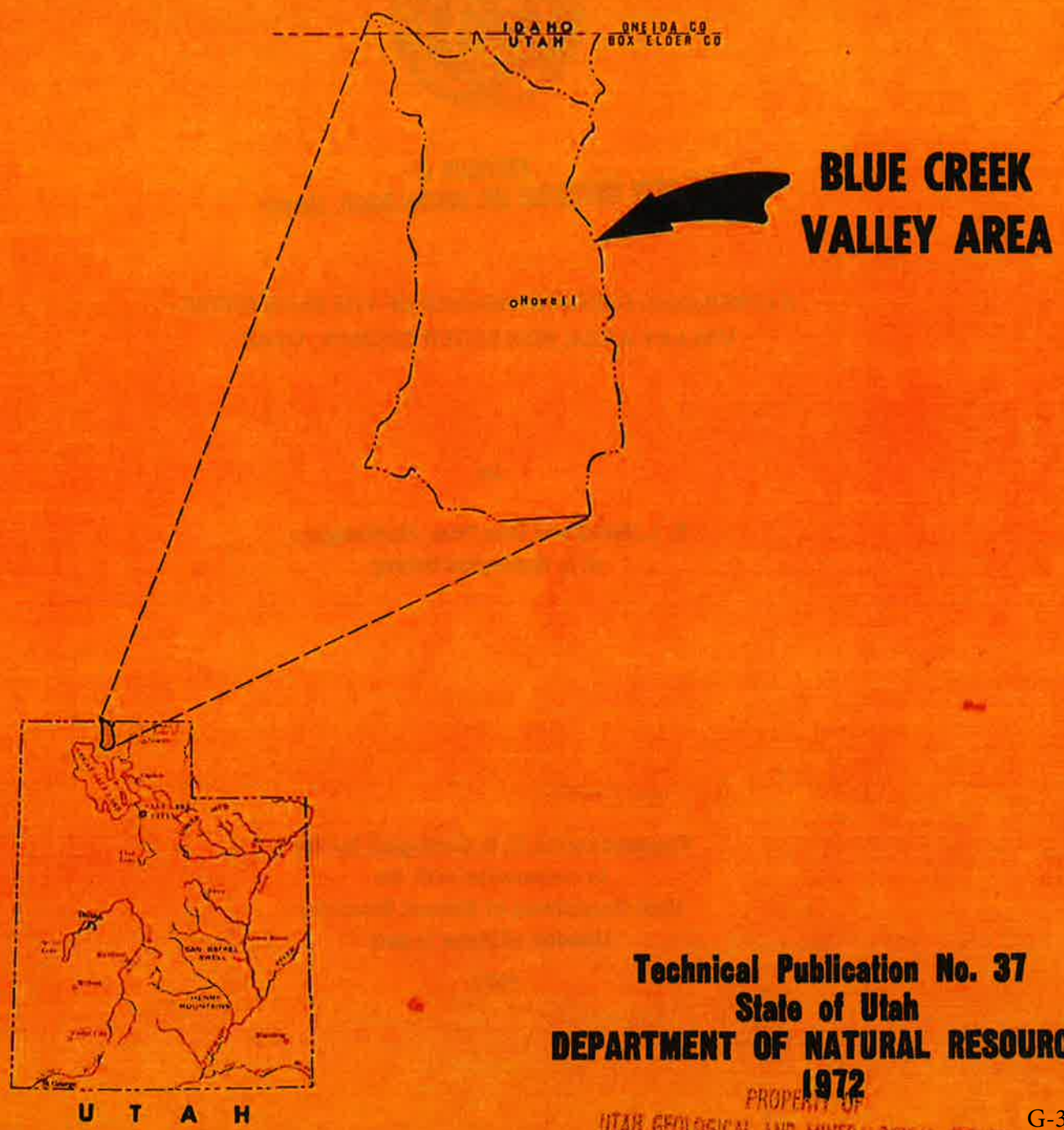
HYDROLOGIC RECONNAISSANCE OF THE BLUE CREEK VALLEY AREA, BOX ELDER COUNTY, UTAH



Technical Publication No. 37
State of Utah
DEPARTMENT OF NATURAL RESOURCES
1972

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DEPARTMENT OF NATURAL RESOURCES

Technical Publication No. 37

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HYDROLOGIC RECONNAISSANCE OF THE BLUE CREEK VALLEY AREA, BOX ELDER COUNTY, UTAH

by

E. L. Bolke and Don Price, Hydrologists
U. S. Geological Survey

Prepared by the U. S. Geological Survey
in cooperation with the
Utah Department of Natural Resources
Division of Water Rights

1972

ILLUSTRATIONS

Page

Plate 1. Hydrogeologic maps of the Blue Creek Valley area, Box Elder County, Utah . . In pocket

Figure 1. Map showing location of the Blue Creek Valley area and of other areas described in previously published reports in this reconnaissance series 2

2. Graph showing magnitude and frequency of annual peak discharges for Blue Creek . . 9

3. Graphs showing depth to water in wells in the Blue Creek Valley area and cumulative departure from normal annual (1931-60) precipitation at Malad, Idaho . 13

4. Diagram showing classification of water for irrigation 17

5. Diagram showing well- and spring-numbering system used in Utah 24

TABLES

Page

Table 1. Principal lithologic units and their general hydrologic properties 5

2. Estimated average annual volume of precipitation and ground-water recharge from precipitation in the Blue Creek Valley drainage basin 6

3. Records of selected wells 26

4. Records of selected springs 28

5. Selected drillers' logs of wells 29

6. Chemical analyses of selected water samples 31

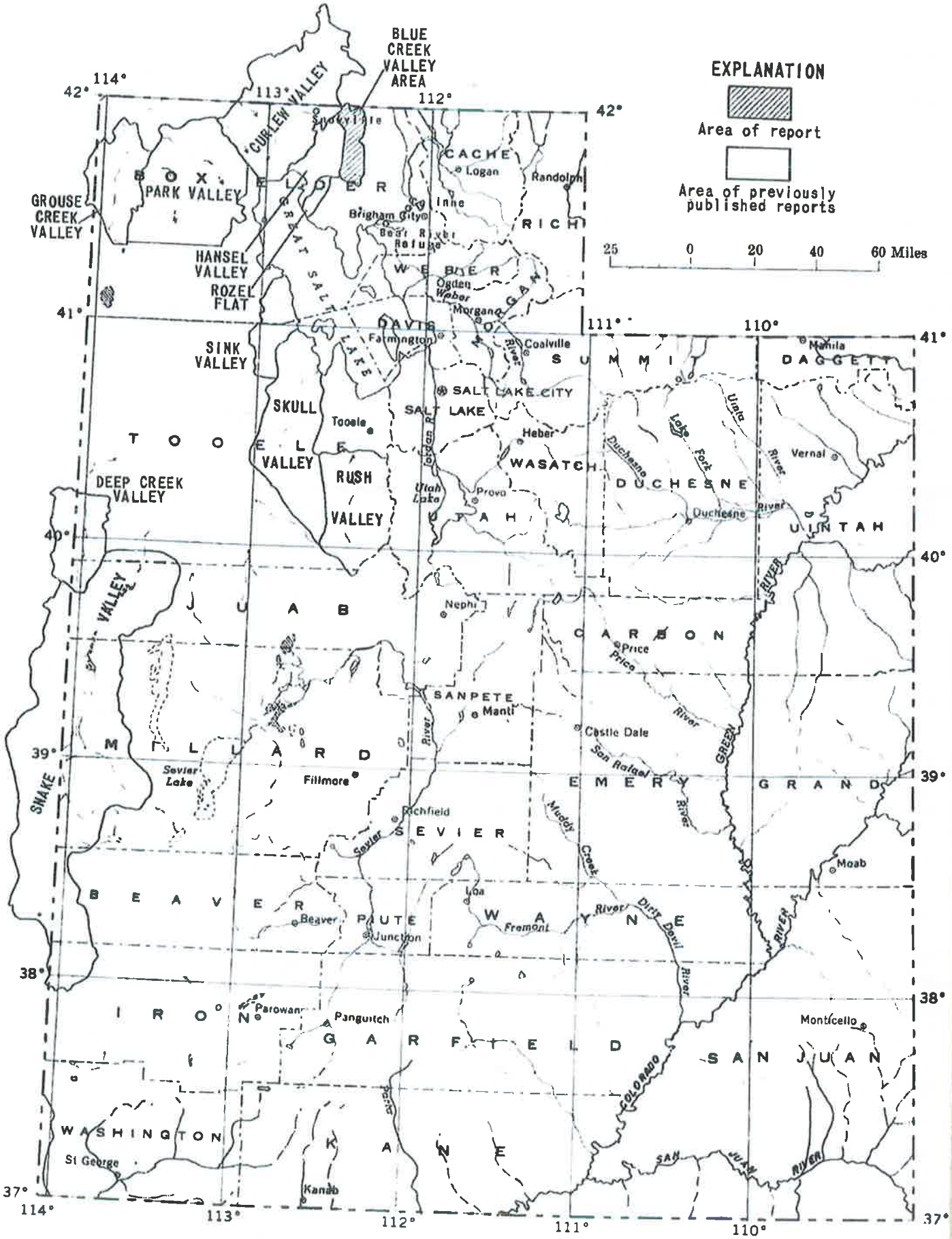

Figure 1.—Location of the Blue Creek Valley area and of other areas described in previously published reports in this reconnaissance series. (See list of technical publications at end of report.)

GEOLOGY

The general geology of the Blue Creek Valley area is shown on plate 1. The age, general lithology, and general hydrologic properties of the principal units are summarized in table 1.

Blue Creek Valley is a structural trough formed by the deformation of rocks of Paleozoic and Tertiary age. The mountain ranges, which consist of rocks of Paleozoic age, were elevated in relation to rocks of the same age that underlie the valley fill by basin- and range-type faulting. Complex folding and faulting accompanied the major structural displacements. The Salt Lake Formation of Tertiary age, which overlies the Paleozoic rocks, was also involved in this structural deformation.

Rocks of Paleozoic and Tertiary age have considerable local relief beneath the valley fill, as indicated by outliers of those rocks (as in Andersons Hill) that protrude above the valley floor. The relief in the consolidated rock is attributed at least in part to faults concealed beneath the valley fill. Such faults are also inferred from (1) the presence of Blue Springs, a thermal spring area that discharges from highly fractured Paleozoic rocks (B. L. Bridges, Geologist, U. S. Soil Conserv. Service, oral commun., 1969) near the north end of Andersons Hill, (2) an apparent "subsurface dam" of upfaulted Paleozoic rocks near the lower end of the valley that impedes drainage from the valley, and (3) local anomalies in the chemical character of the ground water (p. 15). However, subsurface data are not adequate to accurately map any of these inferred faults.

Volcanic activity, which was widespread in adjacent parts of southern Idaho and northern Utah during the Tertiary Epoch, is evidenced in Blue Creek Valley by tuffaceous rocks of the Salt Lake Formation and by layered basaltic lava flows and associated deposits of tuff near the northwest margin of the valley. Lava is reported in logs of several wells drilled in that general area.

The valley fill, which forms the most permeable part of the valley ground-water reservoir, consists largely of detritus eroded from the mountains. Some of the fill was deposited in ancient Lake Bonneville and other pre-existing lakes and reworked by wave action. Shoreline features and deposits of Lake Bonneville are clearly visible at many places along the margins of the valley, especially near the highest level (about 5,200 feet) reached by that lake. Because of the high relief on the underlying rocks, the thickness of the valley fill varies considerably over short distances.

WATER RESOURCES

The quantitative estimates given in this section pertain only to the area within the Blue Creek Valley drainage basin above the narrows in sec. 17, T. 11 N., R. 5 W.

Volume of precipitation

The normal annual (1931-60) precipitation in the Blue Creek Valley drainage basin is shown by isohyets (lines of equal precipitation) on plate 1. The total volume of precipitation was estimated by determining the areas between isohyets, multiplying those areas by the mean value of precipitation between the isohyets and accumulating the total (table 2). The average annual volume of precipitation is about 184,000 acre-feet. Most of this precipitation is returned directly to the atmosphere by evapotranspiration at or near the point of fall; the remaining precipitation becomes runoff or ground-water recharge.

Age	Lithologic unit	General character of material	General hydrologic properties
Mississippian to Permian	Sedimentary and metasedimentary rocks undivided	These rocks form Andersons Hill and the bulk of the mountains that bound Blue Creek Valley. The Oquirrh Formation (Pennsylvanian-Permian age), which consists chiefly of limestone and orthoquartzite with some sandstone, comprises more than 90 percent of the exposures. Manning Canyon Shale (mostly shale and sandstone of Mississippian and Pennsylvanian age) and Great Blue Limestone (mostly massive limestone of Mississippian age) are exposed only locally in Andersons Hill, along the lower slopes of Blue Spring Hills, and in the hills that protrude into the valley from the south. The oldest formation penetrated by oil test (B-11-5)18ddc-1 is reported to be the Laketown Dolomite of Silurian age. All the Paleozoic rocks have undergone considerable deformation and possible local metamorphism. Exposures display intense fracturing, and large solution cavities are evident in several places.	Water-bearing properties are highly variable. The unit as a whole has low permeability, but interconnected fracture zones and solution cavities are capable of transmitting water readily; the possibility of drilling a successful well at any given site is highly unpredictable. The rocks yield less than 10 gpm to most springs in the area; yields to wells range from about 10 to 450 gpm. These rocks probably are the source rocks for most of the flow of Blue Springs and several springs near the south end of Blue Spring Hills.

Table 2.—Estimated average annual volume of precipitation and ground-water recharge from precipitation in the Blue Creek Valley drainage basin

Average annual precipitation: Precipitation zone (inches)	Average annual precipitation: Weighted mean (feet)	Area over which precipitation occurs (acres)	Volume of precipitation (acre-feet)	Precentage of precipitation as recharge	Recharge (acre-feet)
Area where Quaternary and Tertiary sedimentary rocks are exposed					
12-16	1.25	95,770	119,710	5	5,990
16-20	1.50	5,710	8,560	10	860
Subtotals (rounded)		101,500	128,300		6,800
Area where Tertiary igneous rocks and Paleozoic rocks are exposed					
12-16	1.25	21,270	26,590	10	2,660
16-20	1.50	18,950	28,420	15	4,260
More than 20	1.90	440	840	20	170
Subtotals (rounded)		40,700	55,800		7,100
Totals (rounded)		142,000	184,000		14,000

M, Measured by U.S. Geological Survey; F, flowing, but unmeasured (observed by Thiokol Chemical Corp.); E, estimated by U.S. Geological Survey.

Discharge (cfs)	Date
5.0M	Sept. 30, 1959
3.1M	Apr. 19, 1960
4.2M	Oct. 16, 1963
10E	Mar. 19, 1964
11.0M	Apr. 10, 1964
9.0M	Apr. 24, 1964
17.8M	May 7, 1964
2.5M	June 11, 1964
.1E	Sept. 15, 1964
F	Jan. 17, 1969- May 19, 1969
Dry	June 17, 1969
Dry	July 29, 1969
Dry	Aug. 15, 1969
Dry	Sept. 25, 1969
F	Oct. 21, 1969- Dec. 19, 1969
6.8M	Feb. 19, 1970
1.1M	Mar. 18, 1970
1.7M	Apr. 14, 1970
2.4M	May 14, 1970
.5E	July 15, 1970
.3E	Sept. 1, 1970
Dry	Sept. 21, 1970

Ground water

Recharge

The principal source of recharge to the ground-water reservoir in Blue Creek Valley is precipitation that falls on the drainage basin. The volume of recharge was estimated by a method described by Hood and Waddell (1968, p. 22). The estimated recharge is about 14,000 acre-feet annually (table 2) or about 8 percent of the estimated average annual volume of precipitation.

Thiokol Chemical Corp. imports about 150 acre-feet of water per year. About 90 percent of that water is either consumed or percolates into the ground-water reservoir; the remainder is discharged to Blue Creek as treated sewage effluent.

Shallow aquifers in the irrigated segment of the valley below Blue Springs receive some recharge from leaky canals and ditches and from flooded fields; this recharge is regarded as "recycled" ground water and does not add to the total recharge figure. Some additional ground water may enter the Blue Creek Valley area from outside the drainage basin along fault zones and solution cavities. However, data collected for this study were not adequate to confirm this means of recharge or to estimate its magnitude.

Occurence and movement

Ground water in the Blue Creek Valley area occurs under both confined (artesian) and unconfined (water table) conditions. In most of the ground-water reservoir beneath the valley, artesian conditions apparently exist in permeable water-bearing strata that underlie thick beds of clay or other material of poor permeability. Water-table conditions exist in shallow aquifers beneath the valley flat south of Blue Springs. Perched water-table conditions exist locally, especially near the margins of the valley where permeable lakeshore deposits overlie rocks of relatively low permeability. However, the perched aquifers probably are of limited extent and may not be a reliable perennial source of water.

Artesian conditions also exist in the consolidated rocks. These conditions are indicated by Blue Springs and Engineer Spring, which apparently rise along faults in the Paleozoic rocks; and also by the water level in well (B-11-5)5acd-1 (table 3), which taps Paleozoic rocks. Water-table conditions exist in some deep bedrock aquifers such as those tapped by wells (B-11-5)28bba-1 and (B-12-5)27bac-1.

The general direction of ground-water movement in the ground-water reservoir beneath the valley is shown by water-level contours and arrows on plate 1. Ground water moves generally from principal areas of natural recharge on the sides and upper reaches of the valley toward the axis of the valley; movement is then downvalley through the narrow gap near the south boundary of the project area to Great Salt Lake. The overall gradient along the main axis of the valley is slightly more than 500 feet in 25 miles or about 20 feet per mile. The flattening of the gradient near the center of the valley may be due in part to discharge of ground water by evapotranspiration and in part to a subsurface constriction in T. 11 N., R. 5 W., which impedes ground-water movement.

Movement of ground water in the consolidated rocks is controlled largely by geologic structures, such as fault and fracture zones, bedding planes, and solution cavities. Movement is from areas of natural recharge toward the valley fill or toward springs and seeps near the edge of the valley.

Evapotranspiration

Phreatophytes, chiefly greasewood (*Sarcobatus vermiculatus*), rabbitbrush (*Chrysothamnum greenei (?)*), sedges (*Carex* sp.), other marsh grasses, and alfalfa (*Medicago sativa*) discharge ground water by evapotranspiration. Ground water probably was transpired by native vegetation in most of the area presently cultivated; when the land was cleared of native vegetation, evapotranspiration probably was reduced. Excluding the irrigated alfalfa fields, about 200 acres of land below Blue Creek Reservoir contain various amounts of phreatophytes (plant density about 50 percent). In this area the water table is less than 20 feet below land surface. Adjusting the plant density to 100 percent yields about 100 acres covered by phreatophytes. The rate of evapotranspiration is about 2 acre-feet per acre per year (Mower and Nace, 1957, p. 17-21), hence the total evapotranspiration by native phreatophytes is about 200 acre-feet per year.

There are at least 1,000 acres of well-established alfalfa under irrigation in the valley. This alfalfa probably consumes some ground water to supplement the water applied by irrigation. Assuming a ground-water consumption of 0.5 acre-foot per acre per year (J.W. Hood, U.S. Geol. Survey, oral commun., 1971), the evapotranspiration by alfalfa is about 500 acre-feet per year. Thus the total discharge of ground water by evapotranspiration is about 700 acre-feet per year.

Pumpage

Only two large-diameter (more than 6 inches) irrigation wells exist in Blue Creek Valley. In 1969, 256 acre-feet of water was discharged from well (B-13-6)1dbb-1 (estimated from power-consumption records), and about 50 acre-feet was discharged from well (B-13-5)31daa-1. About 30 small-diameter (6 inches or less) domestic and stock wells (pumped at the rate of 1-10 gpm) discharge about 200 acre-feet annually. The total pumpage is about 500 acre-feet annually.

Ground-water outflow

A direct determination of ground-water outflow was not made. The detailed study of the water-bearing properties of the aquifers needed for such a determination is beyond the scope of this investigation. Therefore, the ground-water outflow was estimated as the difference between the total annual recharge (14,000 acre-feet) and the annual discharge by springs, seeps, wells, and evapotranspiration (8,500 acre-feet). The difference is 5,500 acre-feet, which is assumed to be the ground-water outflow from Blue Creek Valley. Ground-water inflow to Blue Creek, unknown but probably small, is included in that amount.

Water-level fluctuations

Changes in ground-water storage resulting from changes in ground-water recharge and discharge are reflected by changes of water levels in wells. Under natural conditions, ground-water recharge and discharge are equal over the long term, and ground-water levels fluctuate in response to changes in precipitation. (See fig. 3.)

A considerable amount of water is stored in the valley fill and in the consolidated rocks that surround and underlie the valley, but no estimate was made of the total amount. Much of this water is probably saline.

Budget

The estimated annual volumes of ground-water recharge and discharge in the Blue Creek Valley drainage basin are given in the following table:

	Acre-feet
Recharge:	
Precipitation (p. 4)	14,000
Total	14,000
Discharge:	
Springs and seeps (p. 11)	7,300
Withdrawal by wells (p. 12)	500
Evapotranspiration (p. 12)	700
Ground-water outflow (p. 12)	5,500
Total	14,000

Of the 8,500 acre-feet of water discharged by wells, springs, and evapotranspiration, about 8,000 acre-feet is used beneficially and about 500 acre-feet is regarded as salvageable.

Perennial yield

The perennial yield of a ground-water system is the maximum amount of water that can be withdrawn from the system each year indefinitely without causing a permanent and continuing depletion of ground water in storage or a deterioration of chemical quality of the ground water. The perennial yield is limited to the amount of natural discharge of water of suitable chemical quality that can economically be salvaged for beneficial use.

Assuming (1) that subsurface outflow is of suitable chemical quality and could be economically intercepted by wells and (2) that the evapotranspiration loss by nonbeneficial phreatophytes could be salvaged, then the perennial yield of the basin would approximate the discharge from the ground-water reservoir or about 14,000 acre-feet.

Chemical quality of water

Chemical analyses of selected water samples from the Blue Creek Valley area are given in table 6. Plate 1 shows diagrams of chemical quality of water. For some analyses, sulfate ion was not determined, and the sulfate values for the diagrams have been estimated by taking the difference (in milliequivalents per liter) of total cations and anions and assuming the difference to be sulfate ion. These estimated values do not appear in table 6.

Most of the water in Blue Creek Valley exceeds these standards in one or more of the categories listed; exceptions are wells (B-13-6)1dbb-1, (B-14-6)3aaa-2, and (B-15-6)35bdb-1 and some mountain springs.

Little information is available concerning the rating of water for stock supplies. The State of Montana (McKee and Wolf, 1963, p. 113) rates water containing less than 2,500 mg/l of dissolved solids as good, 2,500-3,500 mg/l as fair, 3,500-4,000 mg/l as poor, and more than 4,500 mg/l as unfit for stock. Using these criteria, most of the ground-water sampled in Blue Creek Valley is rated as good for stock use.

The principal chemical quality characteristics that affect the usefulness of water for irrigation are: (1) total concentration of soluble salts, (2) relative proportion of sodium to other cations, (3) concentration of boron or other constituents that may be toxic to some plants, and (4) bicarbonate concentration in excess of the concentration of calcium plus magnesium. The U. S. Salinity Laboratory Staff (1954, p. 79-81) has devised a method for classifying water for irrigation use by plotting data on specific conductance (conductivity) versus sodium-absorption ratio (SAR) on a diagram (fig. 4). This method of classification is based on "average conditions" with respect to soil texture, infiltration rate, drainage, quantity of water used, climate, and salt tolerance of crops. Most of the water sampled in Blue Creek Valley has a low- sodium hazard and a high- to very high-salinity hazard (compare table 6 and fig. 4). Well (B-13-6)1dbb-1 (point 7 in fig. 4) is a large-diameter irrigation well; Blue Springs (point 5 in fig. 4) is the largest source of irrigation water in the valley. Crops are raised using water from Blue Springs, which has both a high SAR and a high mineral content.

SUMMARY OF WATER USE

Past and present development

Development of water in the Blue Creek Valley area began prior to 1900 when the first wells were constructed for domestic and stock supplies. The first recorded well in the area was constructed in 1898. However, most of the domestic and stock wells were constructed during the years 1910-20 and 1930-40. Many of those wells are now used only seasonally by the dryland grain farmers.

The water system for the town of Howell began operating in 1947 with the development and diversion of Hillside Spring (table 4). The system was enlarged about 1965 when well (B-12-6)24add-1 was drilled and put into operation. In 1970 the system served about 150 people.

The Thiokol Chemical Corp. plant was constructed about 1957. About that time, Railroad Springs (table 4), which were formerly used for watering of livestock and for wildlife, were developed and diverted to the plant, chiefly for culinary use.

Irrigation in Blue Creek Valley began in 1904 using water from Blue Springs. In 1960 about 2,800 acres of land in the area was irrigated (U. S. Dept. Agriculture, Soil Conserv. Service, 1960, p. 4). Until 1962, Blue Springs was the only major source of irrigation water. An irrigation well was drilled in 1962 and another in 1968; about 300 acres of land is irrigated with water from these two wells.

Future Development

Because most of the land in Blue Creek Valley is cultivated, future development depends chiefly on additional water supplies to provide for increased irrigation. Blue Springs is fully appropriated for irrigation, and surface runoff in the valley is too meager or of too poor quality for irrigation; therefore, any additional irrigation supplies must be obtained from wells. Theoretically, the annual volume of ground water available for additional development is about 6,000 acre-feet—that is, the assumed perennial yield (about 14,000 acre-feet) less the quantity currently used beneficially (about 8,000 acre-feet). However, full development of the 6,000 acre-feet is not feasible because (1) some of the water is chemically unsuitable for irrigation, (2) the valley ground-water reservoir generally has low permeability and in most places yields water too slowly for large-scale irrigation, and (3) pumping may be too costly for irrigation in the upper part of the valley because water levels are several hundred feet below land surface. Therefore, the volume of ground water economically available probably is considerably less than 6,000 acre-feet a year.

PROPOSALS FOR FUTURE STUDIES

As the need for development of ground water in Blue Creek Valley arises, problems resulting from that development will also arise. Problems resulting from increased pumping might be declining water levels, well interference, decrease in flow of Blue Springs, and deterioration of the chemical quality of water. A detailed study of the basin and adjacent areas would help to better understand these problems and bring about a possible solution. Such a study should include:

1. Establishment of streamflow stations, particularly below Blue Springs and on Blue Creek near site (B-10-5)5bab.

2. Test drilling and gravity surveys to determine the subsurface geology and to delineate major aquifers.

3. Inventory of all wells and water sources, expansion of the observation-well network, and monitoring chemical quality of water at selected sites.

4. Aquifer performance tests to determine the water-bearing properties of the aquifers.

5. Collection of climatic records and detailed geologic mapping to more accurately estimate runoff and ground-water recharge.

6. Detailed mapping of phreatophytes.

APPENDIX

TEMPERATURE-CONVERSION TABLE

Temperatures in °C are rounded to nearest 0.5 degree. Underscored temperatures are exact equivalents. To convert from °F to °C where two lines have the same value for °F, use the line marked with an asterisk (*) to obtain equivalent °C.

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-20.0	-4	-10.0	14	0.0	32	10.0	50	20.0	68	30.0	86	40.0	104
-19.5	-3	-9.5	15	+0.5	33	10.5	51	20.5	69	30.5	87	40.5	105
-19.0	-2	-9.0	16	1.0	34	11.0	52	21.0	70	31.0	88	41.0	106
-18.5	-1	-8.5	17	1.5	35	11.5	53	21.5	71	31.5	89	41.5	107
-18.0 *	0	-8.0 *	18	2.0 *	36	12.0 *	54	22.0 *	72	32.0 *	90	42.0 *	108
-17.5	0	-7.5	18	2.5	36	12.5	54	22.5	72	32.5	90	42.5	108
-17.0	1	-7.0	19	3.0	37	13.0	55	23.0	73	33.0	91	43.0	109
-16.5	2	-6.5	20	3.5	38	13.5	56	23.5	74	33.5	92	43.5	110
-16.0	3	-6.0	21	4.0	39	14.0	57	24.0	75	34.0	93	44.0	111
-15.5	4	-5.5	22	4.5	40	14.5	58	24.5	76	34.5	94	44.5	112
-15.0	5	-5.0	23	5.0	41	15.0	59	25.0	77	35.0	95	45.0	113
-14.5	6	-4.5	24	5.5	42	15.5	60	25.5	78	35.5	96	45.5	114
-14.0	7	-4.0	25	6.0	43	16.0	61	26.0	79	36.0	97	46.0	115
-13.5	8	-3.5	26	6.5	44	16.5	62	26.5	80	36.5	98	46.5	116
-13.0	9	-3.0	27	7.0	45	17.0	63	27.0	81	37.0	99	47.0	117
-12.5	10	-2.5	28	7.5	46	17.5	64	27.5	82	37.5	100	47.5	118
-12.0 *	10	-2.0 *	28	8.0 *	46	18.0 *	64	28.0 *	82	38.0 *	100	48.0 *	118
-11.5	11	-1.5	29	8.5	47	18.5	65	28.5	83	38.5	101	48.5	119
-11.0	12	-1.0	30	9.0	48	19.0	66	29.0	84	39.0	102	49.0	120
-10.5	13	-0.5	31	9.5	49	19.5	67	29.5	85	39.5	103	49.5	121

For temperature conversions beyond the limits of the table, use the equations $C = 0.5556\ (F - 32)$ and $F = 1.8°C + 32$. The formulae say, in effect, that from the freezing point of water (0°C, 32°F) the temperature in °C rises (or falls) 5° for every rise (or fall) of 9°F.

BASIC DATA

Table 3.—Records of selected wells—continued

Well number	Owner	Priority date	Well depth (ft)	Casing Diameter (in.)	Casing Depth (ft)	Casing Finish	Altitude of LSD (ft)	Water level (ft)	Date of water-level measurement	Use of water	Log	Other data available
6/(B-13-5)31daa-1	L. D. Nessen	1962C	405	16	20	P	4,610	27A	7-70	I	D	P
33acc-1	Lawrence Hawkes	1900	180	2	-	O	4,780	170G	3-40	H	-	P
(B-13-6)1bdb-1	R. W. Henrie	1904	195	6	-	-	4,870	175G	3-36	S	-	P
1bdb-2	J. E. Deakin	1929	200	4	-	-	4,875	175G	3-40	H	-	-
1cac-1	M. J. Hyde	1929C	200	4	-	-	4,845	150A	10-49	U	-	P
7/1dbb-1	R. W. Henrie	1968C	704	16	482	P	4,835	121A	9-70	I	D	P
2cab-1	D. B. Bradshaw	1941C	275	6	-	-	4,970	237A	7-70	U	-	-
2dab-1	J. E. Deakin	1906	175	6	-	-	4,885	150G	3-36	U	-	-
10dda-1	H. J. Anderson	1926	364	6	-	O	5,075	311A	7-70	U	-	-
12aba-1	R. W. Henrie	1958C	-	8	-	-	4,900	-	-	S	-	P
14bbc-1	O. P. Canfield	1949C	-	-	-	-	5,070	-	-	S	-	-
24add-1	C. H. Miller	1911	250	6	-	-	4,795	-	-	H	-	-
24dcd-1	W. T. Miller	1911	250	6	-	-	4,825	-	-	H	-	P
36acc-1	Alfred Manning	1911	300	6	-	-	4,800	200G	3-36	S	-	P
(B-14-5)4bab-1	Gerald Jessop	1914	185	6	-	O	5,070	160A	7-70	U	-	-
5aaa-1	L. G. Whitney	1922	150	6	-	-	5,065	130G	4-40	H	-	-
5aba-1	Gerald Jessop	1898	430	3	100	-	5,060	125G	8-36	U	-	-
5bab-1	L. G. Whitney	1932	190	4	-	O	5,070	50G	3-40	U	-	-
8dbc-1	Edward Jessop	1917	180	6	-	O	5,160	31A	7-70	S	-	-
8ddd-1	M. S. Jessop	1918	105	6	-	O	5,175	62A	7-70	H	-	P
17aaa-1	Seth Hammond	1915	125	6	113	P	5,175	70A	7-70	U	-	-
19ccc-1	H. M. Schumann	1934	-	-	-	-	4,920	174A	7-70	U	-	-
28cca-1	William Roberts	1935C	610	-	-	X	5,120	Dry	11-35	U	D	-
29abb-1	H. and L. Schumann	1917	340	42	-	W	5,040	297A	7-70	H	-	P
30cbd-1	James Roberts	1924	200	6	191	-	4,960	166G	3-40	U	-	-
31cdd-1	Edward Doutre	1912	160	4	-	-	4,820	96A	7-70	U	-	-
(B-14-6)3aaa-2	W. R. Bishop	1969C	390	6	348	O	5,115	340D	9-69	H	D	P
9aab-1	Deloris Stokes	1967C	409	6	-	-	5,150	390D	8-67	H	D	P
12add-1	W. E. Fridal	1934	462	6	455	O	5,045	287D	-	U	D	-
12caa-1	Coop Security	1933C	480	8	445	P	5,150	406A	7-70	H	-	P
23add-1	Ray Holdaway	1941C	336	4	-	-	5,050	309A	7-70	U	-	-
23ddd-1	Hyer and Turley	1915C	350	6	348	P	5,030	300G	3-40	H	-	X
24cbc-1	R. B. Hyer	1920	330	6	-	-	5,035	304A	7-70	H	-	P
36cba-1	A. H. Rock	1900	200	2	-	O	4,920	149A	7-70	U	-	-
(B-15-5)32cdd-1	L. G. Whitney	1915	200	8	-	-	5,055	50G	8-44	H	-	P
(B-15-6)34ccc-1	R. W. Tolman	1968C	555	6	-	O	5,230	461D	7-68	H	D	P
35bdb-1	Deloris Stokes	1920	-	-	-	-	5,085	-	-	S	-	P

1/ Reported yield and drawdown: 450 gpm and 20 feet, October, 1962.

2/ Reported yield and drawdown: 90 gpm and 32 feet, July, 1956.

3/ Reported yield and drawdown: 80 gpm and 50 feet, June, 1962.

4/ Well destroyed.

5/ Reported yield and drawdown: 290 gpm and 140 feet, April, 1958.

6/ Reported yield and drawdown: 350 gpm and 200 feet, December, 1962.

7/ Reported yield and drawdown: 580 gpm and 192 feet, October, 1968.

Table 5.—Selected drillers' logs of wells.

Altitudes are in feet above sea level for land surface at well, interpolated from U.S. Geological Survey 7.5-minute topographic maps (20-foot contour interval).
Thickness in feet.
Depth in feet below land surface.

Material	Thickness	Depth
(B-11-5)5acd-1. Log by J. Hy Petersen and Sons. Alt. 4,445 ft.		
Topsoil	3	3
Clay, yellow	61	64
Clay, yellow, and gravel	31	95
Clay, sand, and gravel	49	144
Clay, yellow, and streaks of sandstone	20	164
Gravel, sand, and clay	32	196
Clay, sandy, yellow, and gravel	69	265
Gravel, sand, and hard clay	23	288
Gravel, cemented, hard, and sticky and sandy clay	81	369
Clay, yellow, and fine sandy gravel	29	398
Gravel, cemented	7	405
Gravel, hard, and clay	33	438
Gravel, hard, clay, and broken limestone boulders	7	445
Limestone, solid	94	539
Limestone, soft, black	13	552
Limestone, hard, broken	3	555
Limestone, soft, gray	10	565
Limestone, soft, broken	4	569
Limestone, hard, black	41	610
(B-11-5)28bba-1. Log by Melvin Church Drilling Co. Alt. 4,540 ft.		
Soil, rocky	2	2
Clay	3	5
Conglomerate	6	11
Rocks, large, and clay	183	194
Unlogged	1	195
Silt, yellow	5	200
Silt, red, and rocks	10	210
Silt and rocks; water seep	8	218
Limestone, broken	14	232
Shale, black	86	318
Rock; water seepage	6	324
Shale and limestone, lenticular	41	365
(B-11-5)29abb-1. Log by Melvin Church Drilling Co. Alt. 4,410 ft.		
Soil, rocky	4	4
Clay, gumbo	6	10
Conglomerate	26	36
Clay, gumbo	10	46
Conglomerate	37	83
Boulders and clay	4	87
Conglomerate	48	135
Clay, gumbo	6	141
Conglomerate	9	150
Gravel; water bearing	2	152
Clay	7	159
Gravel; water bearing	13	172
Clay	22	194
Gravel	2	196
Clay	4	200
Gravel; water bearing	14	214
Clay	2	216
(B-11-5)29cbd-1. Log by T. J. Burkhart. Alt. 4,340 ft.		
Soil	2	2
Clay, sandy	21	23
Gravel	7	30
Gravel and clay	15	45
Clay, sandy	15	60
Gravel	2	62
Clay, sandy	9	71
Gravel and clay	17	88
Sand, dirty	11	99
Gravel	8	107
Sand	8	115
Gravel	5	120
Clay	6	126
Sand and gravel	20	146
Clay	9	155
Gravel or sand	3	158
Gravel, dirty	26	184
Clay	8	192
Gravel with some clay	40	232
Gravel, loose	19	251
Gravel and boulders, dirty	53	304
Gravel and sand	6	310
(B-11-6)16bcc-1. Log by D. G. Musselman. Alt. 5,040 ft.		
Topsoil	3	3
Sandstone	17	20
Clay, blue	33	53
Clay, white	73	126
Clay, yellow, and gravel	10	136
Sandrock	156	292
(B-12-5)22dbd-1. Log by Robinson Drilling Co. Alt. 4,750 ft.		
Clay, silt, and cobbles	3	3
Sand and gravel	5	8
Clay, yellow, and boulders	7	15
Clay, red	5	20
Clay and boulders	10	30
Boulders	13	43
(B-12-5)22dbd-1 - Continued		
Limestone	18	61
Clay, red and yellow	4	65
Clay and rock	5	70
Limestone	10	80
Clay and rock	7	87
Boulders	6	93
Clay and rock	27	120
Shale, black	26	146
Limestone	53	199
Shale, black	52	251
Limestone, hard	32	283
Limestone, fractured	17	300
Limestone, hard	13	313
Shale, black	20	333
Limestone, hard	9	342
(B-12-6)24add-1. Log by Waymon Yarbrough. Alt. 4,620 ft.		
Clay	6	6
Clay and boulders	17	23
Clay and sand	22	45
Gravel	50	95
Clay and sand	23	118
Limestone	1	119
Limestone and clay	26	145
Clay and sand	10	155
Sand, soft, tight	5	160
Limestone, hard	117	277
Sand, soft	2	279
Sand	12	291
Limestone, hard	2	293
Sand and clay	7	300
(B-12-6)34acd-1. Log by David Musselman. Alt. 5,170 ft.		
Clay, red	10	10
Rocks	4	14
Clay, red	236	250
"Hardpan"	10	260
Clay, red, and gravel	28	288
Clay, white, sandy	10	298
Clay, red, and gravel	54	352
"Hardpan"	10	362
Clay, red, and gravel	10	372
"Hardpan"	12	384
Clay, soft, red	8	392
Sand	46	438
Gravel and clay	20	458
Sand	8	466
Clay	4	470
(B-13-5)5bcb-2. Log by T. J. Burkhart. Alt. 4,820 ft.		
Soil	2	2
Clay, yellow	38	40
Clay, soft, sandy, yellow	12	52
Clay, hard, sandy, light gray	53	105
Clay, yellow, and gravel	82	187
Clay, dense, gray	45	232
Shale, sandy, hard and soft streaks, light gray	28	260
(B-13-5)6aaa-2. Log by R. J. Howell Drilling Co. Alt. 4,840 ft.		
Clay, brown	5	5
Clay, yellow, and sand	30	35
Gravel, dry	2	37
Clay, yellow	33	70
Clay, brown, and conglomerate	12	82
Clay, brown, and lava rock	4	86
Clay, brown, and sand	10	96
Clay, brown, and lava rock	4	100
Clay and gravel	15	115
Clay and boulders	15	130
Sandstone	20	150
Limestone	25	175
Clay, red	10	185
Limestone, hard	3	188
Sand, red, and gravel; water bearing	10	198
Sand and gravel	32	230
Limestone	5	235
(B-13-5)7acc-1. Log by Davis and Davis. Alt. 4,800 ft.		
Sand and shale	±120	±120
Sandstone, sand, and shale	278	398
Sand; water bearing	14	412
(B-13-5)28bab-1. Alt. 4,665 ft.		
Soil, black	1	1
Clay	110	111
Gravel	1	112
(B-13-5)29aaa-1. Log by T. J. Burkhart. Alt. 4,640.		
Soil	2	2
Clay, light gray	21	23
Clay, light brown, and gravel	15	38
Clay, light gray	16	54
(B-13-5)29aaa-1 - Continued		
Gravel and boulders	3	57
Clay, light brown, and gravel	63	120
Clay, sandy, light brown	31	151
Gravel and light brown clay	40	191
Gravel and boulders; some clay	5	196
Gravel and light brown clay	19	215
Boulders, gravel, and light brown clay	88	303
Sand, clay, and gravel	21	324
Gravel and clay	4	328
(B-13-5)31daa-1. Log by Waymon Yarbrough. Alt. 4,610 ft.		
Soil	7	7
Clay	35	42
Unlogged; water bearing	13	55
Clay, gray	23	78
Gravel, coarse, boulders, and sand	12	90
Clay, white	22	112
Shale, hard	3	115
Clay, blue	30	145
Shale, hard	5	150
Clay, white	50	200
Clay, blue green	20	220
Clay, green	50	270
Sandy (sandy streak)	5	275
Shale	5	280
Clay, white	25	305
Clay, soft, blue	10	315
Sandstone, hard	10	325
Sandy (sandy streak)	1	326
Sandstone	4	330
Sandy (sandy streak)	1	331
Shale	4	335
Clay, hard	10	345
Limestone	25	370
Sand, black	10	380
Clay	20	400
Clay, hard	5	405
(B-13-6)1dbb-1. Log by Robinson Drilling Co. Alt. 4,835 ft.		
Soil	9	9
Clay	28	37
Clay and gravel	77	114
Clay	29	143
Clay with lime seams	57	200
Clay	6	206
Clay with limestone seams	6	212
Clay and gravel	69	281
Clay	13	294
Gravel	2	296
Clay	53	349
Gravel	2	351
Clay and sand	23	374
Gravel	11	385
Clay	14	399
Gravel	4	403
Clay and gravel	78	481
Clay	3	484
Gravel	12	496
Clay	16	512
Gravel	7	519
Clay	13	532
Gravel	2	534
Clay and gravel	39	573
Gravel	61	634
Clay and gravel	6	640
Gravel	31	671
Clay	8	679
Gravel	18	697
Clay and gravel	7	704
(B-14-5)28cca-1. Log by Adam Inthurn and F. H. Hughes. Alt. 5,120 ft.		
Conglomerate	140	140
Clay	35	175
Rock	65	240
Conglomerate	80	320
Rock	35	355
Shale	39	394
Rock, black	12	406
Sand and sandstone	77	483
Rock, black	50	533
Conglomerate	10	543
Rock, black	25	568
Conglomerate	15	583
Rock, black	27	610
(B-14-6)3aaa-2. Log by R. H. Howell Drilling Co. (0-320 ft) and R. O. Denton (328-390 ft). Alt. 5,115 ft.		
Lime(stone), white	12	12
Sandstone, red, hard	10	22
Clay, red	28	50
Sandstone, red	18	68
Red rock or hardpan	4	72
Clay, red	15	87
Cobbles	5	92

Table 6.—Chemical analyses of selected water samples.

