2022 Aquifer Storage and Recovery

SCIENCE PLAN

DRAFT - OCTOBER 2022

Mechanical Integrity Test at L63N

Test/Exploratory Well Drilling at C38S

Proof of Concept Testing Kissimmee River ASR Well

L63N Continuous Coring Program Samples

500 - 510 feet bls

1,800 - 1,810 feet bls

APPENDICES

APPENDIX A:
CHRONOLOGY OF SFWMD ASR AND SUBSURFACE STORAGE STUDIES, PUBLICATIONS, AND MILESTONES

Appendix A Chronology of SFWMD ASR and Subsurface Storage Studies, Publications, and Milestones

(projects and investigations funded wholly by the SFWMD or in cooperation with other Water Management Districts, the USACE, the USGS, the Florida Geological Survey, and/or consultants)

1986 SFWMD construction and operation of the L63N (Taylor Creek) ASR system, utilizing an aquifer exemption for recharge and storage without disinfection

1999 ASR "Issue Team" Report (formed by the South Florida Ecosystem Restoration Working Group); designating 7 main questions regarding the use of ASR technology

1999 Publication of the Yellow Book, including the use of up to 333 ASR wells; included construction of pilot projects

2001 Publication of National Academy of Science critique of the draft CERP ASR Pilot Project Project Management Plans

2001 Construction of ASR/exploratory wells at Port Mayaca, Moore Haven, Berry Groves (C-43), Kissimmee River, and the Hillsboro Canal

2002 Publication of National Academy of Science critique of the draft CERP ASR Regional Study PMP

2002 USGS report: "Inventory and review of aquifer storage and recovery in southern Florida"

2003 Consultant's report: "Analysis of available oil field seismic reflection data to assess its usefulness in deducing regional south Florida geology"

2003 USGS analysis of sequence stratigraphy of cores from the Floridan Aquifer System to determine if predictive patterns of favorable storage zones can be estimated from existing well data

2003 Consultant's report: "Water quality treatment technology pilot investigation to determine optimal processes for surface water for recharge"

2004 Consultant's report: "Survival of fecal indicator bacteria, bacteriophage and protozoa in Florida's surface and groundwater"

2004 USACE report: "Lineament