Sodium and potassium: An entry of C for potassium indicates that sodium and potassium are calculated and reported as sodium.
Agency making analysis: GS, U.S. Geological Survey; IN, Thiokol Chemical Corp.; SU, Utah State University.

Location	Date of collection	Temperature (°C)	Milligrams per liter: Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Hardness as $CaCO_3$	Noncarbonate hardness	Dissolved solids: Determined	Dissolved solids: Calculated	Specific conductance (micromhos/cm at 25°C)	Sodium-adsorption ratio	pH	Agency making analysis
Wells																							
(B-11-6)2bdc-1	7-14-70	11.5	-	-	122	28	37	-	171	0	-	240	-	-	-	418	278	765	-	1,080	0.8	8.0	GS
14bbb-1	8-10-70	14.0	-	-	184	54	42	-	143	0	-	218	-	-	-	680	563	-	-	1,460	-	7.9	GS
(B-12-5)5cdb-1	7-14-70	9.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,690	-	-	GS
5d	1913	-	-	-	1/80	-	160	C	310	0	40	155	-	-	-	205	-	570	-	-	4.9	-	GS
7ccc-1	7-13-70	12.0	-	-	131	98	69	-	192	0	-	460	-	-	-	732	575	1,020	-	1,830	1.1	7.8	GS
7ddc-1	7-13-70	9.5	-	-	418	180	1,520	-	539	0	-	2,580	-	-	-	1,780	1,340	6,080	-	9,280	16	7.8	GS
10bca-1	7-14-70	15.5	-	-	66	37	129	-	254	3	-	226	-	-	-	317	104	708	-	1,220	3.2	8.5	GS
19ba	1913	-	-	-	1/80	-	200	C	215	0	40	275	-	-	-	205	-	690	-	-	6.1	-	GS
20bbb-2	7-14-70	9.5	32	-	97	59	1,020	20	525	25	129	1,470	1.2	4.0	0.45	486	14	3,260	3,120	5,270	20	8.7	GS
20bbb-3	7-14-70	10.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7,320	-	-	GS
(B-12-6)13ddd-1	7-13-70	12.5	44	-	61	47	38	3.0	179	0	33	173	.9	5.4	.01	347	200	526	493	885	.9	8.2	GS
36ada-1	7-14-70	16.5	42	-	77	49	67	7.7	183	0	54	230	.7	2.9	.05	391	241	644	620	1,100	1.5	8.2	GS
(B-13-5)5bcb-2	7- 8-70	14.5	53	-	98	40	61	6.9	173	0	20	267	.5	4.2	.03	410	268	717	636	1,140	1.3	8.1	GS
6aaa-2	7- 8-70	19.0	-	-	185	70	108	-	144	0	-	591	-	-	-	750	632	1,230	-	2,120	1.7	7.9	GS
8d	1913	-	-	-	1/80	-	180	C	220	0	40	275	-	-	-	205	-	700	-	-	5.5	-	GS
16ccc-1	7- 7-70	18.5	-	-	572	245	547	-	142	0	-	2,380	-	-	-	2,430	2,320	4,860	-	7,190	4.8	7.8	GS
18adb-1	7-13-70	-	-	-	152	226	176	-	224	0	-	520	-	-	-	1,310	1,130	1,980	-	2,980	2.1	8.0	GS
18c	1913	-	-	-	1/80	-	110	C	215	0	100	105	-	-	-	205	-	480	-	-	3.3	-	GS
22ccc-1	7- 8-70	16.5	-	-	65	24	78	-	269	0	-	128	-	-	-	260	40	501	-	860	2.1	8.2	GS
28b	1913	-	-	-	1/95	-	180	C	240	0	30	405	-	-	-	240	-	900	-	-	5.1	-	GS
28bab-1	7- 8-70	13.0	-	-	233	94	146	-	163	0	-	751	-	-	-	968	834	1,600	-	2,660	2.0	7.8	GS
31daa-1	7-13-70	20.5	-	-	89	41	153	-	343	4	-	274	-	-	-	391	103	1,010	-	1,440	3.4	8.4	GS
33acc-1	7-14-70	19.0	-	-	52	23	101	-	274	3	-	136	-	-	-	224	0	509	-	901	2.9	8.6	GS
(B-13-6)1bdb-1	7- 6-70	16.5	-	-	149	32	41	-	144	0	-	331	-	-	-	506	388	818	-	1,340	.8	7.8	GS
1cac-1	10-17-57	-	53	-	204	44	49	C	140	0	102	395	-	20	-	688	573	-	936	1,650	.8	7.5	GS
1dbb-1	7- 6-70	19.0	47	-	71	19	31	10	160	0	16	127	.4	6.1	.04	260	124	405	407	701	.8	8.2	GS
12aba-1	7- 7-70	16.5	-	-	325	77	62	-	150	0	-	551	-	-	-	1,130	1,000	1,700	-	2,470	.8	7.9	GS
24dcd-1	7-13-70	14.5	-	-	113	75	48	-	204	0	-	325	-	-	-	597	430	936	-	1,450	.9	7.9	GS
36acc-1	7-13-70	17.5	-	-	447	153	143	-	162	0	-	1,340	-	-	-	1,740	1,610	3,450	-	4,270	1.5	8.0	GS
(B-14-5)8ddd-1	7- 7-70	10.5	29	-	91	19	72	1.7	321	0	69	55	.2	7.6	.06	304	41	600	474	878	1.8	8.2	GS
29abb-1	7- 6-70	13.0	40	-	216	56	48	7.6	138	0	49	490	.3	3.9	.00	770	657	1,330	979	1,850	.8	8.1	GS
(B-14-6)3aaa-2	7- 7-70	12.0	29	-	56	22	59	4.5	187	0	26	131	.5	1.9	.05	231	78	440	422	739	1.7	7.6	GS
9aab-1	7- 7-70	20.5	-	-	67	25	213	-	2/258	0	-	341	-	-	-	270	58	870	-	1,530	5.6	8.3	GS
12caa-1	7- 7-70	12.0	26	-	87	17	41	10	143	0	44	176	.3	.0	.06	285	168	517	471	823	1.1	8.2	GS
23ddd-1	7- 8-70	10.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,270	-	-	GS
24cbc-1	7- 8-70	10.0	-	-	121	30	33	-	183	-	-	230	-	-	-	428	278	773	-	1,080	.7	7.8	GS
(B-15-5)32cdd-1	7- 7-70	12.5	-	-	199	23	119	-	2/249	0	-	234	-	-	-	340	135	772	-	1,230	2.8	8.4	GS
(B-15-6)34ccc-1	7- 7-70	20.5	41	-	60	25	247	5.7	259	0	40	375	1.0	.1	.06	252	40	938	922	1,610	6.8	7.9	GS
35bdb-1	7- 7-70	18.5	-	-	88	16	16	-	258	0	-	64	-	-	-	284	73	417	-	634	.4	8.2	GS
Springs																							
(B-11-5)3cac-S1	7-14-70	17.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	765	-	-	GS
12cca-S1	7-14-70	17.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	631	-	-	GS
21-23-S3/	10- -62	-	13	-	36	5	47	-	-	-	22	75	-	-	0.06	112	-	382	-	-	1.9	8.1	IN
21-23-S3/	11- -62	-	17	-	53	11	73	-	-	-	42	119	-	-	.19	176	-	526	-	-	2.4	8.3	IN
(B-11-6)24ddb-S1	8-11-70	-	-	-	101	19	71	-	187	0	-	190	-	-	-	330	177	-		1,010	-	8.0	GS
(B-12-5)11cdd-S1	7-14-70	11.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	858	-	-	GS
14baa-S1	7-14-70	17.0	-	-	79	15	90	-	243	4	-	140	-	-	-	257	51	543	-	909	2.5	8.5	GS
14ccc-S1	7-14-70	18.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	798	-	-	GS
22dac-S1	7-14-70	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	889	-	-	GS
(B-12-6)33dba-S1	7-14-70	20.5	-	-	81	12	54	-	250	0	-	100	-	-	-	252	46	477	-	751	1.5	8.2	GS
(B-13-5)29-S	1913	-	-	-	1/75	-	630	C	240	0	40	840	-	-	-	185	-	1,600	-	-	20	-	GS
29-S	9-10-64	26.5	-	-	83	24	540	32	268	-	68	886	-	-	.2	306	-	-	1,923	3,580	13	8.0	SU
29-S	7- 7-70	28.0	19	-	56	24	636	22	329	0	84	895	0.4	1.0	.22	238	0	2,010	1,900	3,410	18	7.9	GS
Blue Creek [at location (B-10-5)5bab]																							
Discharge (cfs)																							
-	6-29-59	17.5	19	-	112	68	1,810	C	538	20	426	2,530	-	10	8.1	560	86	-	5,270	8,640	33	8.4	GS
5.0	9-30-59	12.0	26	0.04	98	36	941	34	350	16	202	1,380	2.0	1.7	.40	392	79	-	2,910	5,130	21	8.5	GS
3.1	4-19-60	12.0	26	.04	128	72	1,430	41	397	24	372	2,150	-	1.7	.55	615	250	-	4,440	7,710	25	8.5	GS
-	4- 6-61	6.0	21	.03	184	126	2,540	65	552	0	716	3,740	-	12	-	978	526	-	7,700	12,400	35	8.0	GS
4.2	10-16-63	15.0	-	-	-	-	-	-	-	-	350	2,200	-	-	-	310	-	4,220	-	7,170	-	-	GS
4/10	3-19-64	-	-	-	-	-	-	-	-	-	434	2,200	-	-	-	595	-	4,670	-	7,430	-	-	GS
11.0	4-10-64	7.0	-	-	-	-	-	-	-	-	354	1,950	-	-	-	510	-	3,850	-	6,400	-	-	GS
9.0	4-24-64	7.0	-	-	-	-	-	-	-	-	400	2,300	-	-	-	600	-	4,670	-	7,550	-	-	GS
17.8	5- 7-64	7.0	-	-	-	-	-	-	-	-	362	1,900	-	-	-	430	-	3,820	-	6,400	-	-	GS
2.5	6-11-64	13.5	26	-	136	96	2,330	-	628	-	612	3,290	-	4.7	-	735	220	6,740	-	10,800	-	8.1	GS
4/.1	9-15-64	-	-	-	-	-	-	-	-	-	395	2,440	-	-	-	454	-	4,920	-	8,140	-	-	GS
6.8	2-19-70	-	22	-	160	107	2,110	C	592	0	570	3,080	-	.6	-	840	355	6,540	6,340	10,100	32	7.8	GS
1.1	3-18-70	2.5	23	-	140	95	2,080	-	579	0	626	3,080	-	.2	-	740	265	6,560	6,330	10,100	33	8.1	GS
1.7	4-14-70	7.0	23	-	124	75	1,640	-	498	0	392	2,480	-	.0	-	620	212	5,140	4,980	8,330	29	8.1	GS
7.0	5-14-70	18.0	-	-	-	-	-	-	-	-	-	3,280	-	-	-	-	-	-	-	10,500	-	-	GS
4/.3	9- 1-70	18.5	-	-	-	-	-	-	-	-	-	2,350	-	-	-	-	-	-	-	7,980	-	-	GS

1/ Calcium plus magnesium. 2/ Some CO_3 included as HCO_3. 3/ Composite sample from 12 springs (Railroad Springs). 4/ Estimated.

PUBLICATIONS OF THE UTAH DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER RIGHTS

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TECHNICAL PUBLICATIONS

No. 1. Underground leakage from artesian wells in the Flowell area, near Fillmore, Utah, by Penn Livingston and G. B. Maxey, U. S. Geological Survey, 1944.

No. 2. The Ogden Valley artesian reservoir, Weber County, Utah, by H. E. Thomas, U. S. Geological Survey, 1945.

*No. 3. Ground water in Pavant Valley, Millard County, Utah, by P. E. Dennis, G. B. Maxey, and H. E. Thomas, U. S. Geological Survey, 1946.

*No. 4. Ground water in Tooele Valley, Tooele County, Utah, by H. E. Thomas, U. S. Geological Survey, in Utah State Eng. 25th Bienn. Rept., p. 91-238, pls. 1-6, 1946.

*No. 5. Ground water in the East Shore area, Utah: Part I, Bountiful District, Davis County, Utah, by H. E. Thomas and W. B. Nelson, U. S. Geological Survey, in Utah State Eng. 26th Bienn. Rept., p. 53-206, pls. 1-2, 1948.

*No. 6. Ground water in the Escalante Valley, Beaver, Iron, and Washington Counties, Utah, by P. F. Fix, W. B. Nelson, B. E. Lofgren, and R. G. Butler, U. S. Geological Survey, in Utah State Eng. 27th Bienn. Rept., p. 107-210, pls. 1-10, 1950.

No. 7. Status of development of selected ground-water basins in Utah, by H. E. Thomas, W. B. Nelson, B. E. Lofgren, and R. G. Butler, U. S. Geological Survey, 1952.

*No. 8. Consumptive use of water and irrigation requirements of crops in Utah, by C. O. Roskelly and Wayne D. Criddle, 1952.

No. 8. (Revised) Consumptive use and water requirements for Utah, by W. D. Criddle, K. Harris, and L. S. Willardson, 1962.

No. 9. Progress report on selected ground water basins in Utah, by H. A. Waite, W. B. Nelson, and others, U. S. Geological Survey, 1954.

*No. 10. A compilation of chemical quality data for ground and surface waters in Utah, by J. G. Connor, C. G. Mitchell, and others, U. S. Geological Survey, 1958.

*No. 11. Ground water in northern Utah Valley, Utah: A progress report for the period 1948-63, by R. M. Cordova and Seymour Subitzky, U. S. Geological Survey, 1965.

No. 12. Reevaluation of the ground-water resources of Tooele Valley, Utah, by Joseph S. Gates, U. S. Geological Survey, 1965.

*No. 13. Ground-water resources of selected basins in southwestern Utah, by G. W. Sandberg, U. S. Geological Survey, 1966.

*No. 14. Water-resources appraisal of the Snake Valley area, Utah and Nevada, by J. W. Hood and F. E. Rush, U. S. Geological Survey, 1966.

No. 33. Hydrologic reconnaissance of Hansel Valley and northern Rozel Flat, Box Elder County, Utah, by J.W. Hood, U.S. Geological Survey, 1971.

No. 34. Summary of water resources of Salt Lake County, Utah, by Allen G. Hely, R.W. Mower, and C. Albert Harr, U.S. Geological Survey, 1971.

No. 35. Ground-water conditions in the East Shore area, Box Elder, Davis, and Weber Counties, Utah, 1960-69, by E.L. Bolke and K.M. Waddell, U.S. Geological Survey, 1972.

No. 36. Ground-water resources of Cache Valley, Utah and Idaho, by L.J. Bjorklund and L.J. McGreevy, U.S. Geological Survey, 1971.

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No. 1. Ground water in the Jordan Valley, Salt Lake County, Utah, by Ted Arnow, U. S. Geological Survey, 1965.

No. 2. Ground water in Tooele Valley, Utah, by J. S. Gates and O. A. Keller, U. S. Geological Survey, 1970.

BASIC-DATA REPORTS

*No. 1. Records and water-level measurements of selected wells and chemical analyses of ground water, East Shore area, Davis, Weber, and Box Elder Counties, Utah, by R. E. Smith, U. S. Geological Survey, 1961.

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*No. 16. Summary of water well drilling activities in Utah, 1960 through 1965, compiled by Utah State Engineer's Office, 1966.

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EXPLANATION

GEOLOGY
(See table 1)

Cenozoic

QUATERNARY

Qa — Surficial alluvial deposits
Mostly clay and silt; some gravel and scattered boulders; generally transmit water slowly

Qbm — Lake-bottom deposits
Mostly clay and silt; some very fine sand; transmit water slowly

Qbs — Lakeshore deposits
Sand and gravel in spits, bars, and on terraces; transmit water readily

TERTIARY and QUATERNARY

Qv — Valley-fill deposits
Not exposed, but underlie mapped Quaternary units in much of the area. Mostly clay or clay mixed with sand and gravel strata which yield water readily

TERTIARY

Tb — Extrusive igneous rocks
Layered basaltic lava flows with some local associated tuff deposits; interflow zones transmit water readily

Tsl — Salt Lake Formation
[illegible]

Paleozoic

MISSISSIPPIAN to PERMIAN

Ms — Sedimentary and metasedimentary rocks undivided
Mostly limestone; some sandstone, quartzite, and shale; generally transmit water slowly, but interconnected fracture zones and solution cavities transmit water readily

Approximate contact
Dashed where inferred

Fault
Dashed where concealed; dotted where inferred

Thrust fault
Barbs on side of thrust sheet

A — A'
Line of diagrammatic section

HYDROLOGY

20
Line of equal normal annual precipitation
Interval 4 inches

4300
Water-level contour
[illegible] where approximately located; contour interval 50 feet; datum is mean sea level; arrows denote direction of ground-water movement

Spring
Number by spring symbol indicates number of springs shown in the same location

Well
Open circle indicates well used for water-level control; number by symbol indicates number of wells shown in the same location

Miscellaneous stream discharge measuring site

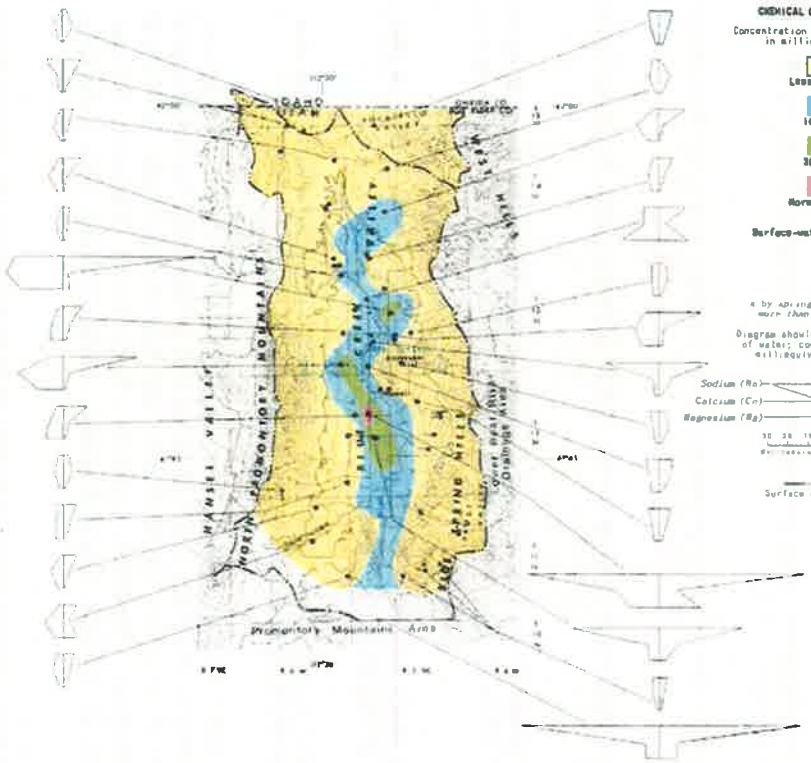
Partial-record gaging station

Surface-drainage divide

Generalized hydrogeology

Hydrogeology by E. L. Bolke and Don Price 1970. Geology adapted from Stokes (1964). Climatologic data from U.S. Weather Bureau 1967

Copyright U.S. Geological Survey
Pocatello and Brigham City 1974



EXPLANATION

CHEMICAL QUALITY OF WATER

Concentration of dissolved solids, in milligrams per liter

Less than 1000

1000–3000

3000–6000

More than 6000

Surface-water sampling site

Well

Spring
a by spring symbol indicates more than one spring area

Diagram showing chemical analyses of water; constituents given in milliequivalents per liter

Sodium (Na) — Chloride (Cl)
Calcium (Ca) — Bicarbonate (HCO_3)
Magnesium (Mg) — Sulfate (SO_4)

30 20 10 0 10 20 30

Surface drainage divide

Chemical quality of water and location of sampling sites

Compiled by E. L. Bolke and Don Price 1970

0 3 MILES
CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL

HYDROGEOLOGIC MAPS OF THE BLUE CREEK VALLEY AREA, BOX ELDER COUNTY, UTAH

ATK

July 11, 2013
8200-FY14-033

Mr. Walter L Baker, Director
Division of Water Quality
Utah Department of Environmental Quality
195 N. 1950 W.
P.O. Box 144870
Salt Lake City, Utah 84114-4870

RECEIVED
JUL 12 2013
Utah Division of Water Quality

Attention: Chris Bittner

Re: ATK Launch Systems-Promontory UPDES Permit #0024805, Blue Creek Site-Specific Standard for Total Dissolved Solids (TDS) Criterion Monitoring Report

Dear Mr. Baker:

In June 2011 ATK Launch Systems Inc. ("ATK") submitted a work plan for the development of a new site-specific TDS standard for Blue Creek. ATK, in cooperation with Chris Bittner of your staff, has completed the monitoring and data collection outlined in the work plan. Enclosed are the monitoring results and data from the sampling that was collected.

ATK appreciates the opportunity to work with the Division in the development of this new stream criterion for Blue Creek.

Please contact me if you have any questions concerning this report. My telephone number is (435)863-2018 or you can contact Blair Palmer at (435)863-2430.

Sincerely

Document Date 7/12/2013
DWQ-2013-004794

George E. Gooch, Manager
Environmental Services

1.0 Introduction

In June 2011 ATK Launch Systems Inc. submitted a work plan for use in the development of a site-specific criterion for Total Dissolved Solids (TDS) on a stream segment of Blue Creek. The stream segment of Blue Creek begins at 41°43'20.40" N, 112°26'33.58" W a location on the northern boundary of ATK's facility along Highway 83 that ATK identifies as Blue Creek Upper with the stream segment ending at the Great Salt Lake. ATK currently has two wastewater treatment discharges along this stream segment under UPDES Permit #UT0024805. (See Figures 1 & 2, Goggle Earth image) The objective of this monitoring report is to assist in the establishment of a site specific standard for the stream segment of Blue Creek from the Blue Creek Reservoir Dam flowing southward to the Great Salt Lake.

2.0 Background

Blue Creek originates approximately 8 miles north of the ATK Facility from Blue Springs. Blue Springs is a warm springs that has a TDS concentration of 2000 mg/L. The primary constituents of the TDS are sodium, chloride, and sulfate which are naturally found in the soils throughout the valley. These soils were generated from localized deposits from the ancient lake Bonneville. It is likely the source feeding the warms springs circulates slowly through these fine-grained sediments allowing these soluble minerals to leach into the groundwater.

The Blue Creek Reservoir Dam was constructed in 1904 and modified, enlarged and repaired in 1949, 1967 and 1986. The current capacity of the reservoir is about 2,185 acre-feet (UDWR, 2001). Water from Blue Springs is stored in the reservoir during the winter months and used for agricultural irrigation during the spring through fall season. The water in the reservoir is distributed by canals owned by the Blue Creek Irrigation Company. The two main canals, the East Canal and the West Canal, are used to irrigate a portion of the valley north of ATK's facility (Bolke and Price, 1972).

Several saline springs feed the main channel of Blue Creek once it leaves the Blue Creek Reservoir. These springs are the major source of flow in Blue Creek during most of the year as it passes through the ATK facility.

Prior to 1975, the stream segment of Blue Creek from the irrigation dam flowing southward was an intermittent stream only flowing significantly after rainfall events and snow melts. As a result of an earthquake in March 1975, Blue Creek became a perennial stream with year round flow resulting from the springs located below the Blue Creek Reservoir Dam.

3.0 Sampling and Investigation

The sampling and investigation was focused on determining the natural and unaltered TDS concentration for the stream segment of Blue Creek beginning at the Blue Creek Reservoir Dam flowing south to Blue Creek Upper (north boundary of ATK property, Hwy 83). This flow is predominantly made up of the springs below the dam.

ATK sampled each site identified below, once a month. During periods of transition, i.e. when conditions changed at the reservoir such as water being discharged or not discharged from the dam to Blue Creek or the irrigation channels, sampling was conducted once a week for a three week period.

- Blue Creek Reservoir below the dam;
- Blue Creek at crossing 14400 N; and
- Blue Creek Upper (north boundary of ATK property, Hwy 83).

These sites are illustrated in Figure 3 (Goggle Earth image), and are all north of the ATK facility.

The samples collected from these sites were analyzed for:

- Metals, Method 200.7 to include, Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Sn, Ti, Tl, V, Zn, Sr;
- Mercury Method 245.1;
- Total Dissolved Solids (TDS), Method 160.1; and
- Anions, Method 300 IC to include, Fluoride, Chloride, Nitrite-N, Bromide, Nitrate-N, Orthophosphate-P, Sulfate.
- Flow (gallons/minute)

During each sampling event, a visual investigation was conducted to verify if water discharged from the Blue Creek Reservoir Dam was flowing into either of the irrigation canals or if it is being discharged directly to Blue Creek.

Sampling these sites and conducting the visual investigations allowed the development of two datasets:

- When water is being discharged from the Blue Creek Reservoir Dam into the main channel of Blue Creek thereby, lowering the TDS level of Blue Creek by dilution; and
- Periods when water is being discharged from the Blue Creek Reservoir into irrigation canals with no flow going to Blue Creek, which is intended to represent natural conditions that predominate most of the year. This would represent the flow and TDS level in the main channel of Blue Creek that result from springs or seeps that occur below the reservoir dam southward.

The development of these datasets will help characterize different flow conditions, as well as allowing the coordination of the sampling and analytical results with the flow conditions.

In addition to collecting samples, a velocity meter was used to measure the average flow velocity of Blue Creek at each sample site. The water depth was measured and used to determine a cross sectional area of the channel at each site providing an estimate for flow in gallons per minute. The flow measurements were used to determine if TDS concentrations correlated with the changing flows over the course of a year.

Field electrical conductivity measurements were also taken from several sources that flow to Blue Creek during a multi-day sampling event. These sources originate from springs and seeps in the property adjacent to Blue Creek as it flows from the reservoir below the dam to the Blue Creek Upper (north boundary of ATK property, Hwy 83) site (see figures 4 & 5). These electrical conductivity measurements were then correlated to calculate TDS concentrations and can be seen in Table 1.

4.0 Sampling Results

Sampling and visual investigations began April 14, 2011 and have been completed monthly for the past two years. The TDS concentrations of each sampling event have been collected over the course of that time and can be found in Table 2. This data has been plotted in Figure 6 to illustrate seasonal trends in concentrations.

Figure 6 shows the plotted results of the TDS concentrations for each of the sampling sites along with correlating flow measurements. The chart has been color coded to distinguish the two datasets listed on the previous page. The time period where Blue Creek was receiving additional flow from the dam is

highlighted in blue. The time period when Blue Creek receives no flow from the dam is highlighted in yellow.

Concentrations have also been color coded to match the measured flow for each site to help decipher which concentration belongs to which flow reading. It can be seen that the flow in Blue Creek does not correlate with the TDS concentrations measured at each site along the stream. TDS concentrations below the dam remain consistent at around 2,000 mg/L while the Upper site and Crossing site show a greater deviation in concentrations and continuously fluctuate over the course of a year, however, they do show TDS levels increase due to the influence of the high TDS springs.

The variation in TDS concentrations and lack of correlation with flow data is most likely the combination of seasonal weather patterns and upstream irrigation practices. Due to the ever changing dynamics of the stream it is difficult to distinguish a specific dataset that would be considered the "natural and unaltered" state for the entire length of Blue Creek. As a result, the focus of the investigation has been directed toward determining the 95% Upper Tolerance Limit (UTL) based on data collected from the Blue Creek Upper site.

ProUCL 4.1 was used to calculate the 95% UTL of 5,918 mg/L for the Blue Creek Upper dataset found in column 4 of Table 2. The same method was used to calculate a second 95% UTL for historical data previously collected each quarter at the Upper site from year 2000 to year 2010. The results from the historical data showed a 95% UTL of 6,123 mg/L. Both levels are much higher than the current standard of 1,200 mg/L set for Blue Creek.

Electrical conductivity measurements taken from several sources that discharge to Blue Creek are identified in Figures 4 and 5 along with Table 1. The conductivity measurements show that those sources have higher levels of TDS than the average concentrations measured at the Upper site. This demonstrates that the high levels of TDS measured in Blue Creek are a result of naturally occurring saline springs that contribute to the TDS loading after the dam and prior to entering ATK property.

The high TDS levels seen in the upstream sources are consistent with concentrations found in groundwater wells and other springs in the area. Historical groundwater monitoring data shows TDS concentrations in wells located in the valley near Blue Creek range from 2,800 mg/L to 8,800 mg/L. Samples taken from nearby springs have TDS concentrations ranging from 4,500 mg/L to 7,170 mg/L. Therefore, it can be seen that the groundwater feeding the springs contributing to the flow of Blue Creek is naturally high in TDS.

5.0 Summary and Conclusions

The objective of this monitoring report is to assist in the establishment of a site specific standard for the stream segment of Blue Creek from the Blue Creek Reservoir Dam flowing southward to the Great Salt Lake. Through the sampling and investigation that was conducted, TDS concentrations, and the concentrations of the individual water constituents that contribute to the Blue Creek TDS have been sampled and monitored along with the different stream flow conditions that occur in Blue Creek. This information will allow a site-specific standard for TDS in Blue Creek to be established that represents the natural and unaltered TDS concentration that is protective of current uses.

ATK believes that the sampling and monitoring that has been completed is sufficient to allow the establishment of a site specific standard for the TDS in Blue Creek. The 95% upper tolerance limits for data from the time period of 2011-2013 and 2000-2010 are 5,918 mg/L and 6,123 mg/L respectively.

Figure 1. Point of Proposed Site Specific Standard for Blue Creek

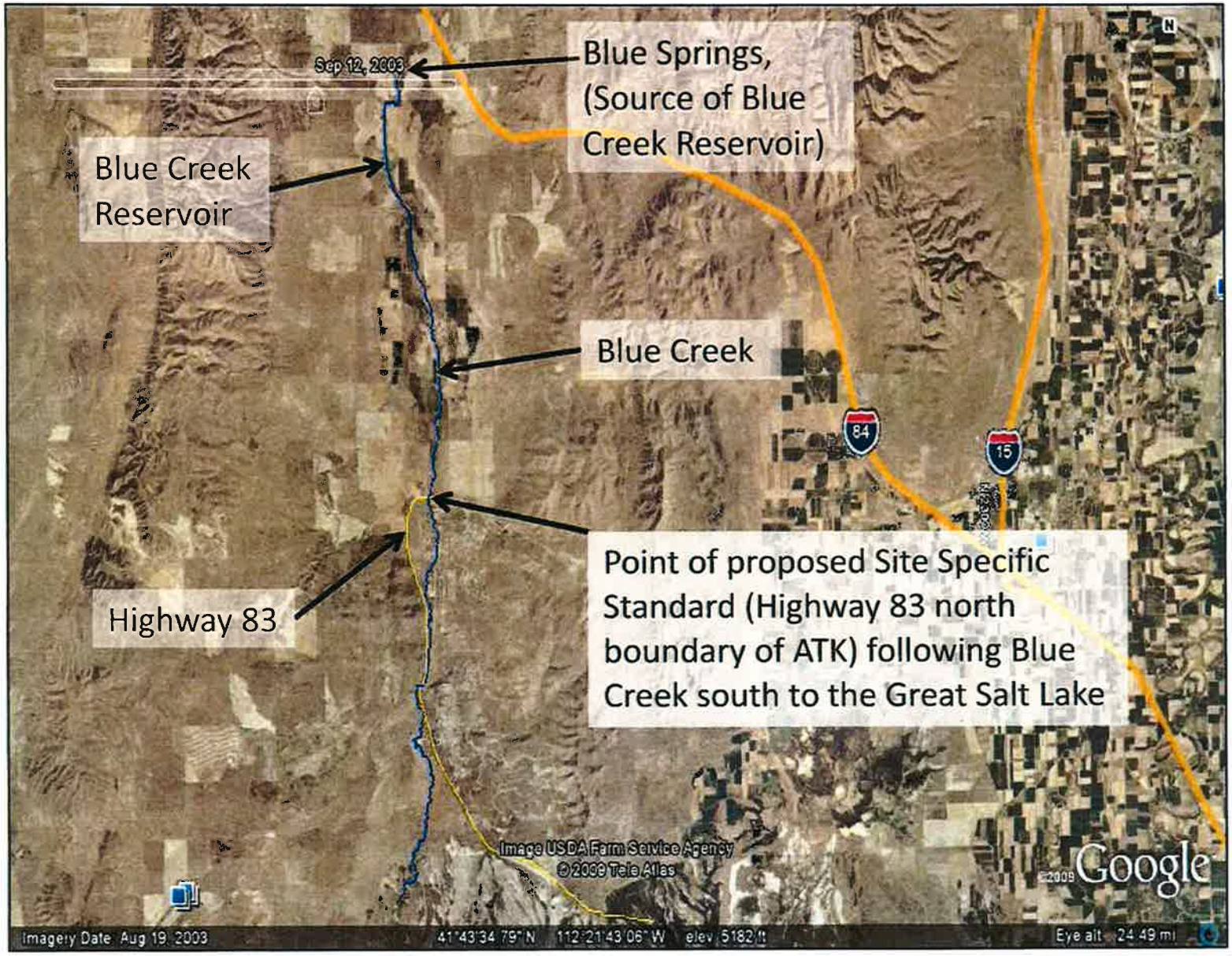


Figure 2. ATK Outfall Locations

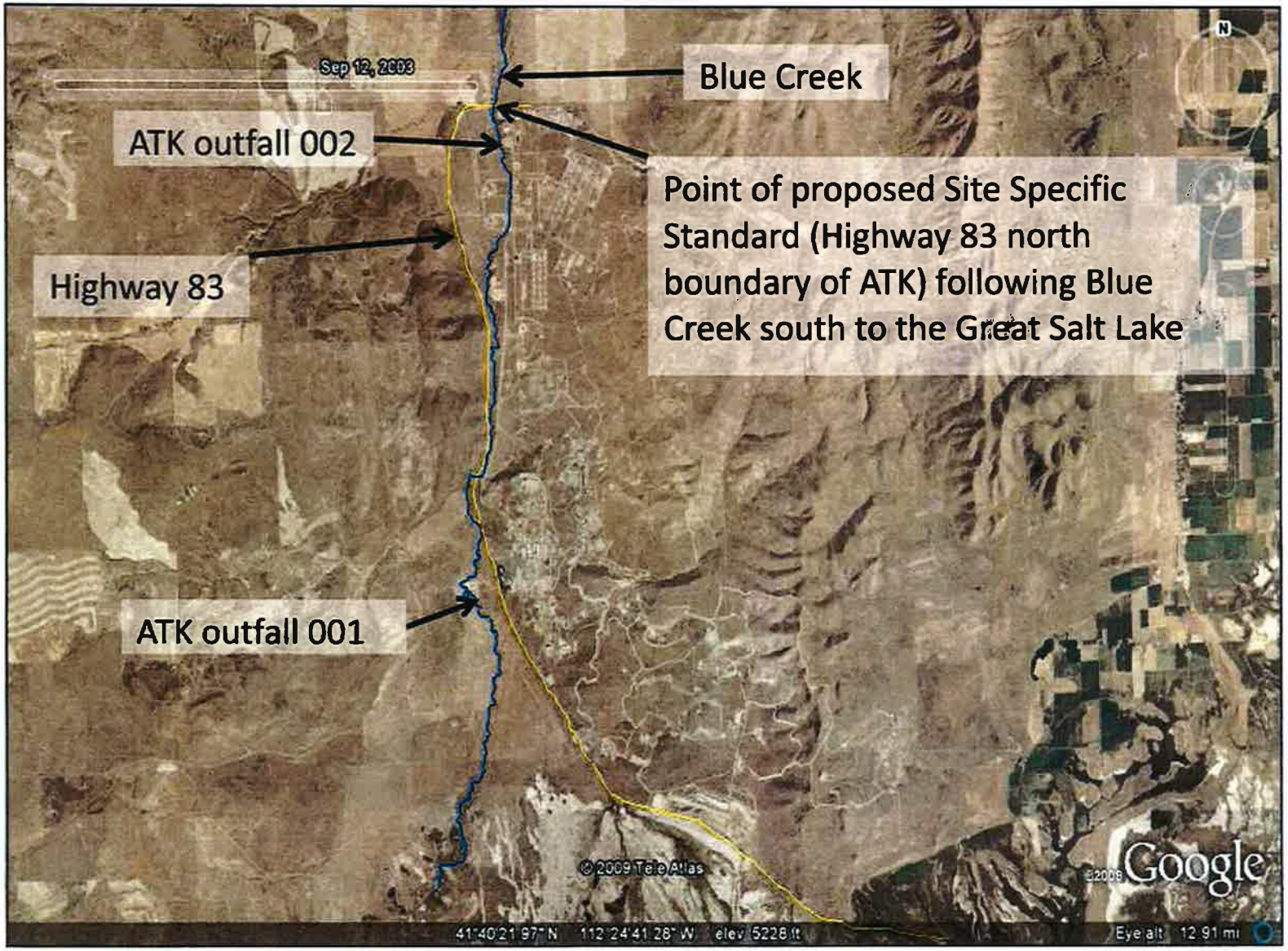


Figure 3. Blue Creek Source and Sample Sites

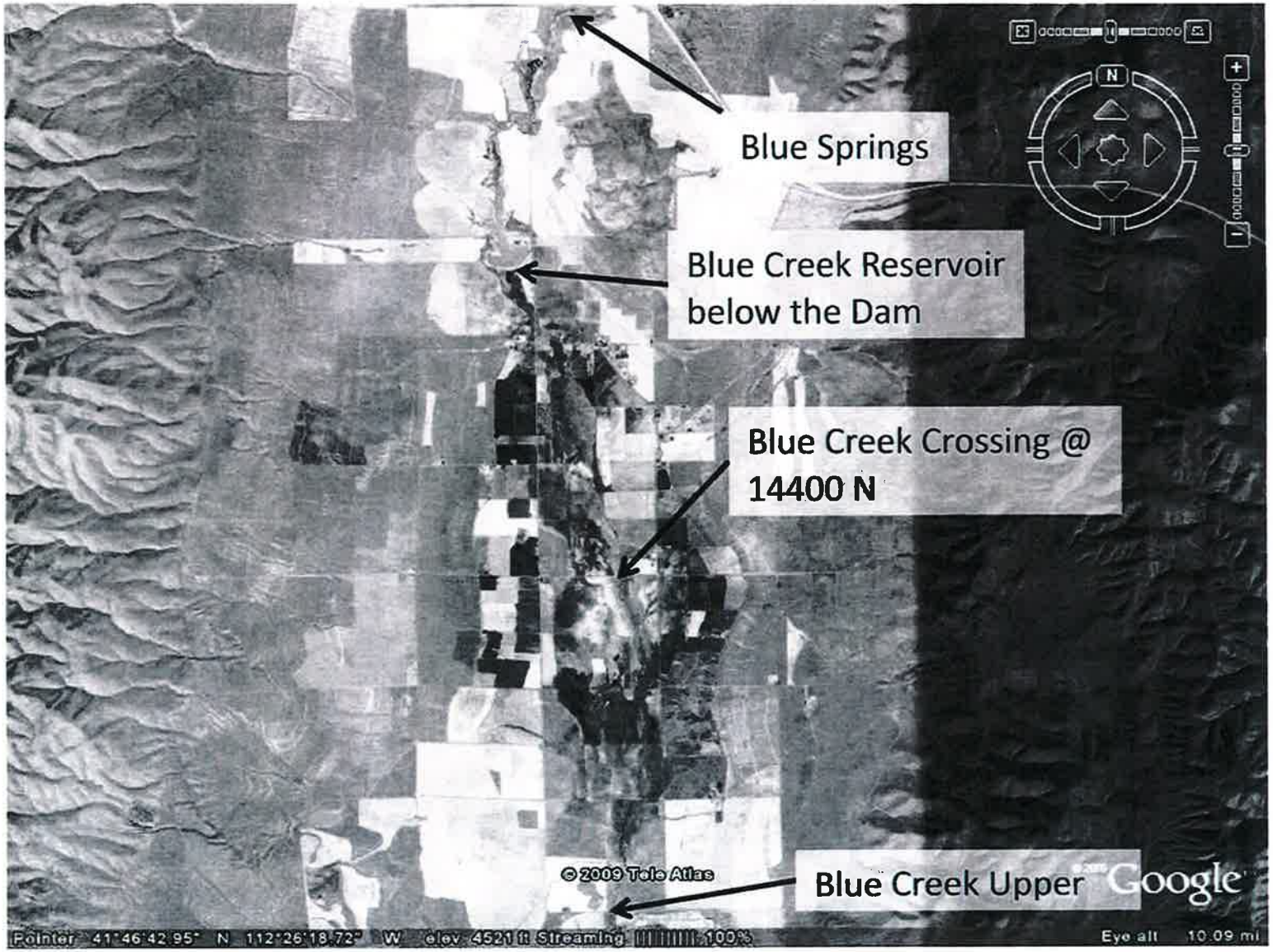


Figure 4. Conductivity Sample Sites of Blue Creek Sources

Figure 5. Conductivity Sample Sites of Blue Creek Sources (Continued)

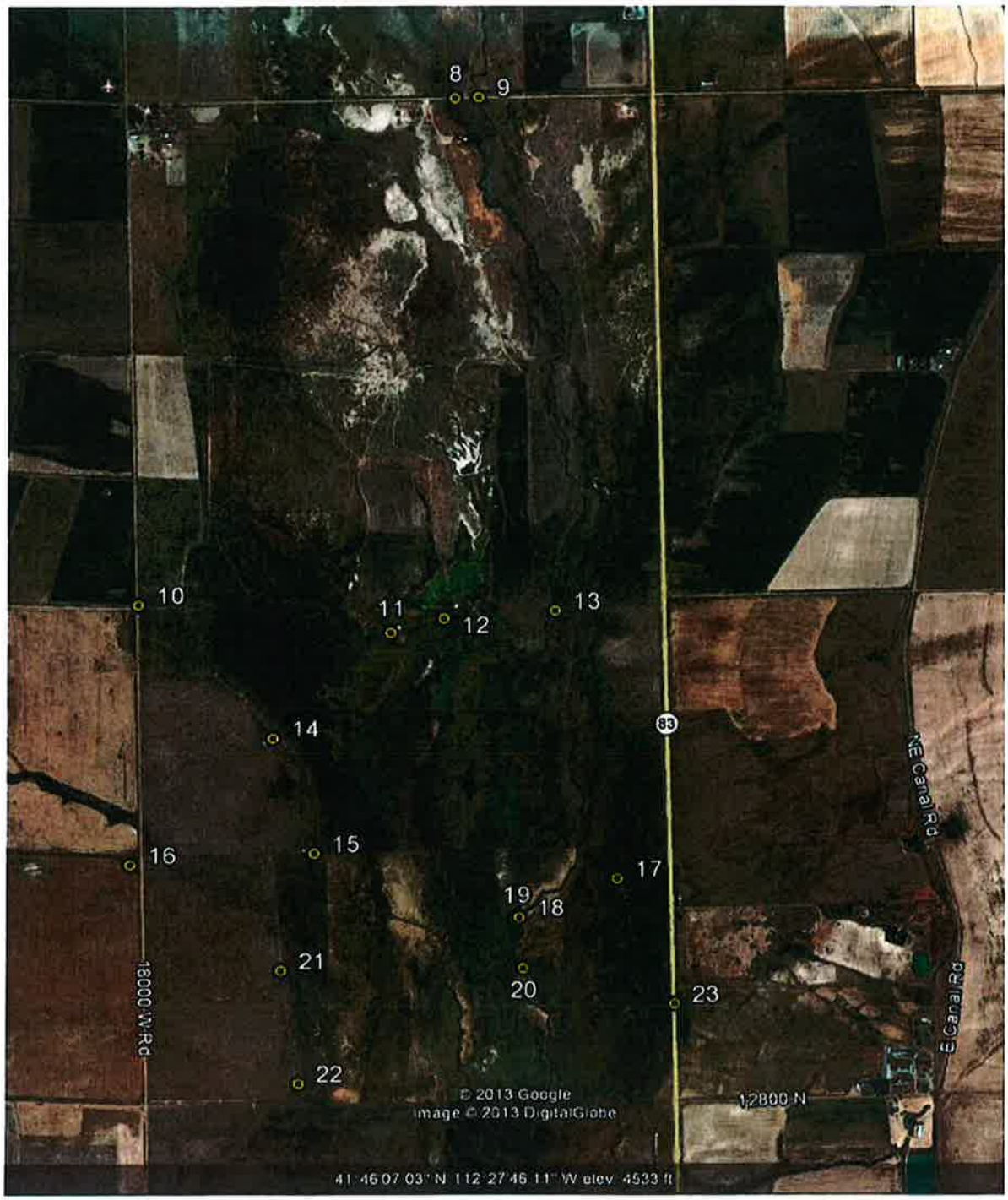


Table 1. Conductivity Sample Site Descriptions and Concentrations

Sample Point	Site Description	Concentration (mg/L)	Sample Point	Site Description	Concentration (mg/L)
1	Below Dam	2,260	13	Cornwall Blue Creek	4,290
2	Blue Creek at Diversion	2,340	14	Cornwall 4	5,950
3	Sorensen 1	3,170	15	Cornwall 3	4,960
4	Irrigation (no sample)	-	16	Snowmelt	-
5	Sorensen 4	2,900	17	Douglass 2	5,050
6	Sorensen 3	5,690	18	Douglass 3.5	28,200
7	Odel 2	3,770	19	Douglass 3	31,300
8	Odel 1	3,840	20	Douglass 1	9,390
9	Blue Creek Crossing	9,320	21	Cornwall 2	4,930
10	Odel 3	448	22	Cornwall 1	4,800
11	Cornwall Pond	6,320	23	East Culvert	4,350
12	Odell's Discharge	6,330			

Table 2. TDS Concentrations from Blue Creek Study (mg/L)

Sample Date	Below Dam	Crossing	Upper
4-14-2011	1,890	3,350	5,270
5-26-2011	1,920	2,600	2,260
6-8-2011	1,910	3,370	3,930
7-26-2011	2,090	2,820	3,380
8-16-2011	1,990	3,310	3,230
9-29-2011	1,980	3,220	3,780
10-21-2011	1,960	4,020	4,260
11-17-2011	2,030	4,160	3,380
12-20-2011	2,080	3,740	4,850
1-27-2012	2,070	3,140	4,570
2-1-2012	2,020	3,140	4,550
2-9-2012	2,040	2,900	4,210
2-16-2012	2,030	3,310	4,890
3-19-2012	1,940	2,470	4,160
4-16-2012	2,070	5,060	6,270
4-23-2012	1,910	3,490	4,710
4-30-2012	1,990	3,410	4,730
5-7-2012	1,990	3,650	4,350
6-4-2012	1,990	2,930	3,720
7-10-2012	2,060	3,040	4,230
8-8-2012	2,110	3,220	2,980
9-5-2012	2,100	3,780	4,140
10-5-2012	2,050	3,120	3,760
11-5-2012	1,990	3,510	3,620
12-6-2012	1,920	4,670	5,630
1-14-2013	2,020	2,840	4,210
1-22-2013	2,100	2,810	4,050
1-30-2013	2,009	2,870	4,180
2-7-2013	2,009	2,640	5,170
3-4-2013	2,009	2,870	5,370
4-1-2013	1,990	2,980	4,260
5-7-2013	1,970	3,080	4,250
Average	2,009	3,298	4,261
95% UTL	2,115	4,315	5,918

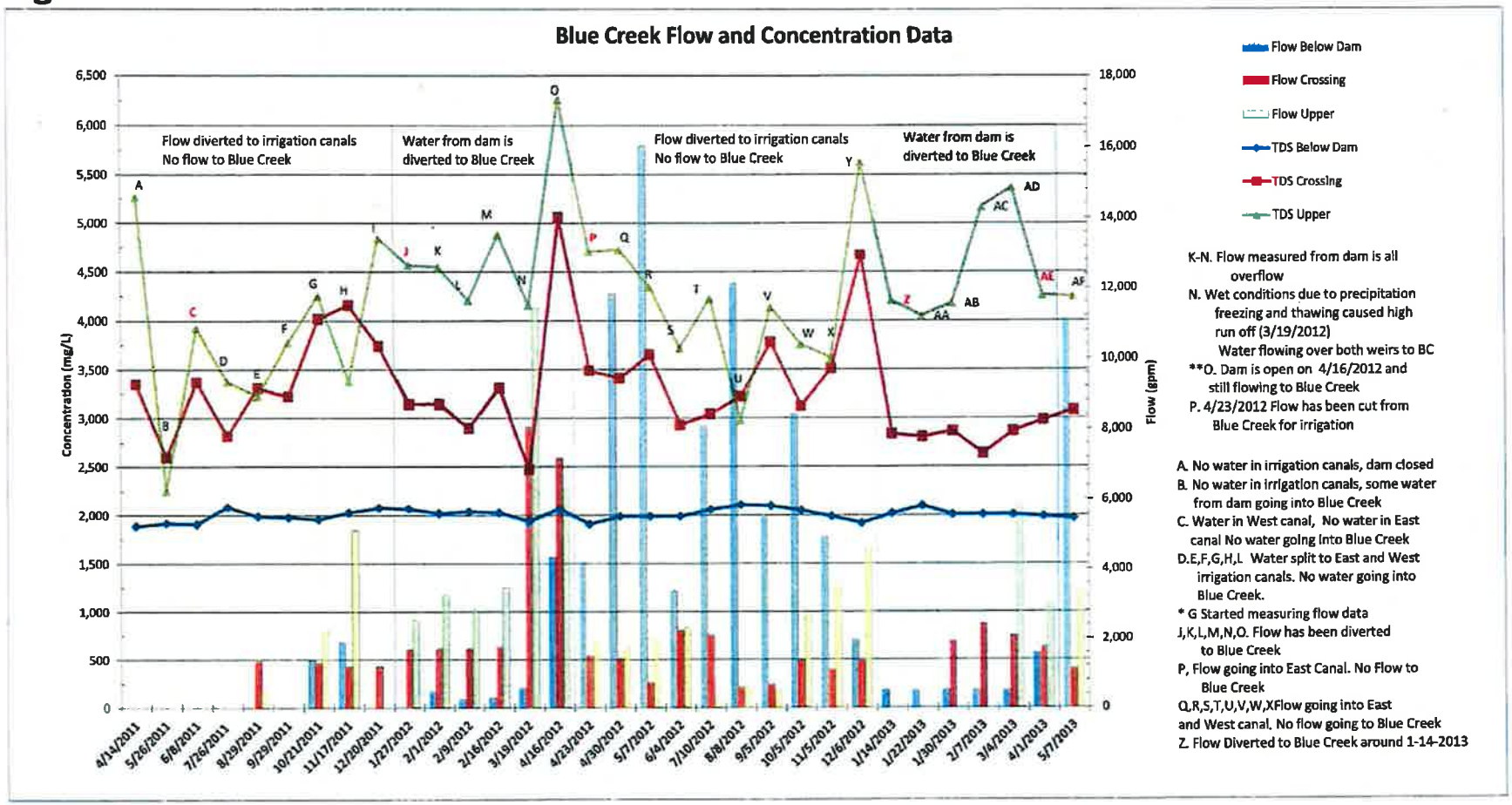
Table 3. ProUCL Results for 2010-2013 Upper Site Concentrations

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2,000
Log-Transformed Statistics	
Number of Valid Observations	32
Number of Distinct Observations	29
Minimum	7.723
Maximum	8.744
Second Largest	8.636
Mean	8.339
First Quartile	8.236
Median	8.348
Third Quartile	8.459
SD	0.198
Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.959
5% Shapiro Wilk Critical Value	0.93
Background Statistics Assuming Lognormal Distribution	
90% Percentile (z)	5,395
95% Percentile (z)	5,797
99% Percentile (z)	6,636
95% UPL	5,887
Tolerance Factor K	1.75
95% UTL with 90% Coverage	**5,918**
Some Nonparametric Background Statistics	
95% Chebyshev UPL	7,814
95% Bootstrap BCA UTL with 90% Coverage	5,604
95% Percentile Bootstrap UTL with 90% Coverage	5,604

Table 4. ProUCL Results for 2000-2010 Upper Site Concentrations

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2000
Log-Transformed Statistics	
Number of Valid Observations	43
Number of Distinct Observations	40
Minimum	7.99
Maximum	8.753
Second Largest	8.723
Mean	8.341
First Quartile	8.162
Median	8.324
Third Quartile	8.5
SD	0.226
Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.938
5% Shapiro Wilk Critical Value	0.943
Background Statistics Assuming Lognormal Distribution	
90% Percentile (z)	5,604
95% Percentile (z)	6,084
99% Percentile (z)	7,098
95% UPL	6,162
Tolerance Factor K	1.67
95% UTL with 90% Coverage	**6,123**
Some Nonparametric Background Statistics	
95% Chebyshev UPL	8,690
95% Bootstrap BCA UTL with 90% Coverage	5,990
95% Percentile Bootstrap UTL with 90% Coverage	6,050

Figure 6.


Blue Creek Flow and Concentration Data
Flow diverted to irrigation canals
No flow to Blue Creek
Water from dam is
diverted to Blue Creek
Flow diverted to irrigation canals
No flow to Blue Creek
Water from dam is
diverted to Blue Creek
Concentration (mg/L)
Flow (gpm)
Flow Below Dam
Flow Crossing
Flow Upper
TDS Below Dam
TDS Crossing
TDS Upper
K-N. Flow measured from dam is all overflow
N. Wet conditions due to precipitation freezing and thawing caused high run off (3/19/2012)
Water flowing over both weirs to BC
**O. Dam is open on 4/16/2012 and still flowing to Blue Creek
P. 4/23/2012 Flow has been cut from Blue Creek for irrigation
A. No water in irrigation canals, dam closed
B. No water in irrigation canals, some water from dam going into Blue Creek
C. Water in West canal, No water in East canal No water going into Blue Creek
D.E,F,G,H,I. Water split to East and West irrigation canals. No water going into Blue Creek.
* G Started measuring flow data
J,K,L,M,N,O. Flow has been diverted to Blue Creek
P, Flow going into East Canal. No Flow to Blue Creek
Q,R,S,T,U,V,W,XFlow going into East and West canal. No flow going to Blue Creek
Z. Flow Diverted to Blue Creek around 1-14-2013

References

Bolke, E.L. and Price D. 1972. Hydrologic Reconnaissance of the Blue Creek Valley Area, Box Elder County, Utah. Utah Department of Natural Resources Technical Publication No. 37.

UDWR (Utah Division of Water Resources). 2001. Utah State Water Plan, West Desert Basin, Salt Lake City, Utah. 3-17p.

DATE SAMPLED	BCBD TDS mg/l	BCCr TDS mg/l	BCU TDS mg/l	BCCr Flow gpm	BCU Flow gpm	BCBD Flow gpm	Flow Code
04/14/11	1890	3350	5270				I
05/26/11	1920	2600	2260				I
06/08/11	1910	3370	3930				I
07/26/11	2090	2820	3380				I
08/29/11	1990	3310	3230	1346.49	586.3403	507.1139	I
09/29/11	1980	3220	3780			254.8779	I
10/21/11	1960	4020	4260	1309.088	2274.60	293.4957	I
11/17/11	2030	4160	3380	1196.88	5117.13	578.8956	I
12/20/11	2080	3740	4850	1196.88		537.5459	I
01/02/12	2070	3140	4570	1705.554	2536.78	454.8466	B
02/01/12	2020	3140	4550	1720.515	3283.90	468.6298	B
02/09/12	2040	2900	4210	1720.515	2857.21	509.9795	B
02/16/12	2030	3310	4890	1795.32	3460.19	0	B
03/19/12	1940	2470	4160	8078.94	11438.42	0	B
04/16/12	2070	5060	6270	7181.28	6329.72	0	B
04/23/12	1910	3490	4710	1496.1	1873.20	0.00	I
04/30/12	1990	3410	4730	1433.763	1739.40	0	I
05/07/12	1990	3650	4350	748.05	2032.89	0	I
06/04/12	1990	2930	3720	2244.15	2319.20	0	I
07/10/12	2060	3040	4230	2119.475	330.22	0	I
08/08/12	2110	3220	2980	623.375	645.16	0	I
09/05/12	2100	3780	4140	698.18	495.34	0	I
10/05/12	2050	3120	3760	1371.425	2658.40	0	I
11/05/12	1990	3510	3620	1122.075	3652.42	0	I
12/06/12	1920	4670	5630	1371.425	4606.01	1582.062	I
01/14/13	2020	2840	4210	0	0.00	1676.045	B
01/22/13	2100	2810	4050	0	0.00	516.7185	B
01/30/13		2870	4180	1944.93	0.00	516.7185	B
02/07/13		2640	5170	2431.163	0.00	516.7185	B
03/04/13		2870	5370	2094.54	5887.21	516.7185	B
04/01/13	1990	2980	4260	1782.853	3025.28	1582.062	B
05/07/13	1970	3080	4250	1134.543	3373.29	11162	B

CLIENT_SAMPLE_ID	SAMPLED_DATE	TEST	ANALYTE	RESULT	FLAG	UNIT	ANALYSIS_DATE	MDL	EQL	DILUTION
C8632 - Blue Creek Upper	02/04/2010	TDS 160.1	Total Dissolved Solids	5700		mg/L	02/08/2010	19.8	40	1
C8635 - Blue Creek Upper Grab	02/17/2010	TDS 160.1	Total Dissolved Solids	6330		mg/L	02/23/2010	19.8	40	1
C8638 - Blue Creek Upper Grab	02/24/2010	TDS 160.1	Total Dissolved Solids	5620		mg/L	03/02/2010	19.8	40	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Ag	0. U	U	ug/L	02/15/2010	1	5	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Ag	-2.1 U	U	ug/L	02/24/2010	1	5	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Ag	0. U	U	ug/L	03/09/2010	1	5	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Al	2860.		ug/L	02/15/2010	10	50	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Al	2570.		ug/L	02/24/2010	10	50	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Al	1570.		ug/L	03/09/2010	10	50	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	As	0. U	U	ug/L	02/15/2010	10	50	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	As	-91. U	U	ug/L	02/24/2010	10	50	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	As	0. U	U	ug/L	03/09/2010	10	50	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Bx	662.		ug/L	02/15/2010	10	50	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Bx	880.		ug/L	02/24/2010	10	50	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Bx	783.		ug/L	03/09/2010	10	50	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Ba	142.		ug/L	02/15/2010	2	10	1

C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Ba	133.		ug/L	02/24/2010	2	10	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Ba	125.		ug/L	03/09/2010	2	10	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Be	0. U	U	ug/L	02/15/2010	0.5	2.5	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Be	0. U	U	ug/L	02/24/2010	0.5	2.5	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Be	0. U	U	ug/L	03/09/2010	0.5	2.5	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Ca	163000.		ug/L	02/15/2010	30	150	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Ca	166000.		ug/L	02/24/2010	30	150	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Ca	156000.		ug/L	03/09/2010	30	150	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Cd	0. U	U	ug/L	02/15/2010	1	5	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Cd	0.7 U	U	ug/L	02/24/2010	1	5	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Cd	0. U	U	ug/L	03/09/2010	1	5	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Co	0. U	U	ug/L	02/15/2010	1	5	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Co	-5.9 U	U	ug/L	02/24/2010	1	5	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Co	0. U	U	ug/L	03/09/2010	1	5	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Cr	0. U	U	ug/L	02/15/2010	10	50	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Cr	3. U	U	ug/L	02/24/2010	10	50	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Cr	0. U	U	ug/L	03/09/2010	10	50	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Cu	0. U	U	ug/L	02/15/2010	2	10	1

C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Cu	1. U	U	ug/L	02/24/2010	2	10	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Cu	0. U	U	ug/L	03/09/2010	2	10	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Fe	2580.		ug/L	02/15/2010	20	100	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Fe	2050.		ug/L	02/24/2010	20	100	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Fe	1290.		ug/L	03/09/2010	20	100	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	K	62100.		ug/L	02/15/2010	100	500	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	K	73100.		ug/L	02/24/2010	100	500	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	K	70400.		ug/L	03/09/2010	100	500	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Mg	85700.		ug/L	02/15/2010	10	50	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Mg	95200.		ug/L	02/24/2010	10	50	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Mg	79700.		ug/L	03/09/2010	10	50	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Mn	442.		ug/L	02/15/2010	1	5	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Mn	471.		ug/L	02/24/2010	1	5	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Mn	414.		ug/L	03/09/2010	1	5	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Mo	0. U	U	ug/L	02/15/2010	1	5	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Mo	-3.2 U	U	ug/L	02/24/2010	1	5	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Mo	0. U	U	ug/L	03/09/2010	1	5	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Na	2050000.		ug/L	02/15/2010	300	1500	50

C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Na	2180000.		ug/L	02/24/2010	300	1500	50
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Na	2060000.		ug/L	03/09/2010	300	1500	25
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Ni	0. U	U	ug/L	02/15/2010	5	25	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Ni	6.8 J	J	ug/L	02/24/2010	5	25	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Ni	6.1 J	J	ug/L	03/09/2010	5	25	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Px	0. U	U	ug/L	02/15/2010	20	100	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Px	418.		ug/L	02/24/2010	20	100	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Px	38. J	J	ug/L	03/09/2010	20	100	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Pb	0. U	U	ug/L	02/15/2010	20	100	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Pb	-16. U	U	ug/L	02/24/2010	20	100	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Pb	0. U	U	ug/L	03/09/2010	20	100	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Sb	0. U	U	ug/L	02/15/2010	20	100	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Sb	48. J	J	ug/L	02/24/2010	20	100	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Sb	0. U	U	ug/L	03/09/2010	20	100	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Se	0. U	U	ug/L	02/15/2010	10	50	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Se	-44. U	U	ug/L	02/24/2010	10	50	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Se	0. U	U	ug/L	03/09/2010	10	50	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Sn	0. U	U	ug/L	02/15/2010	30	150	1

C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Sn	-140. U	U	ug/L	02/24/2010	30	150	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Sn	0. U	U	ug/L	03/09/2010	30	150	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Ti	85.9		ug/L	02/15/2010	0.5	2.5	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Ti	112.		ug/L	02/24/2010	0.5	2.5	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Ti	40.		ug/L	03/09/2010	0.5	2.5	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Tl	0. U	U	ug/L	02/15/2010	10	50	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Tl	51.		ug/L	02/24/2010	10	50	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Tl	0. U	U	ug/L	03/09/2010	10	50	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	V	98.		ug/L	02/15/2010	5	25	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	V	99.4		ug/L	02/24/2010	5	25	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	V	96.7		ug/L	03/09/2010	5	25	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Zn	21. J	J	ug/L	02/15/2010	10	50	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Zn	18. J	J	ug/L	02/24/2010	10	50	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Zn	21. J	J	ug/L	03/09/2010	10	50	1
C8632 - Blue Creek Upper	02/04/2010	200.7 Metals	Sr	5900.		ug/L	02/15/2010	1	5	1
C8635 - Blue Creek Upper Grab	02/17/2010	200.7 Metals	Sr	5760.		ug/L	02/24/2010	1	5	1
C8638 - Blue Creek Upper Grab	02/24/2010	200.7 Metals	Sr	5460.		ug/L	03/09/2010	1	5	1
C8632 - Blue Creek Upper	02/04/2010	Hg 245.1	Hg	-0. U	U	ug/L	02/10/2010	0.3	1	1

C8635 - Blue Creek Upper Grab	02/17/2010	Hg 245.1	Hg	-0. U	U	ug/L	02/22/2010	0.3	1	1
C8638 - Blue Creek Upper Grab	02/24/2010	Hg 245.1	Hg	-0. U	U	ug/L	03/09/2010	0.3	1	1
C8632 - Blue Creek Upper	02/04/2010	IC 300.0 Anions	Fluoride	3.89		mg/L	02/05/2010	0.02	0.2	10
C8635 - Blue Creek Upper Grab	02/17/2010	IC 300.0 Anions	Fluoride	2.4 J	J	mg/L	03/02/2010	0.02	0.2	25
C8638 - Blue Creek Upper Grab	02/24/2010	IC 300.0 Anions	Fluoride	2.4		mg/L	03/09/2010	0.02	0.2	10
C8632 - Blue Creek Upper	02/04/2010	IC 300.0 Anions	Chloride	2450.		mg/L	02/05/2010	0.03	0.2	100
C8635 - Blue Creek Upper Grab	02/17/2010	IC 300.0 Anions	Chloride	2730.		mg/L	03/02/2010	0.03	0.2	100
C8638 - Blue Creek Upper Grab	02/24/2010	IC 300.0 Anions	Chloride	2610.		mg/L	03/09/2010	0.03	0.2	250
C8632 - Blue Creek Upper	02/04/2010	IC 300.0 Anions	Nitrite-N	0. U	U	mg/L	02/05/2010	0.03	0.2	10
C8635 - Blue Creek Upper Grab	02/17/2010	IC 300.0 Anions	Nitrite-N	0. U	U	mg/L	03/02/2010	0.03	0.2	1
C8638 - Blue Creek Upper Grab	02/24/2010	IC 300.0 Anions	Nitrite-N	0. U	U	mg/L	03/09/2010	0.03	0.2	10
C8632 - Blue Creek Upper	02/04/2010	IC 300.0 Anions	Bromide	1.8 J	J	mg/L	02/05/2010	0.05	0.2	10
C8635 - Blue Creek Upper Grab	02/17/2010	IC 300.0 Anions	Bromide	1.7		mg/L	03/02/2010	0.05	0.2	1
C8638 - Blue Creek Upper Grab	02/24/2010	IC 300.0 Anions	Bromide	1.55		mg/L	03/09/2010	0.05	0.2	1
C8632 - Blue Creek Upper	02/04/2010	IC 300.0 Anions	Nitrate-N	0.54 J	J	mg/L	02/05/2010	0.03	0.2	10
C8635 - Blue Creek Upper Grab	02/17/2010	IC 300.0 Anions	Nitrate-N	0.43		mg/L	03/02/2010	0.03	0.2	1
C8638 - Blue Creek Upper Grab	02/24/2010	IC 300.0 Anions	Nitrate-N	0.42		mg/L	03/09/2010	0.03	0.2	1
C8632 - Blue Creek Upper	02/04/2010	IC 300.0 Anions	Orthophosphate-P	0. U	U	mg/L	02/05/2010	0.03	0.2	10

C8635 - Blue Creek Upper Grab	02/17/2010	IC 300.0 Anions	Orthophosphate-P	0.33 U	U	mg/L	03/02/2010	0.03	0.2	100
C8638 - Blue Creek Upper Grab	02/24/2010	IC 300.0 Anions	Orthophosphate-P	0.16 J	J	mg/L	03/09/2010	0.03	0.2	1
C8632 - Blue Creek Upper	02/04/2010	IC 300.0 Anions	Sulfate	479.		mg/L	02/05/2010	0.03	0.2	100
C8635 - Blue Creek Upper Grab	02/17/2010	IC 300.0 Anions	Sulfate	571.		mg/L	03/02/2010	0.03	0.2	100
C8638 - Blue Creek Upper Grab	02/24/2010	IC 300.0 Anions	Sulfate	477.		mg/L	03/09/2010	0.03	0.2	250

LAB_SAMPLE_ID	FIELD_SAMPLE_ID	METHOD	ANALYTE	MATRIX	RESULT	UNITS	BATCH_ID	DATE SAMPLED	ANALYSIS DATE	CAS NUMBER	MDL	EQL	U DILUTION
1104014-01	C8690 - Blue Creek Upper	EPA 160.1	TOTAL	Water	5270	mg/L	WS1104-072	14-Apr-11	21-Apr-11		19.8	40	1
1104014-02	C8691 - Blue Creek Crossing	EPA 160.1	TOTAL	Water	3350	mg/L	WS1104-072	14-Apr-11	21-Apr-11		19.8	40	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 160.1	TOTAL	Water	1890	mg/L	WS1104-072	14-Apr-11	21-Apr-11		19.8	40	1
1105032-01	C8697 - Blue Creek Crossing	EPA 160.1	TOTAL	Water	2600	mg/L	WS1106-007	26-May-11	02-Jun-11		19.8	40	1
1105032-02	C8698 - Blue Creek Upper	EPA 160.1	TOTAL	Water	2260	mg/L	WS1106-007	26-May-11	02-Jun-11		19.8	40	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 160.1	TOTAL	Water	1920	mg/L	WS1106-007	26-May-11	02-Jun-11		19.8	40	1
1106015-01	C8702 - Blue Creek Upper	EPA 160.1	TOTAL	Water	3930	mg/L	WS1106-031	08-Jun-11	22-Jun-11		19.8	40	1
1106015-02	C8703 - Blue Creek Crossing	EPA 160.1	TOTAL	Water	3370	mg/L	WS1106-031	08-Jun-11	22-Jun-11		19.8	40	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 160.1	TOTAL	Water	1910	mg/L	WS1106-031	08-Jun-11	22-Jun-11		19.8	40	1
1107032-01	C8709 - Blue Creek Upper	EPA 160.1	TOTAL	Water	3380	mg/L	WS1108-011	26-Jul-11	04-Aug-11		19.8	40	1
1107032-02	C8710 - Blue Creek Crossing	EPA 160.1	TOTAL	Water	2820	mg/L	WS1108-011	26-Jul-11	04-Aug-11		19.8	40	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 160.1	TOTAL	Water	2090	mg/L	WS1108-011	26-Jul-11	04-Aug-11		19.8	40	1
1108026-01	C8716 - Blue Creek Upper	EPA 160.1	TOTAL	Water	3230	mg/L	WS1109-003	29-Aug-11	01-Sep-11		19.8	40	1
1108026-02	C8717 - Blue Creek Crossing	EPA 160.1	TOTAL	Water	3310	mg/L	WS1109-003	29-Aug-11	01-Sep-11		19.8	40	1
1108026-03	C8718 - Blue Creek Below Dam	EPA 160.1	TOTAL	Water	1990	mg/L	WS1109-003	29-Aug-11	01-Sep-11		19.8	40	1
1110003-01	C8722 - Blue Creek Upper	EPA 160.1	TOTAL	Water	3780	mg/L	WS1110-007	29-Sep-11	05-Oct-11		19.8	40	1
1110003-02	C8723 - Blue Creek Crossing	EPA 160.1	TOTAL	Water	3220	mg/L	WS1110-007	29-Sep-11	05-Oct-11		19.8	40	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 160.1	TOTAL	Water	1980	mg/L	WS1110-007	29-Sep-11	05-Oct-11		19.8	40	1
1110027-01	C8728 - Blue Creek Upper	EPA 160.1	TOTAL	Water	4260	mg/L	WS1110-035	21-Oct-11	25-Oct-11		19.8	40	1
1110027-02	C8729 - Blue Creek Crossing	EPA 160.1	TOTAL	Water	4020	mg/L	WS1110-035	21-Oct-11	25-Oct-11		19.8	40	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 160.1	TOTAL	Water	1960	mg/L	WS1110-035	21-Oct-11	25-Oct-11		19.8	40	1
1111013-01	C8733 - Blue Creek Upper	EPA 160.1	TOTAL	Water	3380	mg/L	WS1111-031	17-Nov-11	22-Nov-11		19.8	40	1
1111013-02	C8734 - Blue Creek Crossing	EPA 160.1	TOTAL	Water	4160	mg/L	WS1111-031	17-Nov-11	22-Nov-11		19.8	40	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 160.1	TOTAL	Water	2030	mg/L	WS1111-031	17-Nov-11	22-Nov-11		19.8	40	1
1112019-01	C8740 - Blue Creek Upper	EPA 160.1	TOTAL	Water	4850	mg/L	WS1112-035	20-Dec-11	21-Dec-11		19.8	40	1
1112019-02	C8741 - Blue Creek Crossing	EPA 160.1	TOTAL	Water	3740	mg/L	WS1112-035	20-Dec-11	21-Dec-11		19.8	40	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 160.1	TOTAL	Water	2080	mg/L	WS1112-035	20-Dec-11	21-Dec-11		19.8	40	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	ALUMINU	Water	6510.	ug/L	WS1106-001	26-May-11	02-Jun-11	7429-90-5	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	ALUMINU	Water	2990.	ug/L	WS1106-001	26-May-11	02-Jun-11	7429-90-5	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	ALUMINU	Water	309.	ug/L	WS1106-001	26-May-11	02-Jun-11	7429-90-5	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	ALUMINU	Water	2650.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7429-90-5	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	ALUMINU	Water	1090.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7429-90-5	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	ALUMINU	Water	528.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7429-90-5	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	ALUMINU	Water	2140.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7429-90-5	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	ALUMINU	Water	232.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7429-90-5	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	ALUMINU	Water	1060.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7429-90-5	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	ALUMINU	Water	442.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7429-90-5	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	ALUMINU	Water	907.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7429-90-5	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	ALUMINU	Water	2460.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7429-90-5	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	ALUMINU	Water	450.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7429-90-5	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	ALUMINU	Water	370.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7429-90-5	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	ALUMINU	Water	1060.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7429-90-5	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	ALUMINU	Water	724.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7429-90-5	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	ALUMINU	Water	429.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7429-90-5	10	50	1

1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	ALUMINU	Water	1900.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7429-90-5	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	ALUMINU	Water	532.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7429-90-5	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	ALUMINU	Water	610.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7429-90-5	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	ALUMINU	Water	1400.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7429-90-5	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	ALUMINU	Water	1740.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7429-90-5	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	ALUMINU	Water	185.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7429-90-5	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	ALUMINU	Water	241.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7429-90-5	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	ALUMINU	Water	5870.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7429-90-5	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	ALUMINU	Water	5230.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7429-90-5	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	ALUMINU	Water	1060.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7429-90-5	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	ANTIMO	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-36-0	20	100	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	ANTIMO	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-36-0	20	100	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	ANTIMO	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-36-0	20	100	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	ANTIMO	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-36-0	20	100	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	ANTIMO	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-36-0	20	100	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	ANTIMO	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-36-0	20	100	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	ANTIMO	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-36-0	20	100	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	ANTIMO	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-36-0	20	100	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	ANTIMO	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-36-0	20	100	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	ANTIMO	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-36-0	20	100	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	ANTIMO	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-36-0	20	100	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	ANTIMO	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-36-0	20	100	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	ANTIMO	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-36-0	100	500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	ANTIMO	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-36-0	100	500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	ANTIMO	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-36-0	100	500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	ANTIMO	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-36-0	20	100	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	ANTIMO	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-36-0	20	100	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	ANTIMO	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-36-0	20	100	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	ANTIMO	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-36-0	20	100	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	ANTIMO	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-36-0	20	100	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	ANTIMO	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-36-0	20	100	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	ANTIMO	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-36-0	20	100	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	ANTIMO	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-36-0	20	100	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	ANTIMO	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-36-0	20	100	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	ANTIMO	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-36-0	20	100	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	ANTIMO	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-36-0	20	100	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	ANTIMO	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-36-0	20	100	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-38-2	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-38-2	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-38-2	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-38-2	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-38-2	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-38-2	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-38-2	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-38-2	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-38-2	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	70.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-38-2	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	73.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-38-2	10	50	1

1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	59.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-38-2	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-38-2	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-38-2	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-38-2	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-38-2	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-38-2	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-38-2	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	59.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-38-2	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	70.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-38-2	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	36. J	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-38-2	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-38-2	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-38-2	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-38-2	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-38-2	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-38-2	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-38-2	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	163.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-39-3	2	10	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	BARIUM	Water	151.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-39-3	2	10	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	136.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-39-3	2	10	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	BARIUM	Water	126.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-39-3	2	10	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	122.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-39-3	2	10	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	124.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-39-3	2	10	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	BARIUM	Water	121.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-39-3	2	10	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	115.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-39-3	2	10	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	131.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-39-3	2	10	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	BARIUM	Water	118.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-39-3	2	10	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	124.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-39-3	2	10	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	168.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-39-3	2	10	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	BARIUM	Water	115.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-39-3	10	50	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	105.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-39-3	10	50	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	179.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-39-3	10	50	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	BARIUM	Water	112.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-39-3	2	10	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	111.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-39-3	2	10	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	147.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-39-3	2	10	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	BARIUM	Water	90.6	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-39-3	2	10	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	94.5	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-39-3	2	10	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	141.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-39-3	2	10	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	BARIUM	Water	120.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-39-3	2	10	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	94.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-39-3	2	10	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	132.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-39-3	2	10	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	BARIUM	Water	149.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-39-3	2	10	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	152.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-39-3	2	10	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	148.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-39-3	2	10	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-41-7	0.5	2.5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-41-7	0.5	2.5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-41-7	0.5	2.5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-41-7	0.5	2.5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-41-7	0.5	2.5	1

1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-41-7	0.5	2.5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-41-7	0.5	2.5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-41-7	0.5	2.5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-41-7	0.5	2.5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-41-7	0.5	2.5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-41-7	0.5	2.5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-41-7	0.5	2.5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-41-7	2.5	12.5	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-41-7	2.5	12.5	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-41-7	2.5	12.5	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-41-7	0.5	2.5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-41-7	0.5	2.5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-41-7	0.5	2.5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-41-7	0.5	2.5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-41-7	0.5	2.5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-41-7	0.5	2.5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-41-7	0.5	2.5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-41-7	0.5	2.5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-41-7	0.5	2.5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-41-7	0.5	2.5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-41-7	0.5	2.5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	BERYLLIU	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-41-7	0.5	2.5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	BORON	Water	406.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-42-8	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	BORON	Water	284.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-42-8	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	BORON	Water	237.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-42-8	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	BORON	Water	797.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-42-8	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	BORON	Water	444.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-42-8	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	BORON	Water	182.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-42-8	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	BORON	Water	653.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-42-8	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	BORON	Water	550.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-42-8	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	BORON	Water	315.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-42-8	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	BORON	Water	688.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-42-8	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	BORON	Water	575.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-42-8	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	BORON	Water	353.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-42-8	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	BORON	Water	766.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-42-8	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	BORON	Water	781.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-42-8	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	BORON	Water	400.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-42-8	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	BORON	Water	780.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-42-8	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	BORON	Water	603.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-42-8	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	BORON	Water	321.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-42-8	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	BORON	Water	839.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-42-8	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	BORON	Water	780.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-42-8	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	BORON	Water	324.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-42-8	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	BORON	Water	566.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-42-8	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	BORON	Water	743.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-42-8	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	BORON	Water	328.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-42-8	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	BORON	Water	763.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-42-8	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	BORON	Water	624.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-42-8	10	50	1

1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	BORON	Water	325.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-42-8	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	CADMIU	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-43-9	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	CADMIU	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-43-9	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	CADMIU	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-43-9	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	CADMIU	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-43-9	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	CADMIU	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-43-9	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	CADMIU	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-43-9	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	CADMIU	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-43-9	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	CADMIU	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-43-9	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	CADMIU	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-43-9	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	CADMIU	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-43-9	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	CADMIU	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-43-9	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	CADMIU	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-43-9	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	CADMIU	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-43-9	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	CADMIU	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-43-9	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	CADMIU	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-43-9	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	CADMIU	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-43-9	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	CADMIU	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-43-9	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	CADMIU	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-43-9	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	CADMIU	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-43-9	1	5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	CADMIU	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-43-9	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	CADMIU	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-43-9	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	CADMIU	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-43-9	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	CADMIU	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-43-9	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	CADMIU	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-43-9	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	CADMIU	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-43-9	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	CADMIU	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-43-9	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	CADMIU	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-43-9	1	5	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	136000.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7440-70-2	30	150	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	118000.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7440-70-2	30	150	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	60600.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7440-70-2	30	150	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	84900.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-70-2	30	150	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	76300.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-70-2	30	150	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	53900.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-70-2	30	150	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	139000.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-70-2	30	150	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	117000.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-70-2	30	150	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	62000.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-70-2	30	150	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	118000.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-70-2	30	150	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	116000.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-70-2	30	150	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	56700.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-70-2	30	150	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	86600.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-70-2	30	150	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	95500.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-70-2	30	150	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	68900.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-70-2	30	150	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	68600.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-70-2	150	750	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	86900.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-70-2	150	750	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	64300.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-70-2	150	750	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	95600.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-70-2	30	150	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	93800.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-70-2	30	150	1

1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	56200.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-70-2	30	150	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	105000.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-70-2	30	150	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	125000.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-70-2	30	150	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	58100.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-70-2	30	150	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	102000.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-70-2	30	150	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	137000.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-70-2	30	150	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	61300.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-70-2	30	150	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	139000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-70-2	30	150	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	109000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-70-2	30	150	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	53700.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-70-2	30	150	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	CHROMI	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-47-3	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	CHROMI	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-47-3	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	CHROMI	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-47-3	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	CHROMI	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-47-3	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	CHROMI	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-47-3	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	CHROMI	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-47-3	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	CHROMI	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-47-3	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	CHROMI	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-47-3	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	CHROMI	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-47-3	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	CHROMI	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-47-3	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	CHROMI	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-47-3	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	CHROMI	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-47-3	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	CHROMI	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-47-3	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	CHROMI	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-47-3	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	CHROMI	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-47-3	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	CHROMI	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-47-3	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	CHROMI	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-47-3	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	CHROMI	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-47-3	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	CHROMI	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-47-3	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	CHROMI	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-47-3	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	CHROMI	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-47-3	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	CHROMI	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-47-3	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	CHROMI	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-47-3	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	CHROMI	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-47-3	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	CHROMI	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-47-3	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	CHROMI	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-47-3	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	CHROMI	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-47-3	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-48-4	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-48-4	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-48-4	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-48-4	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-48-4	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-48-4	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-48-4	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-48-4	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-48-4	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-48-4	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-48-4	1	5	1

1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-48-4	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-48-4	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-48-4	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-48-4	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-48-4	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-48-4	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-48-4	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-48-4	1	5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-48-4	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-48-4	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-48-4	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-48-4	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-48-4	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	COBALT	Water	1.4 J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-48-4	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	COBALT	Water	1.3 J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-48-4	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-48-4	1	5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-50-8	2	10	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-50-8	2	10	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-50-8	2	10	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-50-8	2	10	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-50-8	2	10	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-50-8	2	10	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-50-8	2	10	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-50-8	2	10	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-50-8	2	10	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-50-8	2	10	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-50-8	2	10	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-50-8	2	10	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-50-8	10	50	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	COPPER	Water	25. J	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-50-8	10	50	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-50-8	10	50	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-50-8	2	10	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-50-8	2	10	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-50-8	2	10	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-50-8	2	10	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-50-8	2	10	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-50-8	2	10	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-50-8	2	10	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-50-8	2	10	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-50-8	2	10	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	COPPER	Water	2.1 J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-50-8	2	10	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	COPPER	Water	3.6 J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-50-8	2	10	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-50-8	2	10	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.7	HARDNES	Water	657.	mg/L	WS1104-051	14-Apr-11	20-Apr-11		0.03	0.15	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.7	HARDNES	Water	478.	mg/L	WS1104-051	14-Apr-11	20-Apr-11		0.03	0.15	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.7	HARDNES	Water	239.	mg/L	WS1104-051	14-Apr-11	20-Apr-11		0.03	0.15	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	IRON	Water	5490.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-89-6	20	100	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	IRON	Water	2580.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-89-6	20	100	1

1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	IRON	Water	281.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-89-6	20	100	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	IRON	Water	2240.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-89-6	20	100	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	IRON	Water	859.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-89-6	20	100	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	IRON	Water	371.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-89-6	20	100	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	IRON	Water	1330.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-89-6	20	100	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	IRON	Water	184.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-89-6	20	100	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	IRON	Water	648.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-89-6	20	100	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	IRON	Water	312.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-89-6	20	100	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	IRON	Water	770.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-89-6	20	100	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	IRON	Water	2080.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-89-6	20	100	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	IRON	Water	370. J	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-89-6	100	500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	IRON	Water	850.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-89-6	100	500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	IRON	Water	750.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-89-6	100	500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	IRON	Water	492.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-89-6	20	100	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	IRON	Water	302.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-89-6	20	100	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	IRON	Water	1270.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-89-6	20	100	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	IRON	Water	293.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-89-6	20	100	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	IRON	Water	406.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-89-6	20	100	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	IRON	Water	807.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-89-6	20	100	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	IRON	Water	1260.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-89-6	20	100	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	IRON	Water	166.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-89-6	20	100	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	IRON	Water	176.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-89-6	20	100	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	IRON	Water	4230.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-89-6	20	100	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	IRON	Water	4000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-89-6	20	100	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	IRON	Water	752.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-89-6	20	100	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-92-1	20	100	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-92-1	20	100	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-92-1	20	100	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-92-1	20	100	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-92-1	20	100	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-92-1	20	100	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-92-1	20	100	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-92-1	20	100	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-92-1	20	100	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-92-1	20	100	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-92-1	20	100	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-92-1	20	100	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-92-1	100	500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-92-1	100	500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-92-1	100	500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-92-1	20	100	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-92-1	20	100	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-92-1	20	100	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-92-1	20	100	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-92-1	20	100	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-92-1	20	100	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-92-1	20	100	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-92-1	20	100	1

1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-92-1	20	100	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-92-1	20	100	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-92-1	20	100	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-92-1	20	100	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.7	MAGNESI	Water	77000.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7439-95-4	10	50	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.7	MAGNESI	Water	44500.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7439-95-4	10	50	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.7	MAGNESI	Water	21400.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7439-95-4	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	MAGNESI	Water	36700.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-95-4	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	MAGNESI	Water	28700.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-95-4	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	MAGNESI	Water	21400.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-95-4	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	MAGNESI	Water	83100.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-95-4	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	MAGNESI	Water	47900.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-95-4	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	MAGNESI	Water	23700.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-95-4	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	MAGNESI	Water	53900.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-95-4	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	MAGNESI	Water	43900.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-95-4	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	MAGNESI	Water	21700.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-95-4	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	MAGNESI	Water	41900.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-95-4	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	MAGNESI	Water	37000.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-95-4	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	MAGNESI	Water	27400.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-95-4	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	MAGNESI	Water	48100.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-95-4	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	MAGNESI	Water	52600.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-95-4	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	MAGNESI	Water	29700.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-95-4	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	MAGNESI	Water	49000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-95-4	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	MAGNESI	Water	38900.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-95-4	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	MAGNESI	Water	24000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-95-4	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	MAGNESI	Water	62700.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-95-4	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	MAGNESI	Water	54300.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-95-4	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	MAGNESI	Water	24300.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-95-4	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	MAGNESI	Water	52900.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-95-4	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	MAGNESI	Water	57800.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-95-4	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	MAGNESI	Water	24700.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-95-4	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	MAGNESI	Water	70700.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-95-4	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	MAGNESI	Water	42000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-95-4	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	MAGNESI	Water	21900.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-95-4	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	MANGAN	Water	170.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-96-5	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	MANGAN	Water	103.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-96-5	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	MANGAN	Water	13.2	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-96-5	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	MANGAN	Water	253.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-96-5	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	MANGAN	Water	230.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-96-5	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	MANGAN	Water	15.7	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-96-5	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	MANGAN	Water	119.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-96-5	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	MANGAN	Water	123.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-96-5	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	MANGAN	Water	24.8	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-96-5	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	MANGAN	Water	9.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-96-5	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	MANGAN	Water	23.8	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-96-5	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	MANGAN	Water	54.4	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-96-5	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	MANGAN	Water	8.9 J	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-96-5	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	MANGAN	Water	31.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-96-5	5	25	5

1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	MANGAN	Water	35.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-96-5	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	MANGAN	Water	13.9	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-96-5	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	MANGAN	Water	38.8	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-96-5	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	MANGAN	Water	30.9	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-96-5	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	MANGAN	Water	23.8	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-96-5	1	5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	MANGAN	Water	71.9	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-96-5	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	MANGAN	Water	23.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-96-5	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	MANGAN	Water	89.1	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-96-5	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	MANGAN	Water	165.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-96-5	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	MANGAN	Water	6.4	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-96-5	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	MANGAN	Water	429.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-96-5	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	MANGAN	Water	505.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-96-5	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	MANGAN	Water	82.9	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-96-5	1	5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	MOLYBD	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-98-7	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	MOLYBD	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-98-7	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	MOLYBD	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-98-7	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	MOLYBD	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-98-7	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	MOLYBD	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-98-7	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	MOLYBD	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-98-7	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	MOLYBD	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-98-7	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	MOLYBD	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-98-7	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	MOLYBD	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-98-7	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	MOLYBD	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-98-7	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	MOLYBD	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-98-7	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	MOLYBD	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-98-7	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	MOLYBD	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-98-7	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	MOLYBD	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-98-7	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	MOLYBD	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-98-7	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	MOLYBD	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-98-7	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	MOLYBD	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-98-7	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	MOLYBD	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-98-7	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	MOLYBD	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-98-7	1	5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	MOLYBD	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-98-7	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	MOLYBD	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-98-7	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	MOLYBD	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-98-7	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	MOLYBD	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-98-7	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	MOLYBD	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-98-7	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	MOLYBD	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-98-7	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	MOLYBD	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-98-7	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	MOLYBD	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-98-7	1	5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-02-0	5	25	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-02-0	5	25	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-02-0	5	25	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-02-0	5	25	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-02-0	5	25	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-02-0	5	25	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-02-0	5	25	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-02-0	5	25	1

1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-02-0	5	25	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-02-0	5	25	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-02-0	5	25	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-02-0	5	25	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-02-0	25	125	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-02-0	25	125	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-02-0	25	125	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-02-0	5	25	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-02-0	5	25	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-02-0	5	25	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-02-0	5	25	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-02-0	5	25	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-02-0	5	25	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-02-0	5	25	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-02-0	5	25	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-02-0	5	25	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-02-0	5	25	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-02-0	5	25	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-02-0	5	25	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	PHOSPH	Water	130.	ug/L	WS1106-001	26-May-11	02-Jun-11	7723-14-0	20	100	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	PHOSPH	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7723-14-0	20	100	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	PHOSPH	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7723-14-0	20	100	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	PHOSPH	Water	138.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7723-14-0	20	100	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	PHOSPH	Water	48. J	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7723-14-0	20	100	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	PHOSPH	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7723-14-0	20	100	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	PHOSPH	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7723-14-0	20	100	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	PHOSPH	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7723-14-0	20	100	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	PHOSPH	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7723-14-0	20	100	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	PHOSPH	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7723-14-0	20	100	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	PHOSPH	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7723-14-0	20	100	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	PHOSPH	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7723-14-0	20	100	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	PHOSPH	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7723-14-0	100	500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	PHOSPH	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7723-14-0	100	500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	PHOSPH	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7723-14-0	100	500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	PHOSPH	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7723-14-0	20	100	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	PHOSPH	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7723-14-0	20	100	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	PHOSPH	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7723-14-0	20	100	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	PHOSPH	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7723-14-0	20	100	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	PHOSPH	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7723-14-0	20	100	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	PHOSPH	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7723-14-0	20	100	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	PHOSPH	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7723-14-0	20	100	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	PHOSPH	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7723-14-0	20	100	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	PHOSPH	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7723-14-0	20	100	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	PHOSPH	Water	32. J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7723-14-0	20	100	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	PHOSPH	Water	87. J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7723-14-0	20	100	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	PHOSPH	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7723-14-0	20	100	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	POTASSI	Water	35400.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-09-7	100	500	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	POTASSI	Water	31100.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-09-7	100	500	1

1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	POTASSI	Water	24800.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-09-7	100	500	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	POTASSI	Water	63100.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-09-7	100	500	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	POTASSI	Water	45400.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-09-7	100	500	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	POTASSI	Water	26600.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-09-7	100	500	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	POTASSI	Water	46500.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-09-7	100	500	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	POTASSI	Water	43100.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-09-7	100	500	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	POTASSI	Water	26200.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-09-7	100	500	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	POTASSI	Water	53400.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-09-7	100	500	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	POTASSI	Water	63100.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-09-7	100	500	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	POTASSI	Water	36000.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-09-7	100	500	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	POTASSI	Water	49100.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-09-7	500	2500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	POTASSI	Water	48900.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-09-7	500	2500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	POTASSI	Water	27700.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-09-7	500	2500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	POTASSI	Water	49800.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-09-7	100	500	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	POTASSI	Water	43000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-09-7	100	500	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	POTASSI	Water	26000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-09-7	100	500	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	POTASSI	Water	60400.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-09-7	100	500	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	POTASSI	Water	57200.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-09-7	100	500	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	POTASSI	Water	27600.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-09-7	100	500	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	POTASSI	Water	47200.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-09-7	100	500	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	POTASSI	Water	64600.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-09-7	100	500	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	POTASSI	Water	31200.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-09-7	100	500	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	POTASSI	Water	59600.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-09-7	100	500	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	POTASSI	Water	50900.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-09-7	100	500	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	POTASSI	Water	27900.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-09-7	100	500	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	SELENIU	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7782-49-2	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	SELENIU	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7782-49-2	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	SELENIU	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7782-49-2	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	SELENIU	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7782-49-2	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7782-49-2	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7782-49-2	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7782-49-2	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7782-49-2	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7782-49-2	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7782-49-2	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7782-49-2	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7782-49-2	10	50	1

1108026-01	C8716 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7782-49-2	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7782-49-2	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7782-49-2	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7782-49-2	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7782-49-2	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7782-49-2	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7782-49-2	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7782-49-2	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7782-49-2	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7782-49-2	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7782-49-2	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7782-49-2	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7782-49-2	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7782-49-2	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7782-49-2	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-22-4	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-22-4	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-22-4	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-22-4	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-22-4	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-22-4	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-22-4	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-22-4	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-22-4	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-22-4	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-22-4	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-22-4	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-22-4	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-22-4	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-22-4	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-22-4	1	5	1

1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-22-4	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-22-4	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-22-4	1	5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-22-4	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-22-4	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-22-4	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-22-4	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-22-4	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-22-4	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-22-4	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-22-4	1	5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	794000.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-23-5	300	1500	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	SODIUM	Water	684000.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-23-5	300	1500	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	622000.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-23-5	300	1500	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	SODIUM	Water	211000	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-23-5	6000	30000	20
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	134000	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-23-5	6000	30000	20
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	659000.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-23-5	300	1500	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	SODIUM	Water	131000	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-23-5	15000	75000	50
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	122000	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-23-5	15000	75000	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	700000.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-23-5	15000	75000	50
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	SODIUM	Water	105000	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-23-5	15000	75000	50
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	896000.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-23-5	15000	75000	50
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	662000.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-23-5	15000	75000	50
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	SODIUM	Water	114000	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-23-5	1500	7500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	124000	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-23-5	1500	7500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	750000.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-23-5	1500	7500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	SODIUM	Water	120000	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-23-5	15000	75000	50
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	105000	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-23-5	15000	75000	50
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	669000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-23-5	15000	75000	50
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	SODIUM	Water	143000	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-23-5	15000	75000	50
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	132000	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-23-5	15000	75000	50
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	680000.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-23-5	15000	75000	50
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	SODIUM	Water	110000	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-23-5	15000	75000	50
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	132000	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-23-5	15000	75000	50
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	666000.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-23-5	15000	75000	50
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	SODIUM	Water	159000	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-23-5	15000	75000	50
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	122000	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-23-5	15000	75000	50
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	725000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-23-5	15000	75000	50
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	2680.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-24-6	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	2340.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-24-6	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2050.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-24-6	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	4790.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-24-6	1	5	1

1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3620.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-24-6	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2030.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-24-6	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	3770.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-24-6	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3460.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-24-6	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2110.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-24-6	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	3440.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-24-6	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3400.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-24-6	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2700.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-24-6	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	3240.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-24-6	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3540.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-24-6	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2650.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-24-6	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	3660.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-24-6	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3160.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-24-6	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2340.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-24-6	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	4350.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-24-6	50	250	50
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	4100.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-24-6	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2440.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-24-6	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	3740.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-24-6	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	4560.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-24-6	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2560.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-24-6	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	4580.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-24-6	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3670.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-24-6	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2430.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-24-6	1	5	1

1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-28-0	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-28-0	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-28-0	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-28-0	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-28-0	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-28-0	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-28-0	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-28-0	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-28-0	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-28-0	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-28-0	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-28-0	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-28-0	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-28-0	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-28-0	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-28-0	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-28-0	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-28-0	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-28-0	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-28-0	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-28-0	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-28-0	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-28-0	10	50	1

1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-28-0	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-28-0	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-28-0	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-28-0	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-31-5	30	150	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-31-5	30	150	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-31-5	30	150	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-31-5	30	150	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-31-5	30	150	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-31-5	30	150	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-31-5	30	150	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-31-5	30	150	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-31-5	30	150	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-31-5	30	150	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-31-5	30	150	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-31-5	30	150	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-31-5	150	750	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-31-5	150	750	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-31-5	150	750	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-31-5	30	150	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-31-5	30	150	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-31-5	30	150	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-31-5	30	150	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-31-5	30	150	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-31-5	30	150	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-31-5	30	150	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-31-5	30	150	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-31-5	30	150	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-31-5	30	150	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-31-5	30	150	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-31-5	30	150	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	200.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-32-6	0.5	2.5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	95.1	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-32-6	0.5	2.5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	7.4	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-32-6	0.5	2.5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	75.7	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-32-6	0.5	2.5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	25.2	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-32-6	0.5	2.5	1

1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	12.2	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-32-6	0.5	2.5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	89.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-32-6	0.5	2.5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	4.3	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-32-6	0.5	2.5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	40.9	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-32-6	0.5	2.5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	7.2	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-32-6	0.5	2.5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	24.4	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-32-6	0.5	2.5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	74.8	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-32-6	0.5	2.5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	11. J	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-32-6	2.5	12.5	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	11. J	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-32-6	2.5	12.5	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	31.2	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-32-6	2.5	12.5	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	14.7	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-32-6	0.5	2.5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	6.8	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-32-6	0.5	2.5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	46.1	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-32-6	0.5	2.5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	13.9	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-32-6	0.5	2.5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	17.9	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-32-6	0.5	2.5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	50.4	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-32-6	0.5	2.5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	46.7	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-32-6	0.5	2.5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	1. J	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-32-6	0.5	2.5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	4.8	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-32-6	0.5	2.5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	146.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-32-6	0.5	2.5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	130.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-32-6	0.5	2.5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	22.9	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-32-6	0.5	2.5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-62-2	5	25	1

1105032-02	C8698 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-62-2	5	25	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-62-2	5	25	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-62-2	5	25	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-62-2	5	25	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-62-2	5	25	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-62-2	5	25	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-62-2	5	25	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-62-2	5	25	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	8.4 J	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-62-2	5	25	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	12. J	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-62-2	5	25	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	8. J	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-62-2	5	25	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-62-2	25	125	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-62-2	25	125	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-62-2	25	125	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	5.5 J	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-62-2	5	25	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	5.2 J	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-62-2	5	25	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-62-2	5	25	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	7.5 J	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-62-2	5	25	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	14. J	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-62-2	5	25	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-62-2	5	25	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	5.3 J	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-62-2	5	25	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	9.8 J	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-62-2	5	25	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-62-2	5	25	1

1112019-01	C8740 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-62-2	5	25	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-62-2	5	25	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-62-2	5	25	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	ZINC	Water	29. J	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-66-6	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	ZINC	Water	22. J	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-66-6	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-66-6	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	ZINC	Water	14. J	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-66-6	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	ZINC	Water	11. J	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-66-6	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-66-6	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	ZINC	Water	12. J	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-66-6	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	ZINC	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-66-6	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-66-6	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	ZINC	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-66-6	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	ZINC	Water	13. J	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-66-6	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	22. J	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-66-6	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	ZINC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-66-6	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	ZINC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-66-6	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-66-6	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	ZINC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-66-6	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	ZINC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-66-6	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-66-6	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	ZINC	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-66-6	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	ZINC	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-66-6	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-66-6	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	ZINC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-66-6	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	ZINC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-66-6	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-66-6	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	ZINC	Water	19. J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-66-6	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	ZINC	Water	18. J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-66-6	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-66-6	10	50	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	200.8 ACID DIGESTION	Water	04/19/2011 12:00:00 am			14-Apr-11	19-Apr-11				1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	200.8 ACID DIGESTION	Water	04/19/2011 12:00:00 am			14-Apr-11	19-Apr-11				1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	200.8 ACID DIGESTION	Water	04/19/2011 12:00:00 am			14-Apr-11	19-Apr-11				1

1104014-01	C8690 - Blue Creek Upper	EPA 200.8	ALUMINUM	Water	2030.	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7429-90-5	2.5	12.5	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	ALUMINUM	Water	771.	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7429-90-5	2.5	12.5	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	ALUMINUM	Water	275.	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7429-90-5	2.5	12.5	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	ARSENIC	Water	42.9	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-38-2	1.25	6.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	ARSENIC	Water	32.9	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-38-2	1.25	6.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	ARSENIC	Water	20.1	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-38-2	1.25	6.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	BERYLLIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-41-7	0.25	1.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	BERYLLIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-41-7	0.25	1.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	BERYLLIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-41-7	0.25	1.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	CADMIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-43-9	1.25	6.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	CADMIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-43-9	1.25	6.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	CADMIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-43-9	1.25	6.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	CHROMIUM	Water	3.8	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-47-3	0.25	1.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	CHROMIUM	Water	1.5	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-47-3	0.25	1.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	CHROMIUM	Water	0.7 J	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-47-3	0.25	1.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	LEAD	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7439-92-1	2.5	6.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	LEAD	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7439-92-1	2.5	6.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	LEAD	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7439-92-1	2.5	6.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	SELENIUM	Water	12.1	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7782-49-2	1.25	6.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	SELENIUM	Water	9.2	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7782-49-2	1.25	6.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	SELENIUM	Water	5. J	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7782-49-2	1.25	6.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	SILVER	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-22-4	1.25	6.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	SILVER	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-22-4	1.25	6.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	SILVER	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-22-4	1.25	6.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		5	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		5	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		5	20	100

1106015-01	C8702 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		2.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		2.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		2.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		5	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		5	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		5	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		5	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		5	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		2.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		5	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		5	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		5	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		5	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		5	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		5	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		5	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		5	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		5	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		10	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		5	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		5	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	2440.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1550.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100

1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	912.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	1710.	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1470.	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	884.	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	1520.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1350.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	1000.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	1680.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1690.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	1030.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		1.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	1820.	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1570.	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	992.	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	2030.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1900.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	991.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	1590.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1890.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	971.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	2270.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		6	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1710.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	1010.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		2	20	100

1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	3.5 J	mg/L	WS1104-066	14-Apr-11	20-Apr-11		2	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		2	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	4.8 J	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	2.4 J	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	1.9 J	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	2.1 J	mg/L	WS1108-027	26-Jul-11	08-Aug-11		2	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	2.2 J	mg/L	WS1108-027	26-Jul-11	08-Aug-11		2	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	2.2 J	mg/L	WS1108-027	26-Jul-11	08-Aug-11		2	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	3.3 J	mg/L	WS1109-006	29-Aug-11	07-Sep-11		2	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	5.5 J	mg/L	WS1109-006	29-Aug-11	07-Sep-11		2	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	2.6 J	mg/L	WS1109-006	29-Aug-11	07-Sep-11		1	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	2.2 J	mg/L	WS1110-028	29-Sep-11	11-Oct-11		2	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		2	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		2	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		2	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		2	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		2	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		2	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		2	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		2	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		4	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		2	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		2	20	100

1104014-01	C8690 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		1.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		6	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100

1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		1.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		6	40	200

1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		1.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100

1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		6	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	SULFATE	Water	501.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	274.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	107.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	SULFATE	Water	303.	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	258.	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	94.4	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	SULFATE	Water	232.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	198.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	114.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	SULFATE	Water	274.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	274.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	117.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		1.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	SULFATE	Water	317.	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	253.	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	113	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	SULFATE	Water	377.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100

1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	350.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	115.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	SULFATE	Water	275.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	359.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	106.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	SULFATE	Water	414.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		6	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	300.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	104.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 350.1	AMMONIA DISTILLATION	Water	04/26/2011 00:00			14-Apr-11	25-Apr-11				1
1105032-01	C8697 - Blue Creek Crossing	EPA 350.1	AMMONIA DISTILLATION	Water	06/07/2011 00:00			26-May-11	07-Jun-11				1
1104014-01	C8690 - Blue Creek Upper	EPA 350.1	AMMONIA-N	Water	U	mg/L	WS1104-078	14-Apr-11	25-Apr-11	7664-41-7	0.06	0.1	1
1105032-01	C8697 - Blue Creek Crossing	EPA 350.1	AMMONIA-N	Water	0.71	mg/L	WS1106-010	26-May-11	07-Jun-11	7664-41-7	0.06	0.1	1

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
6/2/1989	4038	Irrigate	June	Summer	4038
6/16/1989	3348	Irrigate	June	Summer	3348
6/29/1989	3536	Irrigate	June	Summer	3536
7/7/1989	3910	Irrigate	July	Summer	3910
7/21/1989	4200	Irrigate	July	Summer	4200
8/11/1989	3726	Irrigate	Aug	Summer	3726
8/25/1989	4864	Irrigate	Aug	Summer	4864
9/8/1989	3130	Irrigate	Sept	Summer	3130
9/22/1989	3020	Irrigate	Sept	Summer	3020
10/6/1989	3022	Irrigate	Oct	Summer	3022
10/20/1989	3066	Irrigate	Oct	Summer	3066
3/2/1990	2800	No_irr	March	Summer	2800
3/16/1990	2850	No_irr	March	Summer	2850
3/30/1990	4068	No_irr	March	Summer	4068
4/13/1990	3112	No_irr	April	Summer	3112
4/27/1990	3308	Irrigate	April	Summer	3308
5/11/1990	3768	Irrigate	May	Summer	3768
5/25/1990	4588	Irrigate	May	Summer	4588
6/7/1990	4030	Irrigate	June	Summer	4030
6/22/1990	3172	Irrigate	June	Summer	3172
7/6/1990	3744	Irrigate	July	Summer	3744
7/20/1990	3664	Irrigate	July	Summer	3664
8/3/1990	4202	Irrigate	Aug	Summer	4202
8/17/1990	3880	Irrigate	Aug	Summer	3880
8/31/1990	3660	Irrigate	Aug	Summer	3660
9/14/1990	3672	Irrigate	Sept	Summer	3672
9/28/1990	2250	Irrigate	Sept	Summer	2250
10/12/1990	2572	Irrigate	Oct	Summer	2572
10/26/1990	2624	Irrigate	Oct	Summer	2624
3/8/1991	3212	No_irr	March	Summer	3212
3/22/1991	4222	No_irr	March	Summer	4222
4/5/1991	2868	No_irr	April	Summer	2868
4/19/1991	3742	Irrigate	April	Summer	3742
5/3/1991	4364	Irrigate	May	Summer	4364
5/17/1991	3380	Irrigate	May	Summer	3380
5/31/1991	5620	Irrigate	May	Summer	5620
6/12/1991	3394	Irrigate	June	Summer	3394
6/18/1991	3172	Irrigate	June	Summer	3172
6/21/1991	3842	Irrigate	June	Summer	3842
6/25/1991	4766	Irrigate	June	Summer	4766
7/12/1991	3038	Irrigate	July	Summer	3038
7/26/1991	3698	Irrigate	July	Summer	3698

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
8/6/1991	3800	Irrigate	Aug	Summer	3800
8/23/1991	4200	Irrigate	Aug	Summer	4200
9/6/1991	3700	Irrigate	Sept	Summer	3700
9/20/1991	3500	Irrigate	Sept	Summer	3500
9/24/1991	3550	Irrigate	Sept	Summer	3550
10/1/1991	3500	Irrigate	Oct	Summer	3500
10/16/1991	3400	Irrigate	Oct	Summer	3400
3/6/1992	3600	No_irr	March	Summer	3600
3/20/1992	3000	No_irr	March	Summer	3000
4/3/1992	2600	No_irr	April	Summer	2600
4/14/1992	2718	No_irr	April	Summer	2718
4/17/1992	2800	Irrigate	April	Summer	2800
4/29/1992	4500	Irrigate	April	Summer	4500
5/15/1992	3800	Irrigate	May	Summer	3800
5/29/1992	4400	Irrigate	May	Summer	4400
6/2/1992	4702	Irrigate	June	Summer	4702
6/12/1992	3400	Irrigate	June	Summer	3400
6/25/1992	4000	Irrigate	June	Summer	4000
7/9/1992	4000	Irrigate	July	Summer	4000
7/21/1992	3924	Irrigate	July	Summer	3924
7/22/1992	3600	Irrigate	July	Summer	3600
8/6/1992	3930	Irrigate	Aug	Summer	3930
8/21/1992	4490	Irrigate	Aug	Summer	4490
9/2/1992	3530	Irrigate	Sept	Summer	3530
9/9/1992	3686	Irrigate	Sept	Summer	3686
10/2/1992	4020	Irrigate	Oct	Summer	4020
10/13/1992	5020	Irrigate	Oct	Summer	5020
10/20/1992	5242	Irrigate	Oct	Summer	5242
10/30/1992	7180	Irrigate	Oct	Summer	
3/12/1993	4437	No_irr	March	Summer	4437
3/26/1993	3293	No_irr	March	Summer	3293
4/9/1993	4488	No_irr	April	Summer	4488
4/28/1993	3264	Irrigate	April	Summer	3264
5/4/1993	3750	Irrigate	May	Summer	3750
5/13/1993	3106	Irrigate	May	Summer	3106
5/27/1993	4136	Irrigate	May	Summer	4136
6/4/1993	4231	Irrigate	June	Summer	4231
6/15/1993	4124	Irrigate	June	Summer	4124
6/18/1993	4528	Irrigate	June	Summer	4528
6/30/1993	3668	Irrigate	June	Summer	3668
7/9/1993	3536	Irrigate	July	Summer	3536
7/20/1993	3116	Irrigate	July	Summer	3116

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
8/6/1993	3652	Irrigate	Aug	Summer	3652
8/20/1993	4115	Irrigate	Aug	Summer	4115
8/24/1993	4728	Irrigate	Aug	Summer	4728
9/2/1993	3853	Irrigate	Sept	Summer	3853
9/16/1993	4233	Irrigate	Sept	Summer	4233
9/30/1993	4561	Irrigate	Sept	Summer	4561
10/12/1993	3556	Irrigate	Oct	Summer	3556
10/15/1993	3522	Irrigate	Oct	Summer	3522
10/29/1993	2918	Irrigate	Oct	Summer	2918
3/9/1994	3735	No_irr	March	Summer	3735
3/23/1994	4933	No_irr	March	Summer	4933
4/13/1994	3336	No_irr	April	Summer	3336
4/19/1994	2986	Irrigate	April	Summer	2986
4/29/1994	3456	Irrigate	April	Summer	3456
5/11/1994	5042	Irrigate	May	Summer	5042
5/26/1994	3333	Irrigate	May	Summer	3333
6/9/1994	3935	Irrigate	June	Summer	3935
6/24/1994	3710	Irrigate	June	Summer	3710
7/8/1994	3419	Irrigate	July	Summer	3419
7/19/1994	3321	Irrigate	July	Summer	3321
7/20/1994	3890	Irrigate	July	Summer	3890
8/4/1994	3934	Irrigate	Aug	Summer	3934
8/18/1994	3820	Irrigate	Aug	Summer	3820
9/1/1994	3846	Irrigate	Sept	Summer	3846
9/16/1994	3394	Irrigate	Sept	Summer	3394
9/26/1994	3512	Irrigate	Sept	Summer	3512
10/12/1994	3961	Irrigate	Oct	Summer	3961
10/28/1994	4048	Irrigate	Oct	Summer	4048
3/8/1995	4803	No_irr	March	Summer	4803
3/22/1995	4003	No_irr	March	Summer	4003
4/13/1995	3122	No_irr	April	Summer	3122
4/28/1995	5016	Irrigate	April	Summer	5016
5/4/1995	4567	Irrigate	May	Summer	4567
5/22/1995	5047	Irrigate	May	Summer	5047
5/24/1995	5264	Irrigate	May	Summer	5264
6/8/1995	3491	Irrigate	June	Summer	3491
6/21/1995	2787	Irrigate	June	Summer	2787
7/6/1995	3380	Irrigate	July	Summer	3380
7/13/1995	3081	Irrigate	July	Summer	3081
7/28/1995	3455	Irrigate	July	Summer	3455
8/10/1995	2859	Irrigate	Aug	Summer	2859
8/21/1995	3796	Irrigate	Aug	Summer	3796

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
9/7/1995	3315	Irrigate	Sept	Summer	3315
9/20/1995	4589	Irrigate	Sept	Summer	4589
10/4/1995	5097	Irrigate	Oct	Summer	5097
10/20/1995	4196	Irrigate	Oct	Summer	4196
10/27/1995	5016	Irrigate	Oct	Summer	5016
3/7/1996	3800	No_irr	March	Summer	3800
3/20/1996	3070	No_irr	March	Summer	3070
4/1/1996	2950	No_irr	April	Summer	2950
4/17/1996	4240	Irrigate	April	Summer	4240
5/8/1996	4074	Irrigate	May	Summer	4074
5/22/1996	4660	Irrigate	May	Summer	4660
6/7/1996	4240	Irrigate	June	Summer	4240
6/19/1996	3040	Irrigate	June	Summer	3040
7/16/1996	3780	Irrigate	July	Summer	3780
7/30/1996	3352	Irrigate	July	Summer	3352
7/31/1996	4170	Irrigate	July	Summer	4170
8/7/1996	3310	Irrigate	Aug	Summer	3310
8/22/1996	2970	Irrigate	Aug	Summer	2970
9/10/1996	4270	Irrigate	Sept	Summer	4270
9/25/1996	4740	Irrigate	Sept	Summer	4740
10/9/1996	4070	Irrigate	Oct	Summer	4070
10/24/1996	4824	Irrigate	Oct	Summer	4824
3/12/1997	3570	No_irr	March	Summer	3570
3/26/1997	3420	No_irr	March	Summer	3420
4/8/1997	3070	No_irr	April	Summer	3070
4/29/1997	3640	Irrigate	April	Summer	3640
5/8/1997	4728	Irrigate	May	Summer	4728
8/7/1997	3086	Irrigate	Aug	Summer	3086
10/22/1997	2506	Irrigate	Oct	Summer	2506
5/14/1998	4254	Irrigate	May	Summer	4254
7/14/1998	2766	Irrigate	July	Summer	2766
10/27/1998	3182	Irrigate	Oct	Summer	3182
4/13/1999	2794	No_irr	April	Summer	2794
8/18/1999	3662	Irrigate	Aug	Summer	3662
4/3/2000	3136	No_irr	April	Summer	3136
4/12/2000	2802	No_irr	April	Summer	2802
6/22/2000	3372	Irrigate	June	Summer	3372
7/12/2000	2977	Irrigate	July	Summer	2977
8/9/2000	3548	Irrigate	Aug	Summer	3548
10/6/2000	4485	Irrigate	Oct	Summer	4485
4/5/2001	3814	No_irr	April	Summer	3814
7/2/2001	2952	Irrigate	July	Summer	2952

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
7/26/2001	3958	Irrigate	July	Summer	3958
10/2/2001	3436	Irrigate	Oct	Summer	3436
4/2/2002	3812	No_irr	April	Summer	3812
7/11/2002	2968	Irrigate	July	Summer	2968
8/13/2002	4338	Irrigate	Aug	Summer	4338
10/29/2002	4910	Irrigate	Oct	Summer	4910
4/4/2003	4121	No_irr	April	Summer	4121
5/15/2003	5886	Irrigate	May	Summer	5886
7/8/2003	4147	Irrigate	July	Summer	4147
7/15/2003	4198	Irrigate	July	Summer	4198
8/19/2003	5228	Irrigate	Aug	Summer	5228
9/23/2003	3996	Irrigate	Sept	Summer	3996
10/2/2003	3965	Irrigate	Oct	Summer	3965
10/28/2003	5524	Irrigate	Oct	Summer	5524
3/16/2004	5520	No_irr	March	Summer	5520
4/7/2004	4590	No_irr	April	Summer	4590
7/2/2004	3450	Irrigate	July	Summer	3450
10/12/2004	4470	Irrigate	Oct	Summer	4470
4/4/2005	4400	No_irr	April	Summer	4400
4/20/2005	4942	Irrigate	April	Summer	4942
8/2/2005	3044	Irrigate	Aug	Summer	3044
8/3/2005	3860	Irrigate	Aug	Summer	3860
10/7/2005	3640	Irrigate	Oct	Summer	3640
10/18/2005	3716	Irrigate	Oct	Summer	3716
4/6/2006	3660	No_irr	April	Summer	3660
7/5/2006	3336	Irrigate	July	Summer	3336
7/10/2006	3560	Irrigate	July	Summer	3560
10/11/2006	2939	Irrigate	Oct	Summer	2939
4/3/2007	3440	No_irr	April	Summer	3440
5/14/2007	3180	Irrigate	May	Summer	3180
7/2/2007	2792	Irrigate	July	Summer	2792
7/10/2007	3160	Irrigate	July	Summer	3160
10/9/2007	3754	Irrigate	Oct	Summer	3754
10/11/2007	4260	Irrigate	Oct	Summer	4260
4/9/2008	2996	No_irr	April	Summer	2996
5/5/2008	3570	Irrigate	May	Summer	3570
7/2/2008	3450	Irrigate	July	Summer	3450
7/15/2008	3386	Irrigate	July	Summer	3386
8/4/2008	3438	Irrigate	Aug	Summer	3438
9/22/2008	3544	Irrigate	Sept	Summer	3544
10/12/2008	4470	Irrigate	Oct	Summer	4470
3/2/2009	5202	No_irr	March	Summer	5202

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
4/8/2009	4140	No_irr	April	Summer	4140
7/1/2009	3320	Irrigate	July	Summer	3320
10/6/2009	3410	Irrigate	Oct	Summer	3410
5/10/2010	4010	Irrigate	May	Summer	4010
7/14/2010	3970	Irrigate	July	Summer	3970
10/6/2010	5680	Irrigate	Oct	Summer	5680
4/14/2011	5270	No_irr	April	Summer	5270
5/26/2011	2260	Irrigate	May	Summer	2260
6/8/2011	3930	Irrigate	June	Summer	3930
7/26/2011	3380	Irrigate	July	Summer	3380
8/29/2011	3230	Irrigate	Aug	Summer	3230
9/29/2011	3780	Irrigate	Sept	Summer	3780
10/21/2011	4260	Irrigate	Oct	Summer	4260
3/19/2012	4160	No_irr	March	Summer	4160
4/16/2012	6270	Irrigate	April	Summer	6270
4/23/2012	4710	Irrigate	April	Summer	4710
4/30/2012	4730	Irrigate	April	Summer	4730
5/7/2012	4350	Irrigate	May	Summer	4350
6/4/2012	3720	Irrigate	June	Summer	3720
7/10/2012	4230	Irrigate	July	Summer	4230
8/8/2012	2980	Irrigate	Aug	Summer	2980
9/5/2012	4140	Irrigate	Sept	Summer	4140
10/5/2012	3760	Irrigate	Oct	Summer	3760
3/4/2013	5370	No_irr	March	Summer	5370
4/1/2013	4260	No_irr	April	Summer	4260
5/7/2013	4250	Irrigate	May	Summer	4250

Goodness-of-Fit Test Statistics for Full Data Sets without Non-Detects

From File	F:\Permits\ATK Blue Creek\WriteUp\Blue Creek ProUCL.xls.wst
Full Precision	OFF
Confidence Coefficient	0.95

Blue Creek Below Dam TDS (mg/l)

Raw Statistics

Number of Valid Observations	29
Number of Missing Values	3
Number of Distinct Observations	18
Minimum	1890
Maximum	2110
Mean of Raw Data	2007
Standard Deviation of Raw Data	63.63
Kstar	920.8
Mean of Log Transformed Data	7.604
Standard Deviation of Log Transformed Data	0.0318

Normal Distribution Test Results

Correlation Coefficient R	0.985
Shapiro Wilk Test Statistic	0.954
Shapiro Wilk Critical (0.95) Value	0.926
Approximate Shapiro Wilk P Value	0.258
Lilliefors Test Statistic	0.124
Lilliefors Critical (0.95) Value	0.165

Data appear Normal at (0.05) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.982
A-D Test Statistic	0.406
A-D Critical (0.95) Value	0.742
K-S Test Statistic	0.122
K-S Critical(0.95) Value	0.162

Data appear Gamma Distributed at (0.05) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.984
Shapiro Wilk Test Statistic	0.953
Shapiro Wilk Critical (0.95) Value	0.926
Approximate Shapiro Wilk P Value	0.243
Lilliefors Test Statistic	0.118
Lilliefors Critical (0.95) Value	0.165

Data appear Lognormal at (0.05) Significance Level

Blue Creek Crossing TDS (mg/L)

Raw Statistics	
Number of Valid Observations	32
Number of Distinct Observations	28
Minimum	2470
Maximum	5060
Mean of Raw Data	3298
Standard Deviation of Raw Data	572.4
Kstar	34.52
Mean of Log Transformed Data	8.088
Standard Deviation of Log Transformed Data	0.161

Normal Distribution Test Results

Correlation Coefficient R	0.944
Shapiro Wilk Test Statistic	0.898
Shapiro Wilk Critical (0.95) Value	0.93
Approximate Shapiro Wilk P Value	0.00543
Lilliefors Test Statistic	0.141
Lilliefors Critical (0.95) Value	0.157

Data not Normal at (0.05) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.964
A-D Test Statistic	0.628
A-D Critical (0.95) Value	0.745
K-S Test Statistic	0.115
K-S Critical(0.95) Value	0.155

Data appear Gamma Distributed at (0.05) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.974
Shapiro Wilk Test Statistic	0.95
Shapiro Wilk Critical (0.95) Value	0.93
Approximate Shapiro Wilk P Value	0.175
Lilliefors Test Statistic	0.105
Lilliefors Critical (0.95) Value	0.157

Data appear Lognormal at (0.05) Significance Level

Blue Creek Upper TDS (mg/L)

Raw Statistics	
Number of Valid Observations	32
Number of Distinct Observations	29
Minimum	2260
Maximum	6270
Mean of Raw Data	4261
Standard Deviation of Raw Data	802.7
Kstar	25.04
Mean of Log Transformed Data	8.339
Standard Deviation of Log Transformed Data	0.198

Normal Distribution Test Results

Correlation Coefficient R	0.986
Shapiro Wilk Test Statistic	0.984
Shapiro Wilk Critical (0.95) Value	0.93
Approximate Shapiro Wilk P Value	0.917
Lilliefors Test Statistic	0.125
Lilliefors Critical (0.95) Value	0.157

Data appear Normal at (0.05) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.986
A-D Test Statistic	0.381
A-D Critical (0.95) Value	0.745
K-S Test Statistic	0.122
K-S Critical(0.95) Value	0.155

Data appear Gamma Distributed at (0.05) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.971
Shapiro Wilk Test Statistic	0.959
Shapiro Wilk Critical (0.95) Value	0.93
Approximate Shapiro Wilk P Value	0.307
Lilliefors Test Statistic	0.135
Lilliefors Critical (0.95) Value	0.157

Data appear Lognormal at (0.05) Significance Level

	A	B	C	D	E	F	G	H	I	J	K	L
1				Goodness-of-Fit Test Statistics for Full Data Sets without Non-Detects								
2		User Selected Options										
3			From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst								
4			Full Precision	OFF								
5			Confidence Coefficient	0.95								
6												
7												
8	BC_upper Sample Site All Data											
9												
10			Raw Statistics									
11			Number of Valid Observations	349								
12			Number of Distinct Observations	304								
13			Minimum	1649								
14			Maximum	7180								
15			Mean of Raw Data	4121								
16			Standard Deviation of Raw Data	943.7								
17			Kstar	19.14								
18			Mean of Log Transformed Data	8.298								
19			Standard Deviation of Log Transformed Data	0.23								
20												
21			Normal Distribution Test Results									
22												
23			Correlation Coefficient R	0.99								
24			Approximate Shapiro Wilk Test Statistic	0.969								
25			Approximate Shapiro Wilk P Value	0.0003089								
26			Lilliefors Test Statistic	0.0704								
27			Lilliefors Critical (0.95) Value	0.0474								
28	Data not Normal at (0.05) Significance Level											
29												
30			Gamma Distribution Test Results									
31												
32			Correlation Coefficient R	0.997								
33			A-D Test Statistic	0.724								
34			A-D Critical (0.95) Value	0.751								
35			K-S Test Statistic	0.0411								
36			K-S Critical(0.95) Value	0.0486								
37	Data appear Gamma Distributed at (0.05) Significance Level											
38												
39			Lognormal Distribution Test Results									
40												
41			Correlation Coefficient R	0.996								
42			Approximate Shapiro Wilk Test Statistic	0.986								
43			Approximate Shapiro Wilk P Value	0.648								
44			Lilliefors Test Statistic	0.0303								
45			Lilliefors Critical (0.95) Value	0.0474								
46	Data appear Lognormal at (0.05) Significance Level											

	A	B	C	D	E	F	G	H	I	J	K	L
1				Goodness-of-Fit Test Statistics for Full Data Sets without Non-Detects								
2			User Selected Options									
3			From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst								
4			Full Precision	OFF								
5			Confidence Coefficient	0.95								
6												
7												
8	TDS_Final Upper Blue Creek (irrigate)											
9												
10			Raw Statistics									
11			Number of Valid Observations	233								
12			Number of Missing Values	1								
13			Number of Distinct Observations	210								
14			Minimum	2250								
15			Maximum	6564								
16			Mean of Raw Data	3977								
17			Standard Deviation of Raw Data	876.2								
18			Kstar	21.42								
19			Mean of Log Transformed Data	8.265								
20			Standard Deviation of Log Transformed Data	0.215								
21												
22			Normal Distribution Test Results									
23												
24			Correlation Coefficient R	0.98								
25			Approximate Shapiro Wilk Test Statistic	0.944								
26			Approximate Shapiro Wilk P Value	8.278E-10								
27			Lilliefors Test Statistic	0.0857								
28			Lilliefors Critical (0.95) Value	0.058								
29	Data not Normal at (0.05) Significance Level											
30												
31			Gamma Distribution Test Results									
32												
33			Correlation Coefficient R	0.992								
34			A-D Test Statistic	1.049								
35			A-D Critical (0.95) Value	0.751								
36			K-S Test Statistic	0.0589								
37			K-S Critical(0.95) Value	0.0597								
38	Data follow Appr. Gamma Distribution at (0.05) Significance Level											
39												
40			Lognormal Distribution Test Results									
41												
42			Correlation Coefficient R	0.996								
43			Approximate Shapiro Wilk Test Statistic	0.975								
44			Approximate Shapiro Wilk P Value	0.0704								
45			Lilliefors Test Statistic	0.0469								
46			Lilliefors Critical (0.95) Value	0.058								
47	Data appear Lognormal at (0.05) Significance Level											
48												
49	TDS_Final Upper Blue Creek (no_irr)											
50												

	A	B	C	D	E	F	G	H	I	J	K	L
51				**Raw Statistics**								
52					Number of Valid Observations	115						
53					Number of Distinct Observations	108						
54					Minimum	1649						
55					Maximum	6724						
56					Mean of Raw Data	4386						
57					Standard Deviation of Raw Data	980.3						
58					Kstar	17.96						
59					Mean of Log Transformed Data	8.359						
60					Standard Deviation of Log Transformed Data	0.243						
61												
62				**Normal Distribution Test Results**								
63												
64					Correlation Coefficient R	0.995						
65					Approximate Shapiro Wilk Test Statistic	0.981						
66					Approximate Shapiro Wilk P Value	0.565						
67					Lilliefors Test Statistic	0.0664						
68					Lilliefors Critical (0.95) Value	0.0826						
69	**Data appear Normal at (0.05) Significance Level**											
70												
71				**Gamma Distribution Test Results**								
72												
73					Correlation Coefficient R	0.985						
74					A-D Test Statistic	0.746						
75					A-D Critical (0.95) Value	0.75						
76					K-S Test Statistic	0.0734						
77					K-S Critical(0.95) Value	0.0854						
78	**Data appear Gamma Distributed at (0.05) Significance Level**											
79												
80				**Lognormal Distribution Test Results**								
81												
82					Correlation Coefficient R	0.976						
83					Approximate Shapiro Wilk Test Statistic	0.954						
84					Approximate Shapiro Wilk P Value	0.00298						
85					Lilliefors Test Statistic	0.0808						
86					Lilliefors Critical (0.95) Value	0.0826						
87	**Data appear Lognormal at (0.05) Significance Level**											

	A	B	C	D	E	F	G	H	I	J	K	L
1				Goodness-of-Fit Test Statistics for Full Data Sets without Non-Detects								
2			User Selected Options									
3			From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst								
4			Full Precision	OFF								
5			Confidence Coefficient	0.95								
6												
7												
8	TDS_Final Blue Creek Upper (summer season)											
9												
10			Raw Statistics									
11			Number of Valid Observations	235								
12			Number of Missing Values	1								
13			Number of Distinct Observations	206								
14			Minimum	2250								
15			Maximum	6270								
16			Mean of Raw Data	3822								
17			Standard Deviation of Raw Data	715.7								
18			Kstar	29.05								
19			Mean of Log Transformed Data	8.231								
20			Standard Deviation of Log Transformed Data	0.185								
21												
22			Normal Distribution Test Results									
23												
24			Correlation Coefficient R	0.989								
25			Approximate Shapiro Wilk Test Statistic	0.968								
26			Approximate Shapiro Wilk P Value	0.00439								
27			Lilliefors Test Statistic	0.0587								
28			Lilliefors Critical (0.95) Value	0.0578								
29	Data not Normal at (0.05) Significance Level											
30												
31			Gamma Distribution Test Results									
32												
33			Correlation Coefficient R	0.998								
34			A-D Test Statistic	0.383								
35			A-D Critical (0.95) Value	0.751								
36			K-S Test Statistic	0.0376								
37			K-S Critical(0.95) Value	0.0595								
38	Data appear Gamma Distributed at (0.05) Significance Level											
39												
40			Lognormal Distribution Test Results									
41												
42			Correlation Coefficient R	0.999								
43			Approximate Shapiro Wilk Test Statistic	0.985								
44			Approximate Shapiro Wilk P Value	0.693								
45			Lilliefors Test Statistic	0.0319								
46			Lilliefors Critical (0.95) Value	0.0578								
47	Data appear Lognormal at (0.05) Significance Level											
48												
49	TDS_Final Blue Creek Upper (winter season)											
50												

	A	B	C	D	E	F	G	H	I	J	K	L
51				**Raw Statistics**								
52					Number of Valid Observations	113						
53					Number of Distinct Observations	107						
54					Minimum	1649						
55					Maximum	6724						
56					Mean of Raw Data	4714						
57					Standard Deviation of Raw Data	1035						
58					Kstar	17.37						
59					Mean of Log Transformed Data	8.43						
60					Standard Deviation of Log Transformed Data	0.251						
61												
62				**Normal Distribution Test Results**								
63												
64					Correlation Coefficient R	0.988						
65					Approximate Shapiro Wilk Test Statistic	0.965						
66					Approximate Shapiro Wilk P Value	0.0425						
67					Lilliefors Test Statistic	0.0705						
68					Lilliefors Critical (0.95) Value	0.0833						
69	**Data appear Normal at (0.05) Significance Level**											
70												
71				**Gamma Distribution Test Results**								
72												
73					Correlation Coefficient R	0.968						
74					A-D Test Statistic	1.683						
75					A-D Critical (0.95) Value	0.75						
76					K-S Test Statistic	0.0928						
77					K-S Critical(0.95) Value	0.0859						
78	**Data not Gamma Distributed at (0.05) Significance Level**											
79												
80				**Lognormal Distribution Test Results**								
81												
82					Correlation Coefficient R	0.953						
83					Approximate Shapiro Wilk Test Statistic	0.908						
84					Approximate Shapiro Wilk P Value	3.755E-09						
85					Lilliefors Test Statistic	0.106						
86					Lilliefors Critical (0.95) Value	0.0833						
87	**Data not Lognormal at (0.05) Significance Level**											

	A	B	C	D	E	F	G	H	I	J	K	L
1					Outlier Tests for Selected Variables							
2				User Selected Options								
3				From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst							
4				Full Precision	OFF							
5				Test for Suspected Outliers with Dixon test	1							
6				Test for Suspected Outliers with Rosner test	1							
7												
8												
9				Rosner's Outlier Test for BC_upper								
10												
11												
12				Mean	4121							
13				Standard Deviation	943.7							
14				Number of data	349							
15				Number of suspected outliers	1							
16												
17				Potential	Obs.	Test	Critical	Critical				
18	#	Mean	sd	outlier	Number	value	value (5%)	value (1%)				
19	1	4121	942.4	7180	99	3.246	3.767	4.137				
20												
21	For 5% Significance Level, there is no Potential Outlier											
22												
23	For 1% Significance Level, there is no Potential Outlier											
24												

	A	B	C	D	E	F	G	H	I	J	K	L
1					**Outlier Tests for Selected Variables**							
2				**User Selected Options**								
3				From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst							
4				Full Precision	OFF							
5				Test for Suspected Outliers with Dixon test	1							
6				Test for Suspected Outliers with Rosner test	1							
7												
8												
9				**Rosner's Outlier Test for BC_upper (irrigate)**								
10												
11												
12				**Mean**	**3990**							
13				**Standard Deviation**	**899**							
14				**Number of data**	**234**							
15				**Number of suspected outliers**	**1**							
16												
17				Potential	Obs.	Test	Critical	Critical				
18	#	Mean	sd	outlier	Number	value	value (5%)	value (1%)				
19	1	3990	897.1	7180	74	3.555	3.65	4.021				
20												
21	For 5% Significance Level, there is no Potential Outlier											
22												
23	For 1% Significance Level, there is no Potential Outlier											
24												
25												
26				**Rosner's Outlier Test for BC_upper (no_irr)**								
27												
28												
29				**Mean**	**4386**							
30				**Standard Deviation**	**980.3**							
31				**Number of data**	**115**							
32				**Number of suspected outliers**	**1**							
33												
34				Potential	Obs.	Test	Critical	Critical				
35	#	Mean	sd	outlier	Number	value	value (5%)	value (1%)				
36	1	4386	976	1649	56	2.804	3.422	3.792				
37												
38	For 5% Significance Level, there is no Potential Outlier											
39												
40	For 1% Significance Level, there is no Potential Outlier											
41												

	A	B	C	D	E	F	G	H	I	J	K	L
1					**Outlier Tests for Selected Variables**							
2				**User Selected Options**								
3				From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst							
4				Full Precision	OFF							
5				Test for Suspected Outliers with Dixon test	1							
6				Test for Suspected Outliers with Rosner test	1							
7												
8												
9				**Rosner's Outlier Test for BC_upper (summer)**								
10												
11												
12				**Mean**	**3836**							
13				**Standard Deviation**	**746.9**							
14				**Number of data**	**236**							
15				**Number of suspected outliers**	**1**							
16												
17				Potential	Obs.	Test	Critical	Critical				
18	#	Mean	sd	outlier	Number	value	value (5%)	value (1%)				
19	1	3836	745.3	7180	71	4.486	3.653	4.023				
20												
21	For 5% Significance Level, there is 1 Potential Outlier											
22	Therefore, Observation 7180 is a Potential Statistical Outlier											
23												
24	For 1% Significance Level, there is 1 Potential Outlier											
25	Therefore, Observation 7180 is a Potential Statistical Outlier											
26												
27												
28				**Rosner's Outlier Test for BC_upper (winter)**								
29												
30												
31				**Mean**	**4714**							
32				**Standard Deviation**	**1035**							
33				**Number of data**	**113**							
34				**Number of suspected outliers**	**1**							
35												
36				Potential	Obs.	Test	Critical	Critical				
37	#	Mean	sd	outlier	Number	value	value (5%)	value (1%)				
38	1	4714	1030	1649	65	2.975	3.416	3.786				
39												
40	For 5% Significance Level, there is no Potential Outlier											
41												
42	For 1% Significance Level, there is no Potential Outlier											
43												

	A	B	C	D	E	F	G	H	I	J	K	L
1					**Outlier Tests for Selected Variables**							
2				**User Selected Options**								
3				From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst							
4				Full Precision	OFF							
5				Test for Suspected Outliers with Dixon test	1							
6				Test for Suspected Outliers with Rosner test	1							
7												
8												
9				**Rosner's Outlier Test for TDS_Final (summer)**								
10												
11												
12				**Mean**	**3822**							
13				**Standard Deviation**	**715.7**							
14				**Number of data**	**235**							
15				**Number of suspected outliers**	**1**							
16												
17				Potential	Obs.	Test	Critical	Critical				
18	#	Mean	sd	outlier	Number	value	value (5%)	value (1%)				
19	1	3822	714.2	6270	224	3.427	3.651	4.022				
20												
21	For 5% Significance Level, there is no Potential Outlier											
22												
23	For 1% Significance Level, there is no Potential Outlier											
24												
25												
26				**Rosner's Outlier Test for TDS_Final (winter)**								
27												
28												
29				**Mean**	**4714**							
30				**Standard Deviation**	**1035**							
31				**Number of data**	**113**							
32				**Number of suspected outliers**	**1**							
33												
34				Potential	Obs.	Test	Critical	Critical				
35	#	Mean	sd	outlier	Number	value	value (5%)	value (1%)				
36	1	4714	1030	1649	65	2.975	3.416	3.786				
37												
38	For 5% Significance Level, there is no Potential Outlier											
39												
40	For 1% Significance Level, there is no Potential Outlier											
41												

▼ Analysis of Variance with Irrigation Status and Season

Effects coding used for categorical variables in model.
The categorical values encountered during processing are

Variables	Levels	
IRR_STATUS$ (2 levels)	Irrigate	No_irr
SEASON$ (2 levels)	Summer	Winter
Summer irrigations status (2 levels)	Irrigate	No_irr

2 case(s) are deleted due to missing data.

Dependent Variable	TDS Blue Creek Upper Final (no outlier)
N	349
Multiple R	0.443
Squared Multiple R	0.197

Estimates of Effects B = $(X'X)^{-1}X'Y$

Factor	Level	TDS Blue Creek Upper no outlier
CONSTANT		4,266.409
IRR_STATUS$	Irrigate	13.152
SEASON$	Summer	-449.473
IRR_STATUS$*SEASON$	Irrigate*Summer	8.297

Analysis of Variance

Source	Type III SS	df	Mean Squares	F-Ratio	p-Value
IRR_STATUS$	40,011.452	1	40,011.452	0.057	0.812
SEASON$	46,733,061.177	1	46,733,061.177	66.082	0.000
IRR_STATUS$*SEASON$	15,922.964	1	15,922.964	0.023	0.881
Error	2.440E+008	345	707,194.753		

▼Nonparametric: Kruskal-Wallis Test for TDS Concentrations by Season

Mann-Whitney U Test for 351 Cases

```
The categorical values encountered during processing are

Variables                              |      Levels
---------------------------------------+------------------
SEASON$ (2 levels)                     | Summer     Winter

Dependent Variable   | TDS Blue Creek
                     | Upper no
                     | outlier
Grouping  Variable   | SEASON$

Group     Count      Rank Sum
----------------------------
Summer      236    34,167.000
Winter      113    26,908.000

Mann-Whitney U Test Statistic : 6,201.000
p-Value                       : 0.000
Chi-Square Approximation      : 65.414
df                            : 1

Kruskal-Wallis Test Statistic: 65.414
The p-value is 0.000 assuming chi-square distribution with 1 df.
```

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-196** APPLICATION/CLAIM NO.: **A29767** CERT. NO.: 7733

==========

OWNERSHIP********

==========

NAME: Merlin H. Larsen
ADDR: Promontory Route
Corinne UT 84307

==========

DATES, ETC.********

==========

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: 03/11/1958|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: |LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-3]|MAP: [123a]|PUB DATE:

TYPE -- DOCUMENT -- STATUS*******

Type of Right: Application to Appropriate Source of Info: Proposed Determination Status: Certificate

==========

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)**********MAP VIEWER**********

==========

FLOW: 2.39 cfs SOURCE: Blue Creek
COUNTY: Box Elder COMMON DESCRIPTION:

POINTS OF DIVERSION -- SURFACE:
(1) S 2030 ft W 2310 ft from NE cor, Sec 07, T 10N, R 5W, SLBM
Diverting Works:
Source:
(2) S 3250 ft W 2530 ft from NE cor, Sec 07, T 10N, R 5W, SLBM
Diverting Works:
Source:
(3) S 4010 ft W 1040 ft from NE cor, Sec 07, T 10N, R 5W, SLBM
Diverting Works:
Source:
(4) S 5240 ft W 1700 ft from NE cor, Sec 07, T 10N, R 5W, SLBM

```
      Diverting Works:
Source:
(5) N   30 ft W  700 ft from SE cor, Sec 18, T 10N, R  5W, SLBM
      Diverting Works:
Source:
(6) S 1460 ft W 1650 ft from NE cor, Sec 18, T 10N, R  5W, SLBM
      Diverting Works:
Source:

Stream Alt Required?: No
==========================================================================
==========================================================================
USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow,
horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
==========================================================================
==========================================================================
SUPPLEMENTAL GROUP NO.: 6272.

.......................................................................
.......................................................................
  IRRIGATION: 349.0 acres
Div Limit: 0.0 acft.       PERIOD OF USE: 04/01 TO 10/31
.......................................................................
.......................................................................
  ###PLACE OF USE:       *-------NORTH WEST QUARTER------*-------NORTH
EAST QUARTER------*-------SOUTH WEST QUARTER------*-------SOUTH EAST
QUARTER------*   Section
                         *  NW   |  NE   |  SW   |  SE   *  NW   |  NE
|  SW   |  SE   *  NW   |  NE   |  SW   |  SE   *  NW   |  NE   |  SW
|  SE   *   Totals
 Sec 07 T 10N R  5W SLBM
*_______|_______|_______|_______*_______|_______|23.5000|11.0000*_______
_|_______|_______|_______*30.8000|12.1000|30.0000|26.8000*    134.2000
 Sec 08 T 10N R  5W SLBM
*_______|_______|_______|_______*_______|_______|_______|_______*
9.5000|_______|30.4000|_______*_______|_______|_______|_______*
39.9000
 Sec 18 T 10N R  5W SLBM *_______|_______|_______|_______*
6.3000|18.4000|
8.3000|21.8000*_______|_______|_______|13.6000*22.6000|31.3000|31.5000|
21.1000*    174.9000

GROUP ACREAGE TOTAL:    349.0000
**************************************************************************
**************************************************************
*********************************************************E N D   O F   D
A T A*************************************************************
**************************************************************************
**************************************************************
```

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-2043** APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP

NAME: Salt Wells Cattle Company, LLC
ADDR: 192 North Highland Blvd
Brigham UT 84302
INTEREST: 100% REMARKS:

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: 00/00/1869|PUB BEGAN: |PUB
ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE
ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: 08/28/1967|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]
PD BOOK: [13-3]|MAP: [108]|PUB DATE:

***TYPE -- DOCUMENT -- STATUS**

Type of Right: Diligence Claim Source of Info: Proposed
Determination Status:

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)***********MAP VIEWER*******************

FLOW: SOURCE: Blue Creek
COUNTY: Box Elder COMMON DESCRIPTION: Howell Valley

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. E 660 ft. from W4 corner, Sec 20, T11N, R5W, SLBM,
to a point at N 660 ft. W 660 ft. from S4 corner, Sec 32, T11N, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ***ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family***

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=================================================================
=================================================================
SUPPLEMENTAL GROUP NO.: 6183.  Water Rights Appurtenant to the
following use(s):
13-1796(WUC),2043(DIL),2634(DIL)

.................................................................
.................................................................
  STOCKWATER: Sole Supply: UNEVALUATED ELUs      Group Total: 1000.0000
Div Limit: 28.0 acft.      PERIOD OF USE: 01/01 TO 12/31
=================================================================
=================================================================
PLACE OF USE for
STOCKWATERING*****************************************************
*********************************************
=================================================================
=================================================================
                                 NORTH-WEST¼       NORTH-EAST¼
SOUTH-WEST¼       SOUTH-EAST¼
                                 NW NE SW SE       NW NE SW SE       NW
NE SW SE       NW NE SW SE
Sec 20 T 11N R  5W SLBM       *  :  :  :  *     *  :  :  :  *     * X:
:  :  *     *  :  :  :  *
Sec 32 T 11N R  5W SLBM       *  :  :  :  *     *  :  :  :  *     *  :
:  : X*     *  :  :  :  *
*************************************************************************
*************************************************************
*********************************************************E N D   O F   D
A T A*********************************************************
*************************************************************************
*************************************************************
```

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-2044** APPLICATION/CLAIM NO.: CERT. NO.:

==========

OWNERSHIP********

==========

NAME: Conner Cattle Company
ADDR: c/o Parley Holmgren
Bear River City UT 84301

==========

DATES, ETC.********

==========

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: 00/00/1869|PUB BEGAN: |PUB
ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE
ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: 08/23/1967|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]
PD BOOK: [13-3]|MAP: [123a]|PUB DATE:

TYPE -- DOCUMENT -- STATUS*******

Type of Right: Diligence Claim Source of Info: Proposed
Determination Status:

==========

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)**********MAP VIEWER**********

==========

FLOW: SOURCE: Blue Creek
COUNTY: Box Elder COMMON DESCRIPTION: Howell Valley

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. W 660 ft. from N4 corner, Sec 05, T10N, R5W, SLBM,
to a point at N 660 ft. E 660 ft. from SW corner, Sec 05, T10N, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

==========

USES OF WATER RIGHT********

ELU -- Equivalent Livestock Unit (cow, horse, etc.) ***** EDU -- Equivalent Domestic Unit or 1 Family***

```
==========================================================================
==============================================================
SUPPLEMENTAL GROUP NO.: 5791.  Water Rights Appurtenant to the
following use(s):
13-1104(DIL),1105(DIL),2044(DIL),2047(DIL),2050(DIL)
2201(DIL),2202(DIL),2203(DIL)

.......................................................................
.............................................................
  STOCKWATER: Sole Supply: UNEVALUATED ELUs      Group Total: 400.0000
Div Limit:                 PERIOD OF USE: 01/01 TO 12/31
*=========================================================================
==========================================================================
========================*
SUPPLEMENTAL GROUP NO.: 7097.  Water Rights Appurtenant to the
following use(s):
13-1104(DIL),1105(DIL),2044(DIL),2047(DIL),2050(DIL)
2201(DIL),2202(DIL),2203(DIL),3407(WUC)

.......................................................................
.............................................................
  STOCKWATER: Sole Supply: UNEVALUATED ELUs      Group Total: 500.0000
Div Limit:                 PERIOD OF USE: 01/01 TO 12/31
==========================================================================
==============================================================
PLACE OF USE for
STOCKWATERING*************************************************************
*******************************************
==========================================================================
==============================================================
                                NORTH-WEST¼       NORTH-EAST¼
SOUTH-WEST¼       SOUTH-EAST¼
                                NW NE SW SE       NW NE SW SE       NW
NE SW SE       NW NE SW SE
Sec 05 T 10N R  5W SLBM       *  : X:  :  *     *  :  :  :  *     *  :
: X:  *     *  :  :  :  *
***************************************************************************
*************************************************************
*************************************************************E N D   O F   D
A T A*************************************************************
***************************************************************************
*************************************************************
```

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-2045** APPLICATION/CLAIM NO.: CERT. NO.:

==========

OWNERSHIP********

==========

NAME: Merlin H. Larsen
ADDR: Promontory Route
Corrine UT 84307

==========

DATES, ETC.********

==========

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: 00/00/1869|PUB BEGAN: |PUB
ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE
ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: 08/22/1967|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]
PD BOOK: [13-3]|MAP: [123a]|PUB DATE:

TYPE -- DOCUMENT -- STATUS----------

Type of Right: Diligence Claim Source of Info: Proposed
Determination Status:

==========

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)**********MAP VIEWER**********

==========

FLOW: SOURCE: Blue creek
COUNTY: Box Elder COMMON DESCRIPTION: Lampo Junction

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at N 660 ft. W 660 ft. from SE corner, Sec 06, T10N, R5W, SLBM,
to a point at N 660 ft. W 660 ft. from SE corner, Sec 18, T10N, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

==========

USES OF WATER RIGHT****** *ELU -- Equivalent Livestock Unit (cow, horse, etc.)* ******** *EDU -- Equivalent Domestic Unit or 1 Family*

```
==================================================================================
==================================================================
SUPPLEMENTAL GROUP NO.: 6267.  Water Rights Appurtenant to the
following use(s):
13-284(UGWC),1955(DIL),1956(DIL),1957(UGWC),1958(UGWC)
1959(UGWC),1960(UGWC),1961(UGWC),1962(UGWC),1963(UGWC)
1964(UGWC),1965(UGWC),1966(UGWC),1967(UGWC),2045(DIL)

.....................................................................
.............................................................
  STOCKWATER: Sole Supply: UNEVALUATED ELUs      Group Total: 210.0000
Div Limit:                 PERIOD OF USE: 01/01 TO 12/31
==================================================================================
==================================================================
PLACE OF USE for
STOCKWATERING*************************************************************
*******************************************
==================================================================================
==================================================================
                                 NORTH-WEST¼       NORTH-EAST¼
SOUTH-WEST¼       SOUTH-EAST¼
                                 NW NE SW SE       NW NE SW SE       NW
NE SW SE       NW NE SW SE
Sec 06 T 10N R  5W SLBM       *  :  :  :  *     *  :  :  :  *     *  :
:  :  *     *  :  :  : X*
Sec 18 T 10N R  5W SLBM       *  :  :  :  *     *  :  :  :  *     *  :
:  :  *     *  :  :  : X*
**********************************************************************
*************************************************************
*************************************************************E N D   O F   D
A T A*************************************************************
**********************************************************************
*************************************************************
```

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-2046** APPLICATION/CLAIM NO.: CERT. NO.:

==========

OWNERSHIP********

==========

NAME: Security Title Company
ADDR: 330 East 4th South
Salt Lake City UT 84111

==========

DATES, ETC.********

==========

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: 00/00/1869|PUB BEGAN: |PUB
ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE
ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: 11/01/1967|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]
PD BOOK: [13-3]|MAP: [123d]|PUB DATE:

TYPE -- DOCUMENT -- STATUS*******

Type of Right: Diligence Claim Source of Info: Proposed
Determination Status:

==========

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)**********MAP VIEWER**********

==========

FLOW: SOURCE: Blue Creek
COUNTY: Box Elder COMMON DESCRIPTION: Lampo Junction

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. W 660 ft. from NE corner, Sec 19, T10N, R5W, SLBM,
to a point at N 660 ft. W 660 ft. from SE corner, Sec 19, T10N, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

==========

USES OF WATER RIGHT********** *ELU -- Equivalent Livestock Unit (cow, horse, etc.)* ********* *EDU -- Equivalent Domestic Unit or 1 Family*

```
=================================================================================
=================================================================
SUPPLEMENTAL GROUP NO.: 5903.  Water Rights Appurtenant to the
following use(s):
13-481(DIL),1248(DIL),1250(DIL),1347(DIL),1413(DIL)
1415(DIL),1467(DIL),1860(DIL),1873(DIL),2046(DIL)
2051(DIL)

.....................................................................
.............................................................
  STOCKWATER: Sole Supply: UNEVALUATED ELUs      Group Total: 100.0000
Div Limit: 2.8 acft.       PERIOD OF USE: 01/01 TO 12/31
*================================================================================
================================================================================
========================*
SUPPLEMENTAL GROUP NO.: 6332.  Water Rights Appurtenant to the
following use(s):
13-2046(DIL),2048(DIL),2051(DIL)

.....................................................................
.............................................................
  STOCKWATER: Sole Supply: UNEVALUATED ELUs      Group Total: 300.0000
Div Limit:                 PERIOD OF USE: 01/01 TO 12/31
================================================================================
=================================================================
PLACE OF USE for
STOCKWATERING*****************************************************************
*******************************************
================================================================================
=================================================================
                                NORTH-WEST¼       NORTH-EAST¼
SOUTH-WEST¼       SOUTH-EAST¼
                                NW NE SW SE       NW NE SW SE       NW
NE SW SE       NW NE SW SE
Sec 19 T 10N R  5W SLBM       *  :  :  :  *     *  : X:  :  *     *  :
:  :  *     *  :  :  : X*
********************************************************************************
*****************************************************************
*****************************************************E N D   O F   D
A T A*************************************************************
********************************************************************************
*****************************************************************
```

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-2873** APPLICATION/CLAIM NO.: **A42932** CERT. NO.:

CHANGES: a13790 Water User's Claim (Issued: 05/05/1987)

==========

OWNERSHIP********

==========

NAME: Stangl B-21 Associates Inc.
ADDR: 90 East 7200 South, Suite 200
Midvale UT 84047
INTEREST: 100% REMARKS:

==========

DATES, ETC.********

==========

LAND OWNED BY APPLICANT? Yes COUNTY TAX ID#:
FILED: 09/26/1973|PRIORITY: 09/26/1973|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate:12/14/1974|PROOF DUE: 01/04/1988 EXTENSION:
|ELEC/PROOF:[Election]|ELEC/PROOF:12/04/1985|CERT/WUC: 05/05/1987|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-]|MAP: [123d,c]|PUB DATE:

TYPE -- DOCUMENT -- STATUS*******

Type of Right: Application to Appropriate Source of Info: Water User's Claim Status: Water User's Claim

==========

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)**********MAP VIEWER**********

==========

FLOW: 3300.0 acre-feet SOURCE: Unnamed Stream (Blue Creek)
COUNTY: Box Elder COMMON DESCRIPTION: 4 1/2 miles SW of Lampo Jnct.

POINTS OF DIVERSION -- SURFACE:
(1) N 1900 ft E 2650 ft from NW cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(2) S 1900 ft W 730 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:

(3) S 2050 ft W 1250 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(4) S 2200 ft W 2450 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(5) S 2700 ft W 2600 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(6) S 2800 ft W 1400 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(7) S 1850 ft E 2350 ft from NW cor, Sec 20, T 10N, R 5W, SLBM
Diverting Works:
Source:
(8) S 2100 ft E 1520 ft from NW cor, Sec 20, T 10N, R 5W, SLBM
Diverting Works:
Source:
(9) S 1700 ft W 500 ft from NE cor, Sec 29, T 10N, R 5W, SLBM
Diverting Works:
Source:
(10)S 1750 ft E 100 ft from NW cor, Sec 29, T 10N, R 5W, SLBM
Diverting Works:
Source:
(11)S 2150 ft W 500 ft from NE cor, Sec 30, T 10N, R 5W, SLBM
Diverting Works:
Source:
(12)S 2800 ft W 480 ft from NE cor, Sec 30, T 10N, R 5W, SLBM
Diverting Works:
Source:
(13)N 50 ft E 800 ft from SW cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(14)S 800 ft E 450 ft from NW cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(15)S 1000 ft E 2100 ft from NW cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(16)S 1100 ft W 1950 ft from NE cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(17)S 1250 ft W 2250 ft from NE cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(18)S 1600 ft W 1000 ft from NE cor, Sec 36, T 10N, R 6W, SLBM
Diverting Works:
Source:

Stream Alt Required?: No

==========

USES OF WATER RIGHT******** ***ELU -- Equivalent Livestock Unit (cow, horse, etc.)*** ******** ***EDU -- Equivalent Domestic Unit or 1 Family***

==========

SUPPLEMENTAL GROUP NO.: 6642.

13-2873(WUC)

.....
.....
STOCKWATER: Sole Supply: UNEVALUATED ELUs Group Total: 50.0000
Div Limit: PERIOD OF USE: 01/01 TO 12/31
.....
.....
WILDLIFE: Waterfowl propogation in marshes and ponds
PERIOD OF USE: 01/01 TO 12/31
Acre Feet Contributed by this Right for this Use:
Unevaluated
A network of earth dikes are used to impound water for wildlife propagation.
*==========
==========
==========*
SUPPLEMENTAL GROUP NO.: 7337. Water Rights Appurtenant to the following use(s):
13-2873(WUC),3632(APP)

.....
.....
IRRIGATION: Sole Supply: UNEVALUATED acres Group Total: 2900.0
Div Limit: 0.0 acft. PERIOD OF USE: 04/01 TO 10/31
.....
.....
STOCKWATER: Sole Supply: UNEVALUATED ELUs Group Total: 399.0000
Div Limit: PERIOD OF USE: 01/01 TO 12/31
.....
.....
###PLACE OF USE: *-------NORTH WEST QUARTER------*-------NORTH EAST QUARTER------*-------SOUTH WEST QUARTER------*-------SOUTH EAST QUARTER------* Section
* NW | NE | SW | SE * NW | NE
| SW | SE * NW | NE | SW | SE * NW | NE | SW
| SE * Totals
Sec 05 T 9N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000
Sec 19 T 10N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000
Sec 29 T 10N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000
Sec 31 T 10N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000

GROUP ACREAGE TOTAL: 0.0000
==========
==========
PLACE OF USE for STOCKWATERING********
****

```
==========================================================================
==========================================================
                                NORTH-WEST¼        NORTH-EAST¼
SOUTH-WEST¼        SOUTH-EAST¼
                                NW NE SW SE        NW NE SW SE        NW
NE SW SE        NW NE SW SE
Sec 05 T  9N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      *  :
X:  : X*      * X: X: X: X*
Sec 19 T 10N R  5W SLBM        *  : X:  : X*      * X: X: X: X*      *  :
X:  :  *      * X: X: X: X*
Sec 20 T 10N R  5W SLBM        * X: X: X: X*      *  :  :  :  *      * X:
X: X: X*      *  :  :  :  *
Sec 29 T 10N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
Sec 30 T 10N R  5W SLBM        *  :  :  :  *      * X: X: X: X*      *  :
:  :  *      * X: X: X: X*
Sec 31 T 10N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
Sec 32 T 10N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
Sec 36 T 10N R  5W SLBM        *  :  :  :  *      *  : X:  : X*      *  :
:  :  *      *  : X:  : X*
==========================================================================
==========================================================
Storage from 01/01 to 12/31, inclusive, in Earthen Dikes and Ditches
with a maximum capacity of 3300.000 acre-feet, located in:
   Height of Dam:          4   NORTH-WEST¼        NORTH-EAST¼
SOUTH-WEST¼        SOUTH-EAST¼
   Area Inundated:   2200.00   NW NE SW SE        NW NE SW SE        NW
NE SW SE        NW NE SW SE

Small Dam Required?: No
**************************************************************************
**************************************************************
*********************************************************E N D   O F   D
A T A*************************************************************
**************************************************************************
**************************************************************
```

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-3642** APPLICATION/CLAIM NO.: **A69440** CERT. NO.:

==========

OWNERSHIP********

==========

NAME: Randy Marriott
ADDR: 5238 West 2150 North
Plain City UT 84404

==========

DATES, ETC.********

==========

LAND OWNED BY APPLICANT? Yes COUNTY TAX ID#:
FILED: 11/02/1995|PRIORITY: 11/02/1995|PUB BEGAN: 11/22/1995|PUB ENDED: 11/29/1995|NEWSPAPER: The Leader
ProtestEnd:12/19/1995|PROTESTED: [HearHeld]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate:06/25/1997|PROOF DUE: 08/31/2002
EXTENSION: |ELEC/PROOF:[Proof]|ELEC/PROOF:09/03/2002|CERT/WUC: |LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-]|MAP: [123d,c]|PUB DATE:

TYPE -- DOCUMENT -- STATUS*******

Type of Right: Application to Appropriate Source of Info: Application to Appropriate Status: Approved

==========

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)**********MAP VIEWER**********

==========

FLOW: 20000.0 acre-feet SOURCE: Unnamed Stream (Blue Creek)
COUNTY: Box Elder COMMON DESCRIPTION: 4 1/2 miles SW of Lampo Jnct.

POINTS OF DIVERSION -- SURFACE:
(1) N 1900 ft E 2650 ft from NW cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(2) S 1900 ft W 730 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(3) S 2050 ft W 1250 ft from NE cor, Sec 19, T 10N, R 5W, SLBM

Diverting Works:
Source:
(4) S 2200 ft W 2450 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(5) S 2700 ft W 2600 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(6) S 2800 ft W 1400 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(7) S 1850 ft E 2350 ft from NW cor, Sec 20, T 10N, R 5W, SLBM
Diverting Works:
Source:
(8) S 2100 ft E 1520 ft from NW cor, Sec 20, T 10N, R 5W, SLBM
Diverting Works:
Source:
(9) S 1700 ft W 500 ft from NE cor, Sec 29, T 10N, R 5W, SLBM
Diverting Works:
Source:
(10)S 1750 ft E 100 ft from NW cor, Sec 29, T 10N, R 5W, SLBM
Diverting Works:
Source:
(11)S 2150 ft W 500 ft from NE cor, Sec 30, T 10N, R 5W, SLBM
Diverting Works:
Source:
(12)S 2800 ft W 480 ft from NE cor, Sec 30, T 10N, R 5W, SLBM
Diverting Works:
Source:
(13)N 50 ft E 800 ft from SW cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(14)S 800 ft E 450 ft from NW cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(15)S 1000 ft E 2100 ft from NW cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(16)S 1100 ft W 1950 ft from NE cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(17)S 1250 ft W 2250 ft from NE cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(18)S 1600 ft W 1000 ft from NE cor, Sec 36, T 10N, R 6W, SLBM
Diverting Works:
Source:

Stream Alt Required?: No

==========

==========

USES OF WATER RIGHT******** ***ELU -- Equivalent Livestock Unit (cow, horse, etc.)*** ******** ***EDU -- Equivalent Domestic Unit or 1 Family***

==========

==========

SUPPLEMENTAL GROUP NO.: 7345.

.....
.....
IRRIGATION: 3000.0 acres
Div Limit: 0.0 acft. PERIOD OF USE: 04/01 TO 10/31
.....
.....
STOCKWATER: 300.0000 Stock Units
Div Limit: PERIOD OF USE: 01/01 TO 12/31
.....
.....
WILDLIFE: Waterfowl propogation in marshes and ponds
PERIOD OF USE: 01/01 TO 12/31
Acre Feet Contributed by this Right for this Use:
10991.6
A network of earth dikes are used to impound water for wildlife
propagation.
.....
.....
###PLACE OF USE: *-------NORTH WEST QUARTER------*-------NORTH
EAST QUARTER------*-------SOUTH WEST QUARTER------*-------SOUTH EAST
QUARTER------* Section
* NW | NE | SW | SE * NW | NE
| SW | SE * NW | NE | SW | SE * NW | NE | SW
| SE * Totals
Sec 05 T 9N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000
Sec 19 T 10N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000
Sec 20 T 10N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000
Sec 29 T 10N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000
Sec 30 T 10N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000
Sec 31 T 10N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000
Sec 32 T 10N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000
Sec 36 T 10N R 5W SLBM *X |X |X |X *X |X
|X |X *X |X |X |X *X |X |X
|X * 0.0000

GROUP ACREAGE TOTAL: 0.0000
==========
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PLACE OF USE for
STOCKWATERING********
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```
                                  NORTH-WEST¼        NORTH-EAST¼
SOUTH-WEST¼        SOUTH-EAST¼
                                  NW NE SW SE        NW NE SW SE        NW
NE SW SE        NW NE SW SE
Sec 05 T  9N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
Sec 19 T 10N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
Sec 20 T 10N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
Sec 29 T 10N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
Sec 30 T 10N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
Sec 31 T 10N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
Sec 32 T 10N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
Sec 36 T 10N R  5W SLBM        * X: X: X: X*      * X: X: X: X*      * X:
X: X: X*      * X: X: X: X*
==========================================================================
==================================================================
Storage from 01/01 to 12/31, inclusive, in Earthen Dikes and Ditches
with a maximum capacity of 3300.000 acre-feet, located in:
   Height of Dam:          4   NORTH-WEST¼        NORTH-EAST¼
SOUTH-WEST¼        SOUTH-EAST¼
   Area Inundated:   2200.00   NW NE SW SE        NW NE SW SE        NW
NE SW SE        NW NE SW SE

Small Dam Required?: No
==========================================================================
==================================================================
OTHER
COMMENTS*****************************************************************
*****************************************************
==========================================================================
==================================================================
     The applicant has a prior application 13-2873 to fill marsh
habitat.  This
     water right is being filed to create year-round waterfowl habitat
and will be
     diverted as needed to keep water levels constant in existing ponds
through
     each year.
==========================================================================
==================================================================
PROTESTANTS**************************************************************
*********************************************************
==========================================================================
==================================================================

NAME: Blue Creek Irrigation Company
NAME: Stangl B-21 Inc.
ADDR: c/o Ray D. Sorensen, President
ADDR: c/o F.C. Stangl III, President
      Box 67
1515 West 2200 South, Suite B-2
```

Howell UT 84316
Salt Lake City UT 84119

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****
**********E N D O F D
A T A**********
****
****

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-3810** APPLICATION/CLAIM NO.: **A75052** CERT. NO.:

==========

OWNERSHIP********

==========

NAME: Stangl B-21 Associates Inc.
ADDR: 90 East 7200 South, Suite 200
Salt Lake City UT 84047

==========

DATES, ETC.********

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LAND OWNED BY APPLICANT? Yes COUNTY TAX ID#:
FILED: 08/04/2003|PRIORITY: 08/04/2003|PUB BEGAN: 08/20/2003|PUB ENDED: 08/27/2003|NEWSPAPER: The Leader
ProtestEnd:09/16/2003|PROTESTED: [No Hear]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate:03/17/2004|PROOF DUE: 03/31/2013
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: |LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-]|MAP: [ ]|PUB DATE:

TYPE -- DOCUMENT -- STATUS*******

Type of Right: Application to Appropriate Source of Info: Application to Appropriate Status: Approved

==========

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)**********MAP VIEWER**********

==========

FLOW: 2.5 cfs SOURCE: Shotgun Springs & Blue Creek
COUNTY: Box Elder COMMON DESCRIPTION: Lampo Junction

POINT OF DIVERSION -- SURFACE:
(1) N 634 ft W 1050 ft from SE cor, Sec 07, T 10N, R 5W, SLBM
Diverting Works:
Source: Blue Creek

Stream Alt Required?: No

POINT OF SPRING:
(1) N 2307 ft W 312 ft from S4 cor, Sec 09, T 10N, R 5W, SLBM

Diverting Works:
Source: Shotgun Springs

==========

USES OF WATER RIGHT****** *ELU -- Equivalent Livestock Unit (cow, horse, etc.)* ******** *EDU -- Equivalent Domestic Unit or 1 Family*

==========

SUPPLEMENTAL GROUP NO.: 7526.

.....

WILDLIFE:
PERIOD OF USE: 09/01 TO 10/30
Acre Feet Contributed by this Right for this Use:
1809.94995

.....

OTHER:
PERIOD OF USE: 03/01 TO 04/30
Acre Feet Contributed by this Right for this Use:
1809.94995
Wetland

==========

PLACE OF USE for STOCKWATERING********

==========

	NORTH-WEST¼	NORTH-EAST¼	SOUTH-WEST¼	SOUTH-EAST¼
	NW NE SW SE	NW NE SW SE	NW NE SW SE	NW NE SW SE
Sec 09 T 10N R 5W SLBM	* X: X: X: X*	* X: X: X: X*	* X: X: X: X*	* X: X: X: X*
Sec 16 T 10N R 5W SLBM	* X: X: X: X*	* X: X: X: X*	* X: X: X: X*	* X: X: X: X*
Sec 20 T 10N R 5W SLBM	* X: X: X: X*	* X: X: X: X*	* X: X: X: X*	* X: X: X: X*
Sec 21 T 10N R 5W SLBM	* X: X: X: X*	* X: X: X: X*	* X: X: X: X*	* X: X: X: X*

==========

OTHER COMMENTS********

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The applicant proposes to construct 35 small retention ponds to enhance
vegetative growth.

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PROTESTANTS********

==========
==========

NAME: Connor Cattle Company
NAME:
ADDR: c/o Clair Holmgren
ADDR:
13599 West Hwy 102
Tremonton UT 84337

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APPLICATIONS FOR EXTENSIONS OF TIME WITHIN WHICH TO SUBMIT PROOF********
**

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FILED: 03/15/2007|PUB BEGAN: |PUB ENDED:
|NEWSPAPER: No Adv Required
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE
ACTION: [Approved]|ActionDate:03/26/2007|PROOF DUE: 03/31/2010

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FILED: 03/31/2010|PUB BEGAN: |PUB ENDED:
|NEWSPAPER: No Adv Required
ProtestEnd: |PROTESTED: [ ]|HEARNG HLD: |SE
ACTION: [Approved]|ActionDate:04/29/2010|PROOF DUE: 03/31/2013

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****
**********E N D O F D A T A**********
****
****

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010 Page 1

CHANGE: **a13790** WATER RIGHT: 13-2873 CERT. NO.:
COUNTY TAX ID#: AMENDATORY? Yes
BASE WATER RIGHTS: 13-2873
RIGHT EVIDENCED BY: A42932
CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [X].

NAME: Stangle B-21 Associates Inc.
ADDR: 90 East 7200 South, Suite 200
Midvale UT 84047
INTEREST: 100% REMARKS:

FILED: 12/26/1986|PRIORITY: 12/26/1986|ADV BEGAN: 01/14/1987|ADV ENDED: |NEWSPAPER: The Leader
ProtestEnd:02/27/1987|PROTESTED: [Yes]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate:04/17/1987|PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: 05/05/1987|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
Status: Water User's Claim

****
****
**********H E R E T O F O R E**********
**********H E R E A F T E R**********
****
****

|FLOW: 76.0 cfs
||FLOW: 3300.0 acre-feet |
|----------||----
----------|
|SOURCE: Unnamed Springs & Streams (Blue Cr.)
||SOURCE: Unnamed Streams (Blue Creek) |
|----------||----
----------|
|COUNTY: Box Elder
||COUNTY: Box Elder COM DESC: 4-1/2 mi SW Lampo Junction |
|----------||----
----------|
| ||
A network of earth dikes is used to |
| ||
impound water for wildlife propagation. |
|----------||----
----------|

```
|POINT(S) OF DIVERSION ------> MAP VIEWER
||CHANGED AS FOLLOWS: (Click Location link for WRPLAT)                |
|-----------------------------------------------------------------||----
-----------------------------------------------------------|
|Point Surface:
||Point Surface:                                                      |
|(1)  N 2400 ft E    5 ft from SW cor, Sec 05, T  9N, R  5W, SLBM||(1)
S 1900 ft W  730 ft from NE cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                      ||
Dvrting Wks:                                                      |
| Source:                                                           ||
Source:                                                           |
|(2)  N 1850 ft E    5 ft from SW cor, Sec 05, T  9N, R  5W, SLBM||(2)
S 2050 ft W 1250 ft from NE cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                      ||
Dvrting Wks:                                                      |
| Source:                                                           ||
Source:                                                           |
|(3)  N  200 ft E 4500 ft from SW cor, Sec 17, T 10N, R  5W, SLBM||(3)
S 2800 ft W 1400 ft from NE cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                      ||
Dvrting Wks:                                                      |
| Source:                                                           ||
Source:                                                           |
|(4)  N  300 ft E 5050 ft from SW cor, Sec 17, T 10N, R  5W, SLBM||(4)
S 2200 ft W 2450 ft from NE cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                      ||
Dvrting Wks:                                                      |
| Source:                                                           ||
Source:                                                           |
|(5)  S  100 ft E    5 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(5)
S 2700 ft W 2600 ft from NE cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                      ||
Dvrting Wks:                                                      |
| Source:                                                           ||
Source:                                                           |
|(6)  S 3150 ft E    5 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(6)
N 1900 ft E 2650 ft from SW cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                      ||
Dvrting Wks:                                                      |
| Source:                                                           ||
Source:                                                           |
|(7)  S 4830 ft E    5 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(7)
S 1850 ft E 2350 ft from NW cor, Sec 20, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                      ||
Dvrting Wks:                                                      |
| Source:                                                           ||
Source:                                                           |
|(8)  S    5 ft E 1450 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(8)
S 2100 ft E 1520 ft from NW cor, Sec 20, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                      ||
Dvrting Wks:                                                      |
| Source:                                                           ||
Source:                                                           |
|(9)  S    5 ft E  300 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(9)
S 1750 ft E  100 ft from NW cor, Sec 29, T 10N, R  5W, SLBM|
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| Dvrting Wks:                                                    ||
Dvrting Wks:                                                     |
| Source:                                                         ||
Source:                                                          |
|(10) S    5 ft E 4125 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(10)
S 1700 ft W  500 ft from NE cor, Sec 29, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                     |
| Source:                                                         ||
Source:                                                          |
|(11) S    5 ft E 4810 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(11)
S 2150 ft W  500 ft from NE cor, Sec 30, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                     |
| Source:                                                         ||
Source:                                                          |
|(12) S    5 ft E 2250 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(12)
S 2800 ft W  480 ft from NE cor, Sec 30, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                     |
| Source:                                                         ||
Source:                                                          |
|(13) S    5 ft E 1180 ft from NW cor, Sec 20, T 10N, R  5W, SLBM||(13)
S 1100 ft W 1950 ft from NE cor, Sec 31, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                     |
| Source:                                                         ||
Source:                                                          |
|(14) S    5 ft E 1725 ft from NW cor, Sec 20, T 10N, R  5W, SLBM||(14)
S 1250 ft W 2250 ft from NE cor, Sec 31, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                     |
| Source:                                                         ||
Source:                                                          |
|(15) S    5 ft E 1700 ft from NW cor, Sec 20, T 10N, R  5W, SLBM||(15)
S 1000 ft E 2100 ft from NW cor, Sec 31, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                     |
| Source:                                                         ||
Source:                                                          |
|(16) S    5 ft E 3050 ft from NW cor, Sec 20, T 10N, R  5W, SLBM||(16)
S  800 ft E  450 ft from NW cor, Sec 31, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                     |
| Source:                                                         ||
Source:                                                          |
|(17) N 2080 ft E    5 ft from SW cor, Sec 29, T 10N, R  5W, SLBM||(17)
N   50 ft E  800 ft from SW cor, Sec 31, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                     |
| Source:                                                         ||
Source:                                                          |
|(18) N 2780 ft E    5 ft from SW cor, Sec 29, T 10N, R  5W, SLBM||(18)
S 1600 ft W 1000 ft from NE cor, Sec 36, T 10N, R  6W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                     |
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| Source:                                                          ||
Source:                                                          |
|(19) N 3300 ft E    5 ft from SW cor, Sec 29, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                     ||
|
| Source:                                                          ||
|
|(20) N 3700 ft E    5 ft from SW cor, Sec 29, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                     ||
|
| Source:                                                          ||
|
|(21) N 4550 ft E 2325 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                     ||
|
| Source:                                                          ||
|
|(22) N    5 ft E  100 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                     ||
|
| Source:                                                          ||
|
|(23) N 4180 ft E  350 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                     ||
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| Source:                                                          ||
|
|(24) N 1880 ft E    5 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                     ||
|
| Source:                                                          ||
|
|(25) N 3490 ft E    5 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                     ||
|
| Source:                                                          ||
|
|(26) N 4750 ft E 3300 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                     ||
|
| Source:                                                          ||
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|                                                                  ||
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||Stream Alt?: No                                                  |
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|PLACE OF USE ------>
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|                                --NW¼--   --NE¼--   --SW¼--   --SE¼-- ||
--NW¼--   --NE¼--   --SW¼--   --SE¼-- |
|                               |N N S S||N N S S||N N S S||N N S S|||
|N N S S||N N S S||N N S S||N N S S||
|                               |W E W E||W E W E||W E W E||W E W E|||
|W E W E||W E W E||W E W E||W E W E||
|Sec 05 T  9N R  5W SLBM      *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*||Sec
05 T  9N R  5W SLBM      *X:X:X:X**X:X:X:X**X:X: :X**X:X:X:X*|
|Sec 19 T 10N R  5W SLBM      *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*||Sec
19 T 10N R  5W SLBM      * :X: :X**X:X:X:X** :X: :X**X:X:X:X*|
|Sec 20 T 10N R  5W SLBM      *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*||Sec
20 T 10N R  5W SLBM      *X:X:X:X** : : : **X:X:X:X** : : : *|
|Sec 29 T 10N R  5W SLBM      *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*||Sec
29 T 10N R  5W SLBM      *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
|Sec 31 T 10N R  5W SLBM      *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*||Sec
30 T 10N R  5W SLBM      * : : : **X:X:X:X** : : : **X:X:X:X*|
|                                                                ||Sec
31 T 10N R  5W SLBM      *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
|                                                                ||Sec
32 T 10N R  5W SLBM      *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
|                                                                ||Sec
36 T 10N R  6W SLBM      * : : : ** :X: :X** : : : ** :X: :X*|
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|NATURE OF USE ------>
||CHANGED as follows:                                              |
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|IRR  = values are in acres.                                      ||
|
|STK  = values are in ELUs meaning Cattle or Equivalent.          ||
|
|DOM  = values are in EDUs meaning Equivalent Domestic Units (F   ||
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|SUPPLEMENTAL to Other Water Rights: No
||SUPPLEMENTAL to Other Water Rights: No                          |
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|IRR:   3184.0000 acres.                      USED 04/01 - 10/31||
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|STK:   1000.0000 Cattle or Equivalent        USED 01/01 - 12/31||STK:
50.0000 Cattle or Equivalent         USED 01/01 - 12/31|
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|OTH: WILDLIFE:         Waterfowl propogation  USED 01/01 - 12/31||OTH:
OTHER:            Waterfowl Propagation  USED 01/01 - 12/31|
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|     in marshes and ponds                                          ||
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|RESERVOIR STORAGE -->
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||Storage 01/01 to 12/31, in Earthen Dikes and Ditches              |
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with a maximum capacity of 3300.000 acre-feet, located in:      |
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--NW¼--  --NE¼--  --SW¼--  --SE¼-- |
|                                                                   ||
Height of Dam:       4 ft |N N S S||N N S S||N N S S||N N S S||
|                                                                   ||
Area Inundat 2200.000 acs|W E W E||W E W E||W E W E||W E W E||
|                                                                   ||Sec
05 T  9N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X: :X**X:X:X:X*|
|                                                                   ||Sec
19 T 10N R  5W SLBM     * :X: :X**X:X:X:X** :X: :X**X:X:X:X*|
|                                                                   ||Sec
20 T 10N R  5W SLBM     *X:X:X:X** : : : **X:X:X:X** : : : *|
|                                                                   ||Sec
29 T 10N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
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30 T 10N R  5W SLBM     * : : : **X:X:X:X** : : : **X:X:X:X*|
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31 T 10N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
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32 T 10N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
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36 T 10N R  6W SLBM     * : : : ** :X: :X** : : : ** :X: :X*|
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||Small Dam Permit Required?: No                                    |
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United States
Environmental Protection
Agency

ProUCL Version 5.0.00 Technical Guide

Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations

RESEARCH AND DEVELOPMENT

G-161

CHAPTER 3

Computing Upper Limits to Estimate Background Threshold Values Based Upon Uncensored Data Sets without Nondetect Observations

3.1 Introduction

In background evaluation studies, site-specific (e.g., soils, groundwater) background level constituent concentrations are needed to compare site concentrations with background level concentrations also known as background threshold values (BTVs). The BTVs are estimated, based upon sampled data collected from reference areas and/or unimpacted site-specific background areas (e.g., upgradient wells) as determined by the project team. The first step in establishing site-specific background level constituent concentrations is to collect an appropriate number of samples from the designated background or reference areas. The Stats/Sample Sizes module of ProUCL software can be used to compute DQOs based sample sizes. Once an adequate amount of data has been collected, the next step is to determine the data distribution. This is typically done using exploratory graphical tools (e.g., quantile-quantile [Q-Q] plot) and formal goodness-of-fit (GOF) tests. Depending upon the data distribution, one uses parametric or nonparametric methods to estimate BTVs. An onsite observation in exceedance of a BTV may be considered as not coming from the background population; such a site observation may be considered as exhibiting some evidence of contamination due to site-related activities. Sometimes, locations exhibiting concentrations higher than a BTV estimate are re-sampled to verify the possibility of contamination. Onsite values less than BTVs potentially represent unimpacted locations and are considered coming from the background (or comparable to the background) population. This approach, comparing individual site or groundwater monitoring well (MW) observations with BTVs, is particularly helpful to: 1) identify and screen constituents/contaminants of concern (COCs); and 2) use after some remediation activities (e.g., installation of a GW treatment plant) have already taken place and the objective is to determine if the remediated areas have been remediated close enough to the background level constituent concentrations.

BTV estimation methods described in this chapter are useful when not enough site data are available to perform hypotheses tests such as the two-sample t-test or the nonparametric Wilcoxon Rank Sum (WRS) test. When enough (e.g., more than 8 to10 observations) site data are available, one may use hypotheses testing approaches to compare onsite and background data or onsite data with some pre-established threshold or screening values. The single-sample hypothesis tests (e.g., t-test, WRS test, proportion test) are used when screening levels or BTVs are known or pre-established. The two-sample hypotheses tests are used when enough data (e.g., at least 8-10 observations from each population) are available from background (e.g., upgradient wells) as well as site (e.g., monitoring wells) areas. This chapter describes statistical limits that may be used to estimate the BTVs for full uncensored data sets without any nondetect (ND) observations. Statistical limits for data sets consisting of NDs are discussed in Chapter 5.

It is implicitly assumed that the background data set used to estimate BTVs represents a single statistical population. However, since outliers (well-separated from the main dominant data) are inevitable in most environmental applications, some outliers such as the observations coming from populations other than the background population may also be present in a background data set. Outliers, when present, distort decision statistics of interest (e.g., upper prediction limits [UPLs], upper tolerance limits [UTLs]), which in turn may lead to incorrect remediation decisions that may not be cost-effective or protective of human

health and the environment. The BTVs should be estimated by statistics representing the dominant background population represented by the majority of the data set. *Upper limits computed by including a few low probability high outliers (e.g., coming from the far tails of data distribution) tend to represent locations with those elevated concentrations rather than representing the main dominant background population.* It is suggested to compute all relevant statistics using data sets with outliers and without outliers, and compare the results. This extra step often helps the project team to see the potential influence of outlier(s) on the various decision making statistics (e.g., upper confidence limits [UCLs], UPLs, UTLs), and to make informative decisions about the disposition of outliers. That is, the project team and experts familiar with the site should decide which of the computed statistics (with outliers or without outliers) represent more accurate estimate(s) of the population parameters (e.g., mean, exposure point concentration [EPC], BTV) under consideration. Since the treatment and handling of outliers in environmental applications is a subjective and controversial topic, it is also suggested that the outliers be treated on a site-specific basis using all existing knowledge about the site and reference areas under investigation. A couple of classical outlier tests, incorporated in ProUCL, are described in Chapter 7.

Extracting a Site-Specific Background Data Set From a Broader Mixture Data Set: In practice, not many background samples are collected due to resource constraints and difficulties in identifying suitable background areas with anthropogenic activities and natural geological characteristics comparable to onsite areas (e.g., at large Federal Facilities). Under these conditions, due to confounding of site related chemical releases with anthropogenic influences and natural geological variability, it becomes challenging to: 1) identify background/reference areas with comparable anthropogenic activities and geological conditions/formations; and 2) collect adequate amount of data needed to perform meaningful and defensible site versus background comparisons for each geological stratum to determine chemical releases only due to the site related operations and releases. Moreover, a large number of background samples (not impacted by site related chemical releases) may need to be collected representing the various soil types and anthropogenic activities present at the site; which may not be feasible due to several reasons including resource constraints and difficulties in identifying background areas with anthropogenic activities and natural geological characteristics comparable to onsite areas. The lack of sufficient amount of background data makes it difficult to perform defensible background versus site comparisons and computing reliable estimates of BTVs. A small background data set may not adequately represent the background population; and due to uncertainty and larger variability, the use of a small data set tends to yield non-representative estimates of BTVs.

Under these complex conditions present at a site, and using the known fact that that within all environmental site samples (data sets) exist both background level concentrations and concentrations indicative of site-related releases, sometimes it is desirable to extract a site-specific background data set from a mixture data set consisting of all available onsite and offsite concentrations. Several researchers (e.g., Sinclair [1976], Holgresson and Jorner [1978], Fleischhauer and Korte [1990]) have used normal Q-Q plots/probability plots methods to delineate multiple populations potentially present in a mixture data set collected from environmental, geological and mineral exploration studies.

Therefore, when not enough observations are available from reference areas with geological and anthropogenic influences comparable to onsite areas, the project team may want to use population partitioning methods (e.g., Singh, Singh, and Flatman [1994], Fleischhauer and Korte [1990]) on a broader mixture data set to extract a site-specific background data set with geological conditions and anthropogenic influences comparable to those of the various onsite areas. The extraction of a site-specific background data set from a mixture data set is useful when not enough background data are available to properly represent the background of larger sites (e.g., Federal Facilities covering hundreds of acres of

land) consisting of areas with varying geological formations and soil types where it becomes necessary to establish site-specific background.

The topics of population partitioning and the extraction of a site-specific background data set from a mixture data set are beyond the scope of ProUCL software and this technical guidance document. It requires developing a separate chapter describing the iterative population partitioning method including the identification and extraction of a defensible background data set from a mixture data set consisting of all available data collected from background areas (if available), and unimpacted and impacted onsite locations. Currently, work is in progress to develop a background issue paper describing population methods to extract a site-specific background data set from a mixture data set consisting of concentrations from the various onsite areas and offsite areas (if available).

A review of the environmental literature reveals that one or more of the following statistical upper limits are used to estimate BTVs:

- Upper percentiles
- Upper prediction limits (UPLs)
- Upper tolerance limits (UTLs)
- Upper Simultaneous Limits (USLs) – New in ProUCL 5.0

It is noted that the differences between the various limits used to estimate BTVs are not clear to many practitioners. Therefore, a detailed discussion about the use of the various limits with their interpretation is provided in the following sections. Since 0.95 is the commonly used confidence coefficient (CC), these limits are described for a CC of 0.95 and coverage probability of 0.95 associated with a UTL. ProUCL can compute these limits for any valid combination of CC and coverage probabilities including some commonly used values of CC levels (e.g., 0.80, 0.90, 0.95, 0.99) and coverage probabilities (e.g., 0.80, 0.90, 0.95, 0.975).

Caution: To provide a proper balance between false positives and false negatives, the upper limits described above, especially a 95% USL (USL95) should be used only when the background data set represents a single environmental population without outliers (observations not belonging to background). Inclusion of multiple populations and/or outliers tends to yield elevated values of USLs (and also of UPLs and UTLs) which can result in a high number (and not necessarily high percentage) of undesirable false negatives, especially for data sets of larger sizes (e.g., $n > 30$).

Note on Computing Lower Limits: In many environmental applications (e.g., groundwater monitoring), one needs to compute lower limits including: lower prediction limits (LPLs), lower tolerance limits (LTLs), or lower simultaneous limit (LSLs). At present, ProUCL does not directly compute a LPL, LTL, or a LSL. It should be noted that for data sets with and without nondetects, ProUCL outputs the several intermediate results and critical values (e.g., khat, nuhat, K, d2max) needed to compute the interval estimates and lower limits. For data sets with and without nondetects, except for the bootstrap methods, the same critical value (e.g., normal z value, Chebyshev critical value, or t-critical value) can be used to compute a parametric LPL, LSL, or a LTL (for samples of size >30 to be able to use Natrella's approximation in LTL) as used in the computation of a UPL, USL, or a UTL (for samples of size >30). Specifically, to compute a LPL, LSL, and LTL (n>30) the '+' sign used in the computation of the corresponding UPL, USL, and UTL (n>30) needs to be replaced by the '-' sign in the equations used to compute UPL, USL, and UTL (n>30). For specific details, the user may want to consult a statistician. For data sets *without nondetect* observations, the user may want to use the Scout 2008 software package (EPA 2009c) to compute the various parametric and nonparametric LPLs, LTLs (all sample sizes), and LSLs.

3.1.1 Description and Interpretation of Upper Limits used to Estimate BTVs

Based upon a background data set, upper limits such as a 95% upper confidence limit of the 95th percentile (UTL95-95) are used to estimate upper threshold value(s) of the background population. It is expected that observations coming from the background population will lie below that BTV estimate with a specified CC. BTVs should be estimated based upon an "established" data set representing the background population under consideration.

Established background data set: represents background conditions free of outliers which potentially represent locations impacted by the site and/or other activities. An established background data set should be representative of a single environmental background population. This can be determined by using a normal Q-Q plot on a background data set. If there are no jumps and breaks in the normal Q-Q plot, the data set may be considered to represent a single environmental population. Outliers when present in a data set result in inflated values of the various decision statistics including: UPL, UTL, and USL. The use of inflated statistics as BTV estimates tends to result in a higher number of false negatives.

Notes: The user specifies the allowable false positive error rate, α (=1-CC), and the false negative error rate (declaring a location clean when in fact it is contaminated) is controlled by making sure that one is dealing with a defensible/established background data set representing a single background population and the data set is free of outliers.

Let x_1, x_2, x_n represent sampled concentrations of an established background data set collected from some site-specific or general background reference area.

Upper Percentile, $x_{0.95}$: Based upon an established background data set, a 95th percentile represents that statistic such that 95% of the sampled data will be less than or equal to ($\leq$) $x_{0.95}$. It is expected that an observation coming from the background population (or comparable to the background population) will be $\leq x_{0.95}$ with probability 0.95.

Upper Prediction Limit (UPL): Based upon an established background data set, a 95% UPL (UPL95) represents that statistic such that an independently collected new/future observation from the target population (e.g., background, comparable to background) will be less than or equal to the UPL95 with CC of 0.95. We are 95% sure that a *single future value* from the background population will be less than the UPL95 with CC= 0.95. A parametric UPL takes data variability into account.

In practice, many onsite observations are compared with a BTV estimate. It is noted that the use of a UPL95 to compare many observations may result in a higher number of false positives; that is the use of a UPL95 to compare many observations just by chance tends to incorrectly classify observations coming from the background or comparable to background population as coming from the impacted site locations. For example, if many (e.g., 30) independent onsite comparisons (e.g., Ra-226 activity from 10 onsite locations) are made with the same UPL95, each onsite value may exceed that UPL95 with a probability of 0.05 just by chance. The overall probability, α_{actual} of at least one of those 30 comparisons being significant (exceeding BTV) just by chance is given by:

$\alpha_{actual} = 1-(1-\alpha)^k = 1 - 0.95^{30} \sim 1-0.21 = 0.79$ (false positive rate).

This means that the probability (overall false positive rate) is 0.79 (and is not equal to 0.05) that at least one of the 30 onsite locations will be considered contaminated even when they are comparable to background. The use of a UPL95 is not recommended when multiple comparisons are to be made.

Upper Tolerance Limit (UTL): Based upon an established background data set, a UTL95-95 represents that statistic such that 95% observations (current and future) from the target population (background, comparable to background) will be less than or equal to the UTL95-95 with CC of 0.95. A UTL95-95 represents a 95% UCL of the 95th percentile of the data distribution (population). A UTL95-95 is designed to simultaneously provide coverage for 95% of all potential observations (current and future) from the background population (or comparable to background) with a CC of 0.95. A UTL95-95 can be used when many (unknown) current or future onsite observations need to be compared with a BTV. A parametric UTL95-95 takes the data variability into account.

By definition a UTL95-95 computed based upon a background data set just by chance can classify 5% of background observations as not coming from the background population with CC 0.95. This percentage (false positive error rate) stays the same irrespective of the number of comparisons that will be made with a UTL95-95. However, when a large number of observations coming from the target population (background, comparable to background) are compared with a UTL95-95, the number of exceedances (not the percentage of exceedances) of UTL95-95 by background observations can be quite large. This implies that a larger number (but not greater than 5%) of onsite locations comparable to background may be falsely declared as requiring additional investigation which may not be cost-effective.

To avoid this situation, it is suggested to use a USL95 to estimate the BTV provided the background data set represents a single population free of outliers.

Upper Simultaneous Limit (USL): Based upon an established background data set free of outiers and representing a single statistical population, a USL95 represents that statistic such that *all* observations from the "established" background data set are less than or equal to the USL95 with a CC of 0.95. A parametric USL takes the data variability into account. It is expected that all current or future observations coming from the background population (comparable to background population, unimpacted site locations) will be less than or equal to the USL95 with CC, 0.95 (Singh and Nocerino, 2002). The use of a USL as a BTV estimate is suggested when a large number of onsite observations (current or future) need to be compared with a BTV.

It is noted that by definition, USL95 does not discard any observation. The false positive error rate does not change with the number of comparisons, as the USL95 is designed to perform many comparisons simultaneously. Furthermore, the USL95 also has a built in outlier test (Wilks, 1963), and if an observation (current or future) exceeds USL95, then that value definitely represents an outlier and may not come from the background population. The false negative error rate is controlled by making sure that the background data set represents a single background population free of outliers. Typically, the use of a USL95 tends to result in a smaller number of false positives than a UTL95-95, especially when the size of the background data set is greater than 15.

3.1.2 Confidence Coefficient (CC) and Sample Size

This section briefly discusses sample sizes and the selection of CCs associated with various upper limits used to estimate BTVs.

- Higher statistical limits are associated with higher levels of CCs. For an example, a 95% UPL is higher than a 90% UPL.

- Higher values of a CC (e.g., 99%) tend to decrease the power of a test, resulting in a higher number of false negatives- dismissing contamination when present.

Therefore, the CC should not be set higher than necessary.

- Smaller values of the CC (e.g., 0.80) tend to result in a higher number of false positives (e.g., declaring contamination when it is not present).

- In most practical applications, choice of a 95% CC provides a good compromise between confidence and power.

- Higher level of uncertainty in a background data set (e.g., due to a smaller background data set) and higher values of critical values associated with smaller (e.g., <15-20) samples tend to dismiss contamination as representing background conditions (results in higher number of false negatives, i.e., identifying a location that may be dirty as background). This is especially true when one uses UTLs and UPLs to estimate BTVs.

- Nonparametric upper limits based upon order statistics (e.g., the largest, the second largest,...) may not provide the desired coverage as they do not take data variability into account. Nonparametric methods are less powerful than the parametric methods; and they require larger data sets to achieve power comparable to parametric methods.

3.2 Treatment of Outliers

The inclusion of outliers in a background data set tends to yield distorted (inflated) estimates of BTVs. Outlying observations which are significanly higher than the majority of the background data may not be used in establishing background data sets and in the computation of BTV estimates. A couple of classical outlier tests cited in environmental literature (EPA, 2006b, Navy, [2002a, 2002b]) are available in the ProUCL software. It is noted that the classical outlier procedures suffer from masking effects as they get distorted by the same outlying observations that they are supposed to find! It is therefore recommended to supplement outlier tests with graphical displays such as box plots, Q-Q plots. On a Q-Q plot, elevated observations which are well-separated from the majority of data represent potential outliers.

It is noted that nonparametric upper percentiles, UPLs, and UTLs are often represented by higher order statistics such as the largest value or the second largest value. When high outlying observations are present in a background data set, the higher order statistics may represent observations coming from the contaminated onsite/offsite areas. Decisions made based upon outlying observations or distorted upper limits can be incorrect and misleading. Therefore, special attention should be given to outlying observations. The project team and the decision makers involved should decide about the proper disposition of outliers, to include or not include them, in the computation of the various decision making statistics such as the UCL95 and the UTL95-95. Sometimes, performing statistical analyses twice on the same data set – once using the data set with outliers and once using the data set without outliers can help the project team in determining the proper disposition of high outliers. Some examples elaborating on these issues have been discussed in this document.

Notes: It should be pointed out that methods incorporated in ProUCL can be used on any data set with or without nondetects and with or without outliers. It may not be misinterpreted that ProUCL 5.0 is restricted and can only be used on data sets without outliers. It is not a requirement to exclude outliers before using any of the statistical methods incorporated in ProUCL. The intent of the developers of ProUCL software is to inform the users how the inclusion of a few outliers coming from the *low probability tails of the data distribution* can yield distorted values of UCL95, UPLs, UTLs, and various other statistics. The decision limits and test statistics should be computed based upon the majority of data

representing the main dominant population and not by accommodating a few low probability outliers resulting in distorted and inflated values of the decision statistics. The inflated decision statistics tend to represent the locations with those elevated observations rather than representing the main dominant population. The outlying observations may be separately investigated to determine the reasons for their occurrences (e.g., errors or contaminated locations). It is suggested to compute the statistics with and without the outliers, and compare the potential impact of outliers on the decision making processes.

Let $x_1, x_2, \ldots, x_n$ represent concentrations of a contaminant/constituent of concern (COC) collected from some site-specific or general background reference area. The data are arranged in ascending order and the ordered sample (called ordered statistics) is denoted by $x_{(1)} \leq x_{(2)} \leq \ldots \leq x_{(n)}$. The ordered statistics are used as nonparametric estimates of upper percentiles, UPLs, UTLs and USLs. Also, let $y_i = \ln(x_i)$; $i = 1, 2, \ldots, n$, and $\bar{y}$ and s_y represent the mean and standard deviation (*sd*) of the log-transformed data. Statistical details of some parametric and nonparametric upper limits used to estimate BTVs are described in the following sections.

3.3 Upper p*100% Percentiles as Estimates of BTVs

In most statistical textbooks (e.g., Hogg and Craig, 1995), the pth (e.g., $p = 0.95$) sample percentile of the measured sample values is defined as that value, $\hat{x}_p$, such that p*100% of the sampled data set lies at or below it. The carat sign over x_p, indicates that it represents a statistic/estimate computed using the sampled data. The same use of the carat sign is found throughout this guidance document. The statistic $\hat{x}_p$ represents an estimate of the pth population percentile. It is expected that about p*100% of the population values will lie below the pth percentile. Specifically, $x_{0.95}$ represents an estimate of the of the 95th percentile of the background population.

*3.3.1 Nonparametric p*100% Percentile*

Nonparametric 95% percentiles are used when the background data (raw or transformed) do not follow a discernible distribution at some specified (e.g., $\alpha = 0.05, 0.1$) level of significance. It is noted that different software packages (e.g., SAS, Minitab, and Microsoft Excel) use different formulae to compute nonparametric percentiles, and therefore yield slightly different estimates of population percentiles, especially when the sample size is small such as less than 20-30. Specifically, some software packages estimate the pth percentile by using the $p*n^{th}$ order statistic, which may be a whole number between 1 and n or a fraction lying between 1 and n, while other software packages compute the pth percentile by the $p*(n+1)^{th}$ order statistic (e.g., used in ProUCL versions 4.00.02 and 4.00.04) or by the $(pn+0.5)^{th}$ order statistic. For example, if $n = 20$, and $p = 0.95$, then 20*0.95 = 19, thus the 19th ordered statistic represents the 95th percentile. If $n = 17$, and $p = 0.95$, then 17*0.95= 16.15, thus the 16.15^{th} ordered value represents the 95th percentile. The 16.15^{th} ordered value lies between the 16th and the 17th order statistics and can be computed by using a simple linear interpolation given by:

$$x_{(16.15)} = x_{(16)} + 0.15\,(x_{(17)} - x_{(16)}). \qquad (3\text{-}1)$$

It should be noted that the earlier versions (e.g., ProUCL 4.00.02, 4.00.04) of ProUCL used $p*(n+1)^{th}$ order statistic to estimate the nonparametric p^{th} percentile. However, since most users are familiar with Excel and some consultants have developed statistical software packages using Excel, at the request of some users, it was decided to use the same algorithm as incorporated in Excel to compute nonparametric percentiles. ProUCL 4.1 and higher versions compute nonparametric percentiles using the same algorithm as used in Excel 2007. This algorithm is used on data sets with and without ND observations.

Notes: From a practical point of view, nonparametric percentiles computed using the various percentile computation methods described in the literature are comparable unless the data set is small (e.g., n <20-30) and/or comes from a mixed population consisting of some extreme high values. No single percentile computation method should be considered superior to other percentile computation methods available in the statistical literature. In addition to nonparametric percentiles, ProUCL also computes several parametric percentiles described as follows.

*3.3.2 Normal p*100% Percentile*

The sample mean, $\bar{x}$. and *sd*, *s*, are computed first. For normally distributed data sets, the $p*100^{th}$ sample percentile is given by the following statement:

$$\hat{x}_p = \bar{x} + sz_p \tag{3-2}$$

Here z_p is the $p*100^{th}$ percentile of a standard normal, N(0, 1), distribution, which means that the area (under the standard normal curve) to the left of z_p is p. If the distributions of the site and background data are comparable, then it is expected that an observation coming from a population (e.g., site) comparable to the background population would lie at or below the $p*100\%$ upper percentile, $\hat{x}_p$, with probability p.

*3.3.3 Lognormal p*100% Percentile*

To compute the pth percentile, $\hat{x}_p$, of a lognormally distributed data set, the sample mean, $\bar{y}$, and *sd*, s_y, of log-transformed data, y are computed first. For lognormally distributed data sets, the $p*100^{th}$ percentile is given by the following statement:

$$\hat{x}_p = \exp(\bar{y} + s_y z_p), \tag{3-3}$$

z_p is the $p*100^{th}$ percentile of a standard normal, N(0,1), distribution.

*3.3.4 Gamma p*100% Percentile*

Since the introduction of a gamma distribution, G (k, θ), is relatively new in environmental applications, a brief description of the gamma distribution is given first; more details can be found in Section 2.3.3. The maximum likelihood estimator (*MLE*) equations to estimate gamma parameters, k (shape parameter) and θ (scale parameter), can be found in Singh, Singh, and Iaci (2002). A random variable (RV), X (arsenic concentrations), follows a gamma distribution, G(k, θ), with parameters $k > 0$ and $\theta > 0$, if its probability density function is given by the following equation:

$$\begin{aligned} f(x;k,\theta) &= \frac{1}{\theta^k \Gamma(k)} x^{k-1} e^{-x/\theta}; && x > 0 \\ &= 0; && otherwise \end{aligned} \tag{3-4}$$

The mean, variance, and skewness of a gamma distribution are: $\mu = k\theta$, variance $= \sigma^2 = k\theta^2$, and skewness $= 2/\sqrt{k}$. Note that as k increases, the skewness decreases, and, consequently, a gamma

distribution starts approaching a normal distribution for larger values of k (e.g., $k \geq 10$). In practice, k is not known and a normal approximation may be used even when the MLE estimate of k is as small as 6. If needed, the user may want to use graphical Q-Q plots and perform GOF tests to verify if data sets with smaller values of the *MLE* estimates of k follow normal distributions.

Let $\hat{k}$ and $\hat{\theta}$ represent the *MLE*s of k and θ respectively. The relationship between a gamma RV, X = G (k, θ), and a chi-square RV, Y, is given by X = Y * θ/2, where Y follows a chi-square distribution with $2k$ degrees of freedom (*df*). Thus, the percentiles of a chi-square distribution (as programmed in ProUCL) can be used to determine the percentiles of a gamma distribution. In practice, k is replaced by its *MLE*. Once an α*100% percentile, $y_{(\alpha)\ 2k}$, of a chi-square distribution with $2k$ *df* is obtained, the α*100% percentile for a gamma distribution is computed using the following equation:

$$x_\alpha = y_\alpha * \theta / 2 \tag{3-5}$$

3.4 Upper Tolerance Limits

A UTL (1-α)-p (e.g., UTL95-95) based upon an established background data set represents that limit such that p*100% of the observations (current and future) from the target population (background, comparable to background) will be less than or equal to UTL with a *CC*, (1-α). It is expected that p*100% of the observations belonging to the background population will be less than or equal to a UTL with a *CC*, (1-α). A UTL (1-α)-p represents a (1 – α) 100% UCL for the unknown p^{th} percentile of the underlying background population.

A UTL95-95 is designed to provide coverage for 95% of all observations potentially coming from the background or comparable to background population(s) with a CC of 0.95. A UTL95-95 will be exceeded by all (current and future) values coming from the background population less than 5% of the time with a CC of 0.95, that is 5 exceedances per 100 comparisons (of background values) can result just by chance for an overall CC of 0.95. Unlike a UPL95, a UTL95-95 can be used when many ,or unknown number of, current or future onsite observations need to be compared with a BTV. A parametric UTL95-95 takes the data variability into account.

When a large number of comparisons are made with a UTL95-95, the number of exceedances (not the percentage of exceedances) of the UTL95-95 by those observations can also be large just by chance. This implies that just by chance, a larger number (but not larger than 5%) of onsite locations comparable to background can be greater than a UTL95-95 potentially requiring unnecessary investigation which may not be cost-effective. In order to avoid this situation, it is suggested to use a USL95 to estimate a BTV, provided the background data set represents a single statistical population, free of outliers.

3.4.1 Normal Upper Tolerance Limits

First, compute the sample mean, $\bar{x}$, and *sd*, s, using a defensible data set representing a single background population. For normally distributed data sets, an upper (1 – α)*100% UTL with coverage coefficient, p, is given by the following statement.

$$UTL = \bar{x} + K * s \tag{3-6}$$

Here, $K = K(n, \alpha, p)$ is the tolerance factor and depends upon the sample size, n, CC = (1 – α), and the coverage proportion = p. For selected values of n, p, and (1-α), values of the tolerance factor, K, have been tabulated extensively in the various statistical books (e.g., Hahn and Meeker 1991). Those K values

are based upon the non-central t-distribution. Also, some large sample approximations (e.g., Natrella, 1963) are available to compute the K values for one-sided tolerance intervals (same for both UTLs and lower tolerance limits). The approximate value of K is also a function of the sample size, n, coverage coefficient, p, and the CC, $(1 - \alpha)$. For samples of small sizes, $n \leq 30$, ProUCL uses the tabulated (Hahn and Meeker, 1991) K values. Tabulated K values are available only for some selected combinations of p (e.g., 0.90, 0.95, 0.975) and $(1-\alpha)$ values (e.g., 0.90, 0.95, 0.99). For sample sizes larger than 30, ProUCL computes the K values using the large sample approximations, as given in Natrella (1963). The Natrella's approximation seems to work well for samples of sizes larger than 30. ProUCL computes these K values for all valid values of p and $(1-\alpha)$ and samples of sizes as large as 5000.

3.4.2 Lognormal Upper Tolerance Limits

The procedure to compute UTLs for lognormally distributed data sets is similar to that for normally distributed data sets. First, the sample mean, $\bar{y}$, and *sd*, s_y, of the log-transformed data are computed. An upper $(1 - \alpha)*100\%$ tolerance limit with tolerance or coverage coefficient, p is given by the following statement:

$$UTL = \exp(\bar{y} + K * s_y) \tag{3-7}$$

The K factor in (3-7) is the same as the one used to compute the normal UTL.

Notes: It is noted that even though there in no back-transformation bias present in the computation of a lognormal UTL, a lognormal distribution based UTL is typically higher (sometimes unrealistically higher as shown in the following example) than other parametric and nonparametric UTLs; especially when the sample size is less than 20. Therefore, the use of a lognormal UTLs to estimate BTVs should be avoided when skewness is high (e.g., *sd* of logged data > 1 or 1.5) and sample size is small (e.g., < 20-30).

3.4.3 Gamma Distribution Upper Tolerance Limits

Positively skewed environmental data can often be modeled by a gamma distribution. ProUCL software has two goodness-of-fit tests: the Anderson-Darling (A-D) and Kolmogorov-Smirnov (K-S) tests for a gamma distribution. These GOF tests are described in Chapter 2. UTLs based upon normal approximation to the gamma distribution (Krishnamoorthy *et al.*, 2008) have been incorporated in ProUCL. Those approximations are based upon Wilson-Hilferty (WH; 1931) and Hawkins-Wixley (H-W; 1986) approximations. A description of the procedure to compute gamma UTLs is given as follows.

Let $x_1, x_2, \ldots, x_n$ represent a data set of size n from a gamma distribution, $G(k, \theta)$ with shape parameter, k and scale parameter θ.

- According to the WH approximation, the transformation, $Y = X^{1/3}$ follows an approximate normal distribution.
- According to the HW approximation, the transformation, $Y = X^{1/4}$ follows an approximate normal distribution.

Let $\bar{y}$ and s_y represent the mean and *sd* of the observations in the transformed scale (Y).

Using the WH approximation, the gamma UTL (in original scale, X), is given by:

$$UTL = \max\left(0, \left(\bar{y} + K * s_y\right)^3\right) \tag{3-8}$$

Similarly, using the HW approximation, the gamma UTL in original scale is given by:

$$UTL = \left(\bar{y} + K * s_y\right)^4 \tag{3-9}$$

The tolerance factor, K is defined earlier in (3-6) while computing a UTL based upon normal distribution.

Note: that for mildly skewed to moderately skewed gamma distributed data sets, HW and WH approximations yield fairly comparable UTLs. However for highly skewed data sets (e.g., k<0.5) with higher variability, HW method tends to yield higher limits than the WH method. A couple of examples are discussed as follows.

3.4.4 Nonparametric Upper Tolerance Limits

The computation of nonparametric UTLs and associated achieved confidence levels are described as follows. A nonparametric $UTL_{p,(1-\alpha)}$ =UTL p-(1 - α) providing coverage to p*100% observations with CC, (1 – α)*100% UCL for the pth percentile of the target population under study. It is expected that about p*100% of the observations (current and future) coming from the target population (e.g., background, comparable to background) will be $\leq UTL_{p,(1-\alpha)}$ with CC, (1 – α)*100.

Let $x_{(1)} \leq x_{(2)} \leq \ldots x_{(r)} \leq \ldots \leq x_{(n)}$ represent n ordered statistics (arranged in ascending order) of a given data set, $x_1, x_2, \ldots, x_n$. A nonparametric UTL is computed by the higher order statistics such as the largest, the second largest, the third largest, and so on. The order, r of the statistic, $x_{(r)}$ used to compute a nonparametric UTL depends upon the sample size, n, coverage probability, p, and the desired CC, (1 - α). It is noted that in comparison with parametric UTLs, nonparametric UTLs require larger data sets to achieve the desired CC; a nonparametric UTL p-(1 - α) computed by order statistics often fails to exactly achieve the specified CC, (1 – α). The formula to compute the order statistic, sample size, and CC achieved by nonparametric UTLs are described as follows. More details can be found in David and Nagaraja (2003), Conover (1999), Hahn and Meeker (1991), Wald (1963), Scheffe and Tukey (1944) and Wilks (1941).

3.4.4.1 Determining the Order, r, of the Statistic, $x_{(r)}$, to Compute UTLp,(1-α)

Using the cumulative binomial probabilities, a number, r: $1 \leq r \leq n$, is chosen such that the cumulative binomial probability: $\sum_{i=0}^{i=r} \binom{n}{i} p^i (1-p)^{(n-i)}$ becomes as close as possible to (1 – α). The binomial distribution (BD) based algorithm has been incorporated in ProUCL for data sets of sizes up to 2000. For data sets of size, n >2000, ProUCL computes the rth (r: $1 \leq r \leq n$) order statistic by using the normal approximation (Conover, 1999) given by the equation (3-10).

$$r = np + z_{(1-\alpha)}\sqrt{np(1-p)} + 0.5 \tag{3-10}$$

Depending upon the sample size, p, and (1 - α) the largest, the second largest, the third largest, and so forth order statistic is used to estimate the UTL. As mentioned earlier for a given data set of size n, the rth

order statistic, $x_{(r)}$ may or may not achieve the specified CC, (1 - α). ProUCL uses the following F-distribution based probability statement to compute the CC achieved by the UTL determined by the rth order statistic.

3.4.4.2 Determining the Achieved Confidence Coefficient, $CC_{achieve}$, Associated with $x_{(r)}$

For a given data set of size, n, once the rth order statistic, $x_{(r)}$, has been determined, ProUCL can be used to determine if a UTL computed using $x_{(r)}$ achieves the specified CC, (1 - α). ProUCL computes the achieved CC by using the following approximate probability statement based upon the F-distribution with ν_1 and ν_2 *df.*

$$CC_{Achieve} = (1-\alpha_*) = \text{ Probability } (F_{(\nu_1,\nu_2)} \le f);\ \nu_1 = 2(n-r+1), \text{ and } \nu_2 = 2r$$

$$f = \frac{r(1-p)}{(n-r+1)p} \tag{3-11}$$

For a given data set of size n, ProUCL 5.0 first computes the order statistic that is used to compute a nonparametric UTL$p,(1-\alpha)$. Once the order statistic has been determined, ProUCL 5.0 computes the CC actually achieved by that UTL.

3.4.4.3 Determining the Sample Size

For specified values of p and (1 - α), the minimum sample size can be computed using Scheffe and Tukey (1944) approximate sample size formula given by equation (3-12). The minimum sample size formula should be used before collecting any data /samples. Once the data set of size, n has been collected, using the binomial distribution or approximate normal distribution, one can compute the order, r of the statistic that can be used to compute a UTL. As mentioned earlier, the UTLs based upon order statistics often do not achieve the desired confidence level. One can use equation (3-11) to compute the CC achieved by a UTL.

$$n_{needed} = 0.25 * \chi^2_{2m,(1-\alpha)} * (1+p)/(1-p) + (m-1)/2 \tag{3-12}$$

In equation (3-12), $\chi^2_{2m,(1-\alpha)}$ represents the (1 - α) quantile of a chi-square distribution with *2m df.* It should be noted that in addition to p and (1 - α), the Scheffe and Tukey (1944) approximate minimum sample size formula (3-12) also depends upon the order, r of the statistic, $x_{(r)}$ used to compute the UTLp, (1 - α)). Here m: $1 \le m \le n$; and m=1 when the largest value, $x_{(n)}$, is used to compute the UTL; and m=2, when the second largest value, $x_{(n-1)}$ is used to compute a UTL, and $m=n-r+1$ when the rth order statistic, $x_{(r)}$, is used to compute a UTL. For an example, if the largest sample value, $x_{(n)}$, is used to compute a UTL95-95, then a minimum sample size of 59 (see equation (3-12)) will be needed to achieve a confidence level of 0.95 providing coverage to 95% of the observations coming from the target population. A UTL95-95 computed based upon a data set of size less than 59 may not achieve the desired confidence of 0.95 for the 95th percentile of the target population.

For example, when the largest order statistic (with m=1) is used to compute a nonparametric UTL95-95, the approximate minimum sample size needed 0.25*5.99*1.95/0.05 ≈ 58.4 which is rounded upward to 59; and when the second largest value (with m=2) is used to compute a UTL95-95, the approximate minimum sample size needed [(0.25*9.488*1.95)/0.05]+0.5 ≈ 93. Similarly to compute a UTL90-95 by the largest sample value, about 29 observations will be needed to provide coverage for 90% of the

observations from the target population with CC = 0.95. In environmental applications, the number of available observations from the target population is much smaller than 29, 59 or 93 and a UTL computed based upon those data sets may not provide specified coverage with the desired CC.

3.4.4.4 Nonparametric UTL Based Upon the Percentile Bootstrap Method

A couple of bootstrap methods to compute nonparametric UTLs are also available in ProUCL 5.0. Like the percentile bootstrap UCL computation method, for data sets without a discernible distribution, one can use percentile bootstrap resampling method to compute $UTL_{p,(1-\alpha)}$ =UTL $p,(1 - \alpha)$. The N bootstrapped nonparametric p^{th} percentiles, $p,(i:=1,2,...,N)$, are arranged in ascending order: $p_1 \leq p_2 \leq .... \leq p_N$. The $UTL_{p,(1-\alpha)}$ for the target population is given by the value that exceeds the $(1 - \alpha)*100$ of the N bootstrap percentile values. The UTL95-95 is the 95th percentile and is given by:

95% Percentile UTL = 95th percentile of p_i *values;* $i: = 1, 2, ..., N$

For example when N = 1000, the ULT95-95 is given by the 950th order percentile value of the 1000 bootstrapped 95th percentiles. Typically, this method yields the largest value in the data set to compute a UTL which may not provide the desired coverage (e.g., 0.95) to the 95th population percentile.

3.4.4.5 Nonparametric UTL Based Upon the Bias-Corrected Accelerated (BCA) Percentile Bootstrap Method

Like the percentile bootstrap method, one can use the BCA bootstrap method (Efron and Tibshirani 1993) to compute nonparametric UTLs. However, this method needs further investigation. This method is incorporated in ProUCL 4.00.04 and higher versions for interested users. In this method one replaces the sample mean, bootstrap and jackknife (deleting one observation at a time) means by the corresponding bootstrap percentiles and jackknife (computed using (n - 1) observations by deleting one observation at a time) percentiles. The details of the BCA bootstrap method are given in Section 2.4.9.4.

3.5 Upper Prediction Limits

Based upon a background data set, UPLs are computed for a single (UPL_1) and k (UPL_k) future observations. Additionally, in groundwater monitoring applications, an upper prediction limit of the mean of the k future observations, UPL_k (mean) is also used. A brief description of parametric and nonparametric upper prediction limits is provided in this section.

<u>UPL_1 for a Single Future Observation:</u> A UPL_1 computed based upon an established background data set represents that statistic such that a single future observation from the target population (e.g., background, comparable to background) will be less than or equal to $UPL_1$95 with a CC of 0.95. A parametric UPL takes the data variability into account. A UPL_1 is designed for a *single future* observation comparison; however in practice users tend to use $UPL_1$95 to perform many future comparisons which results in a high number of false postives (observations declared contaminated when in fact they are clean).

When k>1 future comparisons are made with a UPL_1, some of those future observations will exceed the UPL_1 just by chance, each with probability 0.05. For proper comparison, a UPL needs to be computed accounting for the number of comaprisons that will be performed. For example, if 30 independent onsite comparisons (e.g., Pu-238 activity from 30 onsite locations) are made with the same background $UPL_1$95,

each onsite value comparable to background may exceed that $UPL_1 95$ with probability 0.05. The overall probability of at least one of those 30 comparisons being significant (exceeding the BTV) just by chance is given by:

$\alpha_{actual} = 1-(1-\alpha)^k = 1 - 0.95^{30} \sim 1-0.21 = 0.79$ (false positive rate).

This means that the probability (overall false positive rate) is 0.79 (and not 0.05) that at least one of the 30 onsite observations will be considered contaminated even when they are comparable to background. Similar arguments hold when multiple *(=j,* a positive integer*)* constituents are analyzed, and status (clean or impacted) of an onsite location is determined based upon *j* comparisons (one for each analyte). The use of a UPL_1 is not recommended when multiple comparisons are to be made.

3.5.1 Normal Upper Prediction Limit

The sample mean, $\bar{x}$, and the *sd*, *s*, are computed first based upon a defensible background data set. For normally distributed data sets, an upper $(1 - \alpha)*100\%$ prediction limit is given by the following well known equation:

$$UPL = \bar{x} + t_{((1-\alpha),(n-1))} * s * \sqrt{(1+1/n)} \tag{3-13}$$

Here $t_{((1-\alpha),(n-1))}$ is a critical value from the Student's t-distribution with $(n-1)$ *df.*

3.5.2 Lognormal Upper Prediction Limit

An upper $(1 - \alpha)*100\%$ lognormal UPL is similarly given by the following equation:

$$UPL = \exp(\bar{y} + t_{((1-\alpha),(n-1))} * s_y * \sqrt{(1+1/n)}) \tag{3-14}$$

Here $t_{((1-\alpha),(n-1))}$ is a critical value from the Student's t-distribution with $(n-1)$ *df.*

3.5.3 Gamma Upper Prediction Limit

Given a sample, $x_1, x_2, \ldots, x_n$ of size n from a gamma distribution $G(k, \theta)$, approximate (based upon WH and HW approximations described earlier in Section 3.4.3, Gamma Distribution Upper Tolerance Limits), $(1 - \alpha)*100\%$ upper prediction limits for a future observation from the same gamma distributed population are given by:

$$\textit{Wilson-Hilferty (WH) UPL} = \max\left(0, \left(\bar{y} + t_{((1-\alpha),(n-1))} * s_y * \sqrt{1 + 1/n}\right)^3\right) \tag{3-15}$$

$$\textit{Hawkins-Wixley (HW) UPL} = \left(\bar{y} + t_{((1-\alpha),(n-1))} * s_y * \sqrt{1 + 1/n}\right)^4 \tag{3-16}$$

Here $t_{((1-\alpha),(n-1))}$ is a critical value from the Student's t-distribution with $(n-1)$*df.*

3.5.4 Nonparametric Upper Prediction Limit

A one-sided nonparametric UPL is simple to compute and is given by the following m^{th} order statistic. One can use linear interpolation if the resulting number, m, given below does not represent a whole number (a positive integer).

$$UPL = X_{(m)}, \text{ where } m = (n + 1) * (1 - \alpha). \quad (3\text{-}17)$$

For example, for a nonparametric data set of size n=25, a 90% UPL is desired. Then m = (26*0.90) = 23.4. Thus, a 90% nonparametric UPL can be obtained by using the 23rd and the 24th ordered statistics and is given by the following equation:

$$UPL = X_{(23)} + 0.4 * (X_{(24)} - X_{(23)})$$

Similarly, if a nonparametric 95% UPL is desired, then m = 0.95 * (25 + 1) = 24.7, and a 95% UPL can be similarly obtained by using linear interpolation between the 24th and 25th order statistics. However, if a 99% UPL needs to be computed, then m = 0.99 * 26 = 25.74, which exceeds 25, the sample size; for such cases, the highest order statistic is used to compute the 99% UPL of the background data set. The largest value(s) should be used with caution (as they may represent outliers) to estimate the BTVs.

Since nonparametric upper limits (e.g., UTLs, UPLs) are based upon higher order statistics, often the CC achieved by these nonparametric upper limits is much lower than the specified CC of 0.95, especially when the sample size is small. In order to address this issue, one may want to compute a UPL based upon the Chebyshev inequality. In addition to various parametric and nonparametric upper limits, ProUCL computes Chebyshev inequality based UPL.

3.5.4.1 Upper Prediction Limit Based Upon the Chebyshev Inequality

Like UCL of mean, the Chebyshev inequality can be used to obtain a reasonably conservative but stable UPL and is given by the following equation:

$$UPL = \bar{x} + [\sqrt{((1/\alpha) - 1) * (1 + 1/n)}]s_x$$

This is a nonparametric method since the Chebyshev inequality does not require any distributional assumptions. It should be noted that just like the Chebyshev UCL, a UPL based upon the Chebyshev inequality tends to yield higher estimates of BTVs than the various other methods. This is especially true when skewness is mild (e.g., *sd* of log-transformed data is low < 0.75), and the sample size is large (e.g., > 30). The user is advised to use professional judgment before using this method to compute a UPL. Specifically, for larger skewed data sets, instead of using a 95% UPL based upon the Chebyshev inequality, the user may want to compute a Chebyshev UPL with a lower CC (e.g., 85%, 90%) to estimate a BTV. ProUCL can compute a Chebyshev UPL (and all other UPLs) for any user specified CC in the interval [0.5, 1].

3.5.5 Normal, Lognormal, and Gamma Distribution based Upper Prediction Limits for k Future Comparisons

A UPL_k95 computed based upon an established background data set represents that statistic such that k future (next, independent andnot belonging to the current data set) observations from the target population (e.g., background, comparable to background) will be less than or equal to the UPL_k95 with a CC of 0.95.

A UPL_k95 for k (≥ 1) future observations is designed to compare k future observations; we are 95% sure that "k" future values from the background population will be less than or equal to UPL_k95 with CC of 0.95. In addition to UPL_k, ProUCL also computes an upper prediction limit of the mean of k future observations, UPL_k (mean). A UPL_k (mean) is commonly used in groundwater monitoring applications. A UPL_k controls the false positive error rate by using the Bonferroni inequality based critical values to perform k future comparisons. These UPLs statisfy the relationship: $UPL_1 \leq UPL_2 \leq UPL_3 \leq \ldots \leq UPL_k \ldots$.

A normal distribution based UPL_k (1 - α) for k future observations, $x_{n+1}, x_{n+2}, \ldots, x_{n+k}$ is given by the probability statement:

$$P\left(x_{n+1}, x_{n+2}, \ldots, x_{n+k} \leq \bar{x} + t_{((1-\alpha/k),n-1)} s \sqrt{1+\frac{1}{n}} \right) = 1-\alpha \tag{3-18}$$

$$UPL_k = \bar{x} + s * t_{(1-\alpha/k),n-1} \sqrt{1+\frac{1}{n}}$$

$$UPL_k 95 = \left(\bar{x} + t_{((1-0.05/k),n-1)} s \sqrt{1+\frac{1}{n}} \right)$$

For an example, a UPL_3 95 for 3 future observations: x_{01}, x_{02}, x_{03} is given by:

$$UPL_3 95 = \left(\bar{x} + t_{((1-0.05/3),n-1)} s \sqrt{1+\frac{1}{n}} \right)$$

A lognormal distribution based UPL_k (1 - α) for k future observations, $x_{n+1}, x_{n+2}, \ldots, x_{n+k}$ is given by the following equation:

$$UPL_k = \exp(\bar{y} + s_y * t_{(1-\alpha/k),n-1} \sqrt{1+\frac{1}{n}})$$

A gamma distribution based UPL_k for the next k > 1 (k future observations) are computed similarly using the WH and HW approximations described in Section 3.4.3.

3.5.6 Proper Use of Upper Prediction Limits

It is noted that some users tend to use UPLs without taking their definition and intended use into consideration; this is an incorrect application of a UPL. Some important points to note about the proper use of UPL_1 and UPL_k for $k>1$ are described as follows.

- When a UPL_k is computed to compare k future observations collected from a site area or a group of MW within an operating unit (OU), it is assumed that the project team will make a decision about the status (clean or not clean) of the site (MWs in an OU) based upon those *k* future observations.

- The use of an UPL_k implies that a decision about the site-wide status will be made only after k comparisons have been made with the UPL_k. It does not matter if those k observations are collected (and compared) simultaneously or successively. The k observations are compared with the UPL_k as they become available and a decision (about site status) is made based upon those k observations.

- An incorrect use of a UPL_1 95 is to compare many (e.g., 5, 10, 20,...) future observations. This results in a higher than 0.05 false positive rate. Similarly, an inappropriate use of a UPL_{100} would be to compare less than 100 (i.e., 10, 20, or 50 observations) future observations.. Using a UPL_{100} to compare 10 or 20 observations can potentially result in a high number of false negatives (a test with reduced power) declaring contaminated areas comparable to background.

- The use of other statistical limits such as 95%-95% UTLs (UTL95-95) is preferred to estimate BTVs and not-to-exceed values. The computation of a UTL does not depend upon the number of future comparisons which will be made with the UTL.

3.6 Upper Simultaneous Limits

An $(1 - \alpha)$ * 100% upper simultaneous limit (USL) based upon an established background data set is meant to provide coverage for <u>all</u> observations, x_i, $i = 1, 2, n$ simultaneously in the background data set. It is implicitly assumed that the data set comes from a single background population and is free of outliers (established background data set). A USL95 represents that statistic such that all observations from the "established" background data set will be less than or equal to the USL95 with a CC of 0.95. It is expected that observations coming from the background population will be less than or equal to the USL95 with a 95% CC. A USL95 can be used to perform any number (unknown) of comparisons of future observations. The false positive error rate does not change with the number of comparisons as the purpose of the USL95 is to perform any number of comparisons simultaneously.

<u>Notes:</u> If a background population is established based upon a small data set; as one collects more observations from the background populations, some of the new background observations will exceed the largest value in the existing data set. In order to address these uncertainties, the use of a USL is recommended, provided the data set represents a single population without outliers.

3.6.1 Upper Simultaneous Limits for Normal, Lognormal and Gamma Distributions

The normal distribution based two-sided $(1 - \alpha)$ 100% simultaneous interval obtained using the first order Bonferroni inequality (Singh and Nocerino, 1995, 1997) is given as follows:

$$P\left(\bar{x} - sd_{\alpha}^{b} \le x_i \le \bar{x} + sd_{\alpha}^{b}; i := 1, 2, ..., n\right) = 1 - \alpha . \qquad (3\text{-}19)$$

Here, $(d_{\alpha}^{b})^2$ represents the critical value (obtained using the Bonferroni inequality) of the maximum Mahalanobis distance (Max (MDs)) for α level of significance (Singh, 1993). The details about the Mahalanobis distances and computation of the critical values, $(d_{\alpha}^{b})^2$ can be found in Singh (1993) and Singh and Nocerino (1997). These values have been programmed in ProUCL 5.0 to compute USLs for any combination of the sample size, n, and CC, $(1 - \alpha)$.

The normal distribution based, one-sided (1 – α) 100% USL providing coverage for all n sample observations is given as follows:

$$P\left(x_i \le \bar{x} + s d_{2\alpha}^b ; i := 1,2,...,n\right) = 1 - \alpha \ ;$$

$$USL = \bar{x} + s * d_{2\alpha}^b ; \qquad (3\text{-}20)$$

Here $(d_{2\alpha}^b)^2$ is the critical value of Max (MDs) for a 2*α level of significance.

The lognormal distribution based one-sided (1 – α) 100% USL providing coverage for all n sample observations is given by the following equation:

$$USL = \exp(\bar{x} + s * d_{2\alpha}^b) \qquad (3\text{-}21)$$

A gamma distribution based (using WH approximation), one-sided (1 – α) 100% USL providing coverage to all sample observations is given by:

$$USL = \max\left(0, \left(\bar{y} + d_{2\alpha}^b * s_y\right)^3\right)$$

A gamma distribution based (using the HW approximation), one-sided (1 – α) 100% USL providing coverage to all sample observations is given as follows:

$$USL = \left(\bar{y} + d_{2\alpha}^b * s_y\right)^4$$

Nonparametric USL: For nonparametric data sets, the largest value, $x_{(n)}$ is used to compute a nonparametric USL. Just like a nonparametric UTL, a nonparametric USL may fail to provide the specified coverage, especially when the sample size is small (e.g., <60). The confidence coefficient actually achieved by a USL can be computed using the same process as used for a nonparametric UTL described in Sections 3.4.4.2 and 3.4.4.3. Specifically, by substituting r=n in equation (3-11), the confidence coefficient achieved by a USL can be computed, and by substituting m=1 in equation (3-12), one can compute the sample size needed to achieve the desired confidence.

Notes: Nonparametric USLs, UTLs or UPLs should be used with caution; nonparametric upper limits are based upon order statistics and therefore do not take the variability of the data set into account. Often nonparametric BTVs estimated by order statistics do not achieve the specified CC unless the sample size is fairly large.

Some examples illustrating the computations of the various upper limits described in this chapter are discussed as follows.

Example 3-1. Consider a real Superfund site data set. The data set has several inorganic constituents of potential concern, including aluminum, arsenic, chromium (Cr), and lead. The computation of background statistics obtained using ProUCL are summarized as follows. The complete data set is given in Appendix 5 of the *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA, 2002a).

Upper Limits Based upon a Normally Distributed Data Set: The aluminum data set follows a normal distribution as shown in the following GOF Q-Q plot of Figure 3-1.

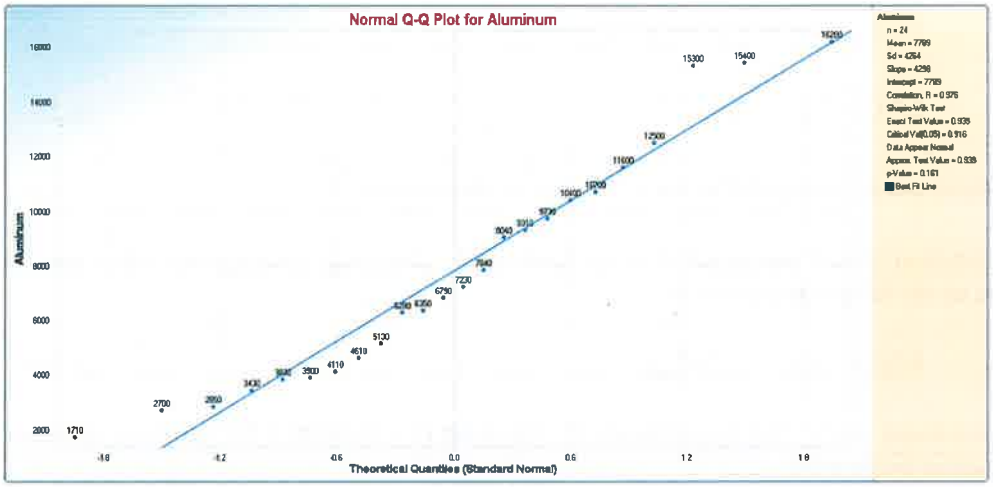

Figure 3-1. Normal Q-Q plot of aluminum with GOF Statistics

From the normal Q-Q plot shown in Figure 3-1, it is noted that the 3 largest values are higher (but not extremely high) than the rest of the 21 observations. These observations may or may not be coming from the same population as the rest of the 21 observations. The classical outlier tests (e.g., Dixon and Rosner tests) did not identify these 3 data points as outliers. Robust outlier tests (e.g., MCD [Rousseeuw and Leroy, 1987)] and PROP influence function [Singh and Nocerino, 1995] based tests) identified the 3 high values as statistical outliers. The project team should decide whether or not the 3 higher concentrations represent outliers. A brief discussion about robust outlier identification methods is given in Chapter 7. The inclusion of the 3 higher values in the data set resulted in higher upper limits. The various upper limits have been computed with (Table 3-1) and without the 3 high observations (Table 3-2).

Table 3-1. BTV Estimated Based upon All 24 Observations

Aluminum

General Statistics

Total Number of Observations	24	Number of Distinct Observations	24
Minimum	1710	First Quartile	4058
Second Largest	15400	Median	7010
Maximum	16200	Third Quartile	10475
Mean	7789	SD	4264
Coefficient of Variation	0.547	Skewness	0.542
Mean of logged Data	8.798	SD of logged Data	0.61

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.309	d2max (for USL)	2.644

Normal GOF Test

Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.109	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.181	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	17635	90% Percentile (z)	13254
95% UPL (t)	15248	95% Percentile (z)	14803
95% USL	19063	99% Percentile (z)	17708

Table 3-2. BTV Estimated Based upon 21 Observations without 3 Higher Values

Aluminum

General Statistics

Total Number of Observations	21	Number of Distinct Observations	21
		Number of Missing Observations	3
Minimum	1710	First Quartile	3900
Second Largest	11600	Median	6350
Maximum	12500	Third Quartile	9310
Mean	6669	SD	3215
Coefficient of Variation	0.482	Skewness	0.25
Mean of logged Data	8.676	SD of logged Data	0.549

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.371	d2max (for USL)	2.58

Normal GOF Test

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.12	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.193	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	14291	90% Percentile (z)	10789
95% UPL (t)	12344	95% Percentile (z)	11957
95% USL	14964	99% Percentile (z)	14147

The project team should make a determination of which statistics (with outliers or without outliers) should be used to estimate BTVs.

Example 3-2. Chromium concentrations of the superfund site data set used in Example 3-1 follow a lognormal distribution. The computation of background statistics using a lognormal model are shown in -3 3. Figure 3-2 is the lognormal Q-Q plot with GOF statistics.

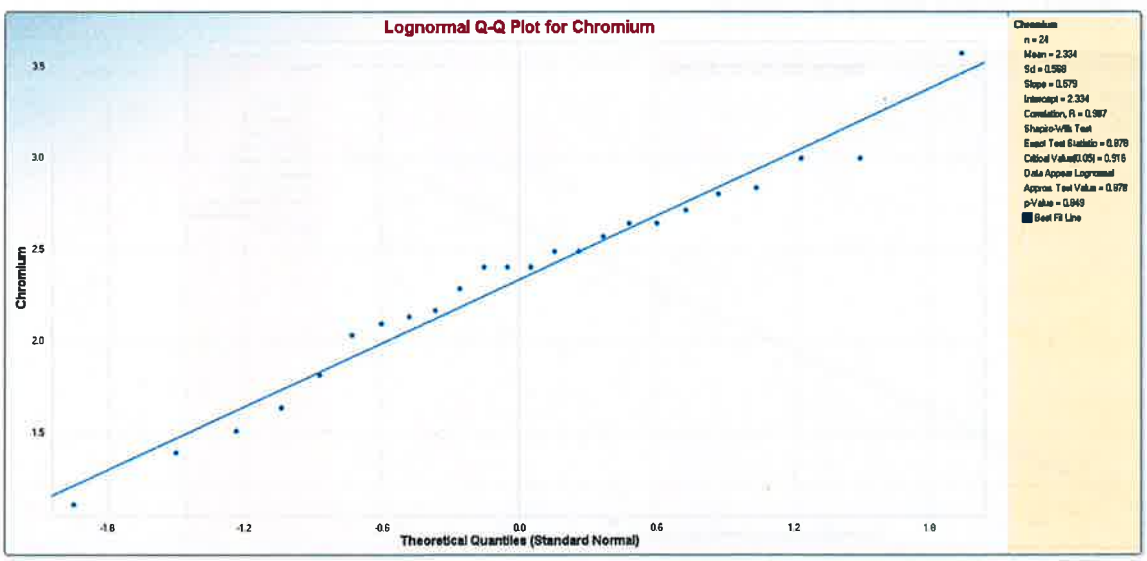

Figure 3-2. Lognormal Q-Q plot of Chromium with GOF Statistics

Table 3-3. Lognormal Distribution Based UPLs, UTLs, and USLs

Chromium

General Statistics

Total Number of Observations	24	Number of Distinct Observations	19
Minimum	3	First Quartile	7.975
Second Largest	20	Median	11
Maximum	35.5	Third Quartile	14.25
Mean	11.97	SD	6.892
Coefficient of Variation	0.576	Skewness	1.728
Mean of logged Data	2.334	SD of logged Data	0.568

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.309	d2max (for USL)	2.644

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.916	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.128	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.181	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	38.3	90% Percentile (z)	21.37
95% UPL (t)	27.87	95% Percentile (z)	26.27
95% UPL for Next 5 Observations	43.96	99% Percentile (z)	38.68
95% UPL for Mean of 5 Observations	16.66	95% USL	46.33

Example 3-3. Arsenic concentrations of the superfund site data set used in Example 3-1 follow a gamma distribution. The background statistics, obtained using a gamma model, are shown in Table 3-4. Figure 3-3 is the gamma Q-Q plot with GOF statistics.

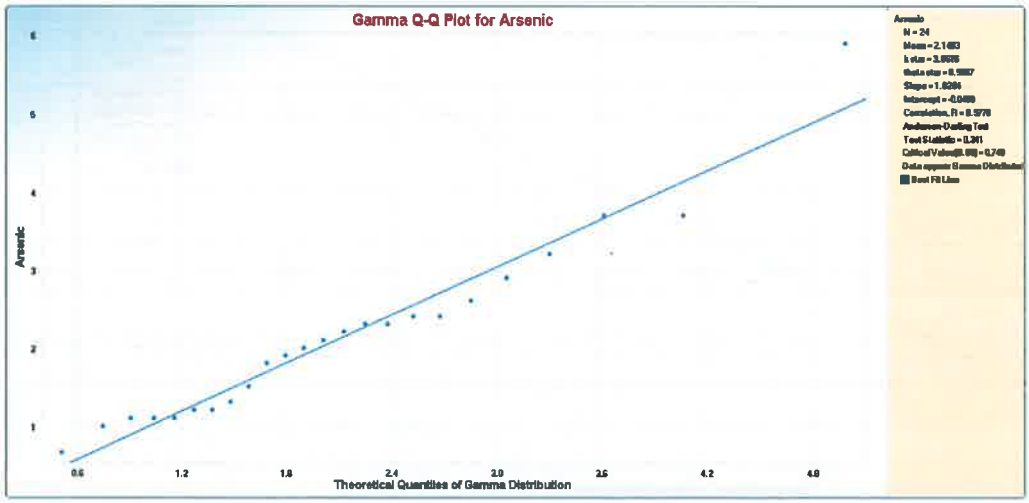

Figure 3-3. Gamma Q-Q plot of Arsenic with GOF Statistics

Table 3-4. Gamma Distribution Based UPLs, UTLs, and USLs

Arsenic

General Statistics

Total Number of Observations	24	Number of Distinct Observations	18
Minimum	0.66	First Quartile	1.2
Second Largest	3.7	Median	2.05
Maximum	5.9	Third Quartile	2.45
Mean	2.148	SD	1.159
Coefficient of Variation	0.54	Skewness	1.554
Mean of logged Data	0.639	SD of logged Data	0.51

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.309	d2max (for USL)	2.644

Gamma GOF Test

A-D Test Statistic	0.341	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.114	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.179	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.153	k star (bias corrected MLE)	3.662
Theta hat (MLE)	0.517	Theta star (bias corrected MLE)	0.587
nu hat (MLE)	199.3	nu star (bias corrected)	175.8
MLE Mean (bias corrected)	2.148	MLE Sd (bias corrected)	1.123

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	4.345	90% Percentile	3.654
95% Hawkins Wixley (HW) Approx. Gamma UPL	4.397	95% Percentile	4.264
95% WH Approx. Gamma UTL with 95% Coverage	5.382	99% Percentile	5.574
95% HW Approx. Gamma UTL with 95% Coverage	5.524		
95% WH USL	6.074	95% HW USL	6.294

Example 3-4. Lead concentrations of the superfund site data set used in Example 3-1 do not follow a discernible distribution. The various nonparametric background statistics for lead are shown in Table 3-5.

Table 3-5. Nonparametric UPLs, UTLs, and USLs for Lead in Soils

Lead

General Statistics

Total Number of Observations	24	Number of Distinct Observations	18
Minimum	4.9	First Quartile	10.43
Second Largest	98.5	Median	14
Maximum	109	Third Quartile	19.25
Mean	22.49	SD	26.83
Coefficient of Variation	1.193	Skewness	2.665
Mean of logged Data	2.743	SD of logged Data	0.771

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.309	d2max (for USL)	2.644

Nonparametric Distribution Free Background Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	24	95% UTL with 95% Coverage	109
Approximate f	1.263	Confidence Coefficient (CC) achieved by UTL	0.708
95% Percentile Bootstrap UTL with 95% Coverage	109	95% BCA Bootstrap UTL with 95% Coverage	109
95% UPL	106.4	90% Percentile	44.81
90% Chebyshev UPL	104.6	95% Percentile	91.72
95% Chebyshev UPL	141.8	99% Percentile	106.6
95% USL	109		

Notes: As mentioned before, nonparametric upper limits are computed by higher order statistics, or by some value in between (based upon linear interpolation) the higher order statistics. In practice, nonparametric upper limits do not provide the desired coverage to the population parameter (upper threshold) unless the sample size is large. From Table 3-5, it is noted that a UTL95-95 is estimated by the maximum value in the data set of size 24. However, the CC actually achieved by UTL95-95 (and also by USL95) is only 0.708. *Therefore, one may want to use other upper limits such as 95% Chebyshev UPL = 141.8 to estimate a BTV.*

Example 3-5: Why Use a Gamma Distribution to Model Positively Skewed Data Sets?

The data set considered in Example 2-2 of Chapter 2 is used to illustrate the deficiencies and problems associated with the use of a lognormal distribution to compute UCL95 of the mean. As noted earlier, the data set follows a lognormal as well as a gamma model; the various upper limits, based upon a lognormal and a gamma model, are summarized as follows. The largest value in the data set is 169.8, the UTL95-95 and UPL95 based upon a lognormal model are 799.7 and 319 both of which are significantly higher than the maximum value of 169.8. A UPL95 (UTL95-95) based upon a gamma model are 245.3(or 285.6) and 163.5 (or 178.2) which appear to represent more reasonable estimates of the BTV. These statistics are summarized in Table 3-6 (lognormal) and Table 3-7 (gamma) below.

Table 3-6. Background Statistics Based Upon a Lognormal Model

x

General Statistics

Total Number of Observations	25	Number of Distinct Observations	25
Minimum	0.349	First Quartile	5.093
Second Largest	164.3	Median	18.77
Maximum	169.8	Third Quartile	72.62
Mean	44.09	SD	51.34
Coefficient of Variation	1.164	Skewness	1.294
Mean of logged Data	2.835	SD of logged Data	1.68

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.292	d2max (for USL)	2.663

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.135	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.177	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	799.7	90% Percentile (z)	146.5
95% UPL (t)	319	95% Percentile (z)	269.7

Table 3-7. Background Statistics Based Upon a Gamma Model

X

General Statistics

Total Number of Observations	25	Number of Distinct Observations	25
Minimum	0.349	First Quartile	5.093
Second Largest	164.3	Median	18.77
Maximum	169.8	Third Quartile	72.62
Mean	44.09	SD	51.34
Coefficient of Variation	1.164	Skewness	1.294
Mean of logged Data	2.835	SD of logged Data	1.68

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.292	d2max (for USL)	2.663

Gamma GOF Test

A-D Test Statistic	0.374	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.794	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.113	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.183	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.643	k star (bias corrected MLE)	0.592
Theta hat (MLE)	68.58	Theta star (bias corrected MLE)	74.42
nu hat (MLE)	32.15	nu star (bias corrected)	29.62
MLE Mean (bias corrected)	44.09	MLE Sd (bias corrected)	57.28

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	163.5	90% Percentile	115
95% Hawkins Wixley (HW) Approx. Gamma UPL	178.2	95% Percentile	159.4
95% WH Approx. Gamma UTL with 95% Coverage	245.3	99% Percentile	266.8
95% HW Approx. Gamma UTL with 95% Coverage	285.6		

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Oily substance in Mill Creek is vegetable oil, preliminary report says

February 17, 2015

SALT LAKE CITY — State water quality officials received preliminary results Tuesday on an oily sheen that appeared on the surface of Mill Creek last week, and the news is encouraging.

The oily substance was first spotted last Friday. It is seeping out of a storm drain near 3300 South and 700 East and straight into Mill Creek. Preliminary water samples taken by the Department of Environmental Quality show the substance is a vegetable oil and not a petroleum product, something officials said was good news.

The results are not yet final — the DEQ expects more conclusive information later this week.

There are no indications of any threat to public or environmental health, according to the Salt Lake County Health Department. Department officials have been monitoring the situation at the site for the past three days.

The area of the source has been isolated within a couple hundred yards, but health officials still don't know exactly where it is coming from.

The first report of the substance came in around 7:30 a.m. Friday morning in the area of 500 East. Firefighters put booms in the water to contain the oil.

While the sheen continues to seep into the area where the storm drain meets the creek, it's not spreading downstream.

The source could be an illegal dump, a leak of some sort percolating through the soil or a natural occurrence, health officials said. The DEQ should receive final test results Wednesday.

Mill Creek spill was motor oil, tests confirm

By MICHAEL MCFALL (/staff/?ID=88) | The Salt Lake Tribune CONNECT (/staff/?ID=88)

First Published Feb 18 2015 11:39AM • Last Updated Feb 18 2015 09:37 pm

continue to article

(http://www.sltrib.com/news/2193631-158/mill-creek-spill-was-motor-oil?pid=2206697)

(Al Hartmann | The Salt Lake Tribune) Brian Minchey, storm water inspector with South Salt Lake City Public Works, right, takes water samples with Utah Dept. of Environmental Quality member at a cluster of three culverts that coverage with Millcreek at about 700 East and 3300 South on Friday morning.

Environment » The source of the oil remains a mystery.

(/csp/mediapool/sites/sltrib/pages/printfriendly.csp?id=2193631) Share This Article

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Health officials have confirmed the substance found floating in Mill Creek last week was motor oil — but how it got there is still a mystery.

Preliminary tests had ruled out a petroleum-based oil, and were leaning toward a vegetable-based oil, said Salt Lake County Health Department spokesman Nicholas Rupp. But when the final results came back Wednesday afternoon, it turned out to be a "very small quantity of motor oil" — so small, the first tests didn't pick up on it, Rupp said.

The confirmation comes five days after a passerby first noticed the oily sheen on the surface of the creek near Fitts Community Park (3050 S. 500 East).

That Friday morning (http://www.sltrib.com/news/2176945-155/hazmat-crews-respond-to-oil-spill), hazmat crews rushed to the scene and contained the substance to a five-block span of the creek. The oil appeared to have entered from a storm drain somewhere above 700 East, which is fed by three canal and drainage inlets. But the health department couldn't find the oil's source.

"They checked all of the storm drain boxes and popped manhole covers all over that area to see if it was dumped," Rupp said.

Unified Fire Battalion Chief Brian Anderton said Friday that the leak did not appear to be large and was not thought to be a public health concern — though experts were on-site to gauge any environmental or wildlife impact.

Salt Lake County Health Department officials said they had no reports of human or animal or wildlife injuries or ailments related to the spill.

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Devil_N_Me • [illegible]

Never having heard of "Naturally occurring vegetable oils I did a quick Google. In short, there is no such thing.

So the question is who is covering whose six, and why?

From Wikipedia:

"A vegetable oil is a triglyceride extracted from a plant. Such oils have been part of human culture for millennia. The term "vegetable oil" can be narrowly defined as referring only to plant oils that are liquid at room temperature, or broadly defined without regard to a substance's state of matter at a given temperature. For this reason, vegetable oils that are solid at room temperature are sometimes called vegetable fats. Vegetable oils are composed of triglycerides, as contrasted with waxes which lack glycerin in their structure. Although many plant parts may yield oil, in commercial practice, oil is extracted primarily from seeds."
http://en.wikipedia.org/wiki/V...

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Mill Creek coated in motor oil, not vegetable oil, report says

February 18, 2015

SALT LAKE CITY — After receiving final test results Wednesday morning, officials at the Utah Department of Environmental Quality now say the oily sheen coating Mill Creek this week is not vegetable oil, as once believed, but motor oil.

The substance was first reported Friday morning near 3300 South and 500 East. Preliminary sample tests showed the oil was not a petroleum product, leading DEQ officials to proclaim it as vegetable oil Tuesday. However, more in-depth testing revealed the substance to be diluted motor oil.

Health department officials stressed the oil's low concentration, saying it poses no threat to public or environmental health.

"It's such a small amount that we don't anticipate there's an issue," said Ron Lund, enforcement coordinator for the Salt Lake County Health Department. "The amount is similar to what we see after a rainstorm."

The oil has been seeping into the creek from a storm drain near 3300 South and 700 East. Officials have been monitoring the area all week. Lund said the pollution appears to be slowing.

Until Wednesday, officials had been searching for the source of a vegetable oil leak or an illegal dump. Now, Lund said, the explanation looks a bit more mundane.

"It could be residual oil that was left in the storm drain system over time," he said. "As we drive our cars and cars are parked, they leak oil at times. That oil then collects in storm drains."

Lund said water quality officials will continue to monitor the storm drain system in their day-to-day work, keeping an eye out for possible leak sources.

Anyone who witnesses unusual or suspicious activity near a storm drain is asked to call the Salt Lake County Health Department hotline at 385-468-8888.

Allison Oligschlaeger is currently studying English and Arabic at the University of Utah while completing an internship with the Deseret News. Contact her at aoligschlaeger@deseretnews.com.

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Groups challenge Utah over mine expansion

By Amy Joi O'Donoghue, Deseret News

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Published: Sunday, Feb. 22 2015 4:41 p.m. MST
Updated: Sunday, Feb. 22 2015 4:41 p.m. MST

This 2011 photo shows z test pit and planned development area for U.S. Oil Sands about 85 miles from Vernal. Western Resource Advocates filed an administrative challenge of Utah's decision to let U.S. Oil Sands expand its oil sands mine in eastern Utah.

Tim Wall, U.S. Oil Sands

Enlarge photo»

Summary

Western Resource Advocates filed an administrative challenge of Utah's decision to let U.S. Oil Sands expand its oil sands mine in eastern Utah. The challenge asserts mining activity will harm surface and ground water and regulators acted improperly.

SALT LAKE CITY — A planned expansion of the country's only commercial oil sands mine is once again under legal challenge by an environmental group because of feared impacts to water resources.

Living Rivers, through Western Resource Advocates, filed an administrative challenge last week to the Utah Division of Water Quality's decision to allow the mine to expand beyond its initial demonstration phase.

"The state of Utah consistently seems to place development of these dirty fuels above protecting public health and the environment," said attorney Rob Dubuc of Western Resource Advocates. "With clear evidence showing that the area of the mine is connected to area seeps and springs, there's simply no justification for DWQ to allow the mine to expand operations without appropriate oversight."

But the division concluded there is no risk from the PR Spring Mine to contaminate ground or surface water because of the lack of water resources in the area.

Dubuc countered that new studies show the area of the expanded mine is a recharge zone for perennial springs in Main Canyon, below the mine. He added that tests conducted by the company show that diesel range organic compounds in the mine tailings will be thousands of times greater than the maximum contaminant levels allowed in drinking water.

Donna Kemp Spangler, spokeswoman for the Utah

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Donna Kemp Spangler, spokeswoman for the Utah Department of Environmental Quality, said regulators stand by their decision.

"Water Quality's decision to allow U.S. Oil Sands to proceed with its project is based on scientific facts that have repeatedly been upheld throughout the legal system, including the Utah Supreme Court," she said. "The Division of Water Quality did not take any further action, so we don't think this appeal has merit."

Last March, the Utah Supreme Court heard another challenge by Living Rivers over their belief that the state should have required a groundwater discharge permit for the mining operation. The case, justices ruled, was not brought in a timely manner.

In that hearing, the state argued hydrology tests in the area demonstrated a general lack of groundwater down to 2,000 feet below the surface, far below where U.S. Oil Sands would be mining.

Company officials believe that ultimately, 190 million barrels of oil can be successfully mined from the site, which occupies school trust lands property in eastern Utah.

U.S. Oil Sands' chief executive officer Cameron Todd said this latest challenge by Living Rivers stems from the company applying for an "environmental improvement" request with state regulators over revisions to how it will proceed with the mining operation.

Todd said the company is reducing the amount of area that will be disturbed in the project and enhancing reclamation efforts by shifting the order in which the mine is developed.

"Local activists seeking to obstruct the lawful development are challenging the company's environmental improvement request," he said. "Arguments made against the improvement are the same as were previously heard and rejected by state regulators, appeals judge and the Utah Supreme Court...The matter has been exhaustively reviewed during the past four years, and the company's plan was validated and approved by the state. "

But Dubuc said those revisions sought by the mining company significantly alter and expand the project enough that state water quality regulators should revisit their position on the mine, require a permit and require monitoring of the springs to ensure they are protected.

"We feel that what we're asking is very reasonable and that it's time for (the division) to properly regulate this mine," he said.

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February 27

From Energy and Climate Report

FREE TRIAL

By Andrew Childers

Feb. 26 — The Environmental Protection Agency's Clean Air Act and Clean Water Act rules infringe on state sovereignty and would impose significant economic burdens on farmers and industries, states told a House subcommittee Feb. 26.

The proposed Clean Power Plan, stronger air quality standards for ozone and a water jurisdiction rule all interfere with the ability of states to manage their own resources and regulate their electricity generation sector, the attorneys general of Montana and Arkansas told the House Oversight and Government Reform Interior Subcommittee.

Economic analysts also argued that the EPA hides the true costs of compliance with its rules by adding in the health benefits of controlling pollutants that aren't directly regulated but will be reduced as a result of compliance with the regulations.

The EPA's proposed waters of the U.S. rule, which would clarify the reach of the Clean Water Act (79 Fed. Reg. 22,188), infringes on Montana's authority to manage its own

natural resources, Montana Attorney General Tim Fox (R) said. States have already taken steps to preserve their waterways, he added.

"The people of Montana have taken steps to fully protect that priceless resource," Fox said.

Arkansas Attorney General Leslie Rutledge (R) said the water jurisdiction rule would cause significant uncertainty for farmers.

Subcommittee Chairwoman Cynthia Lummis (R-Wyo.) agreed. "The waters of the U.S. rule still doesn't provide the regulatory certainty that farmers, small businesses and homeowners need," she said.

Power Plant Rule Called Illegal

Rutledge argued that the EPA's Clean Power Plan (RIN 2060-AR33), which would regulate carbon dioxide emissions from existing power plants, violates the text of the Clean Air Act.

Rutledge said the EPA can't regulate carbon dioxide emissions from power plants under Section 111(d) of the Clean Air Act because power plants are already regulated under Section 112.

"This is a serious overreach of the EPA's authority and different from the implementation of any other limits set under the Clean Air Act," Rutledge said.

Apparently conflicting amendments to Section 111(d) of the Clean Air Act were adopted in 1990. A House amendment would bar the EPA from regulating under Section 111(d) any industrial source category that is already regulated under Section 112, which would include power plants.

The Senate language would merely bar the EPA from regulating under Section 111(d) any pollutants that are already regulated under Section 112.

Rep. Jason Chaffetz (R-Utah), chairman of the full Oversight Committee, said he also is concerned that the EPA's rules impinge on states' authority.

"Time and time again the EPA has been in here talking about all of these problems with mismanagement and waste, and they want to go into states and tell people about

their business," he said.

Air Rules Impose High Costs

Economic analysts said the EPA's proposed air rules would impose significant costs on the economy and could increase electricity costs for ratepayers.

David Harrison from NERA Economic Consulting said the EPA's Clean Power Plan could increase electricity rates in 44 states by an average of 10 percent annually during its 15-year compliance period.

"These two major environmental policies could have major economic impact on states and the nation as a whole," he said of the Clean Power Plan and the EPA's proposal to set more stringent air quality standards for ozone.

In an August 2014 study commissioned by the National Association of Manufacturers, NERA Economic Consulting estimated that revising the national ambient air quality standards for ozone from the current 75 parts per billion down to 60 ppb would cost $270 billion per year and force the closure of one-third of the nation's coal-fired power plants.

The EPA has proposed setting the ozone standard in a range between 60 ppb and 70 ppb, which was recommended by its science advisers.

EPA Critics 'Scare Mongering.'

Rep. Brenda Lawrence (D-Mich.) accused the EPA's critics of "scare mongering."

"History tells us environmental regulations don't cause an economic calamity," she said.

NERA announced Feb. 25 that it has released an updated version of its report to reflect that proposal.

Sue Tierney, senior adviser to the Analysis Group, said accounting for the co-benefits of other pollutants that will be reduced as part of the EPA's proposed ozone standards is an important consideration when tallying the rules' health benefits.

"Economic impact analyses that fail to look at benefits to public health are inherently inconsistent with what the ozone standard is all about, which is public health," she

said.

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Changing the price of water may be the way to beat drought

By Amy Joi O'Donoghue, Deseret News

Follow @amyjoi16

Published: Friday, March 6 2015 2:45 p.m. MST
Updated: Friday, March 6 2015 4:31 p.m. MST

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A small rainbow is created by water sprinklers in this 2002 file photo. A conference Friday in Park City is drawing together water utility managers from Utah and elsewhere in the West to discuss pricing water to survive financially and encourage conservation among consumers. Drought is forcing tough questions on water.

Jeremy Harmon, Deseret News archive

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Summary

A conference Friday in Park City is drawing together water utility managers from Utah and elsewhere in the West to discuss pricing water to survive financially and encourage conservation among consumers. Drought is forcing tough questions on water.

SALT LAKE CITY — Drought across the West and Midwest is driving renewed concerns over water scarcity and the availability to meet demand in the future. But some groups say finding the right price point for water customers will be the key to quenching the thirst for water.

A conference exploring ways for water utility finance mangers to maintain a healthy bottom line — even as water use declines and system repairs loom — was held in Park City Friday, drawing officials from Utah, Colorado and elsewhere in the West.

Called "CFO Connect," the session was organized by Ceres, a nonprofit sustainability advocacy group, and Park City.

"More and more, areas in the West are looking at replacing the storage that had been provided by snowpack. And those are expensive projects," said Sharlene Leurig, a water financing expert with Ceres.

The Boston-based group prepared an analysis two years ago that examines issues confronting public water utilities and their fiscal health in the marketplace, most notably the risk their investors weigh when it comes to borrowing in the municipal bond market, especially for large projects.

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large diversion projects such as the Lake Powell Pipeline or delivery of water to the Front Range of Colorado are being pursued, even as critics say states should first pursue more aggressive pricing and ways to beef up conservation practices.

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A legislative audit is underway at the Division of Water Resources in Utah to probe projections behind projects like the Lake Powell Pipeline, and Utah Gov. Gary Herbert wants funding to pay for an expansive water rates study in the next fiscal year.

And a legislative proposal seeks the establishment of a "water infrastructure" fund with an eye toward coming up with $33 billion in new projects and repairs to existing systems.

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Groups like Ceres say that while water districts prepare their own supply and demand blueprints to meet needs into the future, financial managers would be wise to consider a number of factors, including:

• Credit rating agencies are starting to build water conservation, pricing and supply risks into their analysis.

• Supply constraints are not only impacting the finances of water but aging infrastructure and declining demand are also factors.

Leurig said if the bulk of a water utility's revenues are solely tied to consumption — and there's no consumer incentive for conservation — that dynamic does not bode well given national trends of declining consumption.

"Because the majority of systems' costs are fixed, declines in customer use typically require systems to increase the rates they charge. Yet as systems increase the price they charge per unit of water, their customers use less," Leurig's report points out.

"To make up for lost revenue, the water system has to increase the cost of service. ... This can create a great deal of discomfort for water managers: they fight the political battle to raise rates, only to see revenue increase by less than that needed to cover costs. And in the meantime, customers are irked that they have to pay more for using less water."

Leurig said block pricing — bumping water rates up on a graduated scale based on consumption — and scaling impact fees to a home's "conservation" profile, are examples of how systems can build in sustainability to help them survive longer, on less water and help to delay costly projects.

"In the 21st century, for us to really manage water, we need to understand the economics of water. We have to understand the tools, the pricing, the viability of cost sharing and diversifying our supply," she said. "Those things are the foundation of what will create a financially resilient system in the 21st century, not just engineering."

Page: 1 2 Next» View all

The Salt Lake Tribune

Feds probing concrete mess in Jordan Narrows

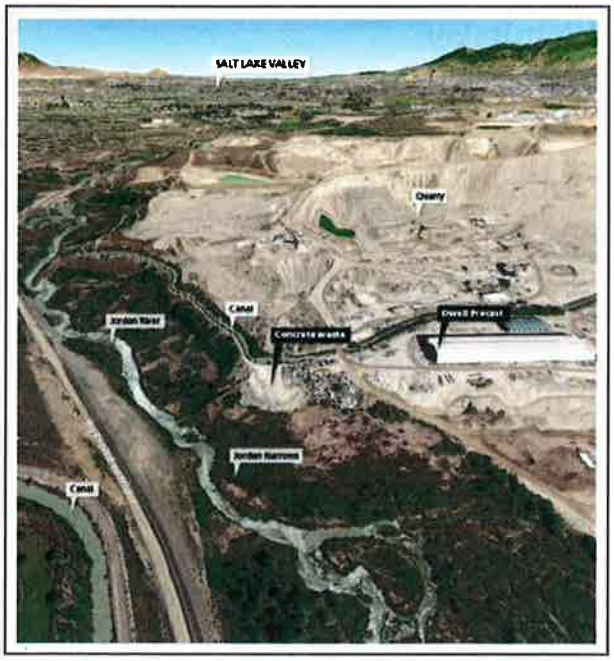
BY BRIAN MAFFLY

THE SALT LAKE TRIBUNE

PUBLISHED: MARCH 25, 2015 12:26PM

UPDATED: MARCH 25, 2015 12:09PM

Federal environmental regulators are investigating reports of illegal dumping of concrete materials that are contaminating the wetlands at the Jordan Narrows.



The dumping of concrete waste from a Bluffdale precast concrete plant may be threatening wetlands in the Jordan Narrows, an area along the Jordan River west of Interstate 15 near Point of the Mountain.

Acting on a report from the public, a U.S. Army Corps of Engineers investigator obtained video Jan. 7 of slurry being poured onto property owned by Owell Precast, a Bluffdale company that supplies concrete and pre-formed building products to Utah contractors. The company's large compound borders the Jordan River at Point of the Mountain.

"It appears to be mostly concrete rubble and concrete washout slurry mix being dumped," according to a brief report on a spill database maintained by the Utah Department of Environmental Quality.

Such wastes, primarily leftovers from construction jobs, contain lime, a caustic substance with a high alkalinity (or pH) that could disrupt the chemistry of the wetlands or the Jordan River should it migrate that far.

The extent of the environmental damage remains unclear and no cleanup has been ordered, but Corps investigators have taken numerous pH samples from the impacted area.

"Hopefully the wetlands were doing their job and filtering the contaminants before

they reached the river," said Ken Champagne, an enforcement officer with the U.S. Environmental Protection Agency. "We are taking a hard look at it because it involves the discharge of fill material."

The material was dumped down a bank above the Jordan River on the southwestern edge of the Owell property, according to coordinates listed in the spill report. The spot is across the river from the Apostolic United Brethren Church, immediately west of Owell's main building and adjacent to an irrigation canal.

Leftover concrete forms also were piled up at the location.

Champagne is probing the incident as a possible violation of the Clean Water Act, which prohibits dumping of dredge and fill materials into "waters of the United States" without a permit issued by the Army Corps under the law's section 404.

Owell had no such permit nor any active permits on file with Salt Lake County or DEQ at the time of the discovery. The company has since applied for an industrial storm water permit from the Utah Division of Water Quality, according to director Walt Baker.

He suspected Owell also would need to get a solid waste permit.

"From what I can see, there is waist-high debris piles," Baker siad. "If that's the case and you start discarding stuff in your backyard, you can't do that beyond a year. You have to get it to a dump or solid waste disposal site or get a permit to permanently dispose of it on your property."

Bluffdale city officials were unaware of the EPA probe and had no knowledge of possible problems with Owell's environmental compliance.

"As far as I know, we haven't had any complaints," said City Manager Mark Reid. The city is resolving a dispute with Owell over a building permit, but that is not related to the concrete waste.

Owell, headquartered at 16120 South Pony Express Road, changed its name to Olympus Precast in January. Company co-owner Bill Ashton declined to comment.

bmaffly@sltrib.com

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Your Input is Shaping the Clean Water Rule

2015 April 6

Gina McCarthy and Jo-Ellen Darcy
April 6, 2015
12:10 pm EDT

Water is the lifeblood of healthy people and healthy economies. We have a duty to protect it. That's why EPA and the U.S. Army Corps of Engineers are finalizing a Clean Water Rule later this spring to protect critical streams and wetlands that are currently vulnerable to pollution and destruction. On April 3 we sent the draft rule to the Office of Management and Budget for interagency review. Since it's not final yet, we can't speak to every detail. But the spirit of this rule boils down to three facts:

First, people depend on clean water: one in three Americans get their drinking water from streams currently lacking clear protection.

Second, our economy depends on clean water: manufacturing, farming, ranching, tourism, recreation, and other major economic sectors need clean water to function and flourish.

Third, our cherished way of life depends on clean water: healthy ecosystems support precious wildlife habitat and pristine places to hunt, fish, boat, and swim.

A year ago, our agencies released the draft Clean Water Rule. Since then, we've held more than 400 meetings across the country and received more than one million public comments from farmers, manufacturers, business owners, hunters and anglers, and others. The input helped us

understand the genuine concerns and interests of a wide range of stakeholders and think through options to address them. In the final rule, people will see that we made changes based on those comments, consistent with the law and the science. We've worked hard to reach a final version that works for everyone – while protecting clean water.

We're confident the final rule will speak for itself. But we can broadly share some of the key points and changes we're considering.

- **Better defining how protected waters are significant.** A key part of the Clean Water Rule is protecting water bodies, like streams and wetlands, which have strong impacts downstream – the technical term is "significant nexus." We will respond to requests for a better description of what connections are important under the Clean Water Act and how agencies make that determination.
- **Defining tributaries more clearly.** We've heard feedback that our proposed definition of tributaries was confusing and ambiguous, and could be interpreted to pick up erosion in a farmer's field, when that's not our aim. So we looked at ways to refine that definition, be precise about the streams we're talking about, and make sure there are bright lines around exactly what we mean.
- **Providing certainty in how far safeguards extend to nearby waters.** The rule will protect wetlands that are situated next to protected waterways like rivers and lakes, because science shows us they impact downstream waters. We will provide a clear definition about what waters are considered adjacent waters.
- **Being specific in the protection of the nation's regional water treasures.** We heard concerns that the category we called "other waters" in the rule was too broad and undefined. We've thought through ways to be more specific about the waters that are important to protect, instead of what we do now, which too often is for the Army Corps to go through a long, complicated, case by case process to decide whether waters are protected.
- **Focusing on tributaries, not ditches.** We're limiting protection to ditches that function like tributaries and can carry pollution downstream—like those constructed out of streams. Our proposal talked about upland ditches, and we got feedback that the word "upland" was confusing, so we'll approach ditches from another angle.
- **Preserving Clean Water Act exclusions and exemptions for agriculture.** We will protect clean water without getting in the way of farming and ranching. Normal agriculture practices like plowing, planting, and harvesting a field have always been exempt from Clean Water Act regulation; this rule won't change that at all.
- **Maintaining the status of waters within Municipal Separate Storm Sewer Systems.** Some state and local governments raised questions about waters within these permitted systems. We listened carefully as we did not intend to change how those waters are treated and have considered ways to address this concern. We will also continue to encourage the use of creative solutions like green infrastructure and low-impact development, as many of these communities have advocated.

The public will see that the agencies listened carefully and made changes based on their input. That's how an open and collaborative process works – so we can ensure everyone's voices are heard, in a way that follows the law and the latest science. Our mission is to uphold that commitment to the American people.

We may have different opinions on how we best protect our water resources, but we can all agree that clean water matters, and that it deserves our protection. The health of our people, our economies, and our way of life deserve protection. That's what the Clean Water Rule is all about.

About the authors: Gina McCarthy is the U.S. EPA Administrator and Jo-Ellen Darcy is the Assistant Secretary of the Army (Civil Works).

Editor's Note: The views expressed here are intended to explain EPA policy. They do not change anyone's rights or obligations.

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1. Barbara Stewart permalink
April 6, 2015

I want to know when the Federal EPA is going to issue federal regulations regarding fracking injection wells. We have four of these going in less than 2 miles from our home (which is in the middle of a small city of the Ohio River). These injection wells are causing earthquakes, and have the ability to turn America's water supply into the biggest Super Fund site ever. If we wait, it will be too late. When is the government agency tasked with protecting our environment going to step up to the plate??

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2. Enviro-Equipment, Inc. permalink
April 6, 2015

Although many farmers have objected to the proposed clean water rule, there's no doubt that it will dramatically ramp-up protection of our waterways and wetlands. However, the weakness of the rule is that it's going to bring significantly more federal control — via the EPA — of privately held property. I just wish the EPA would do a better job of explaining this trade-off to the agricultural community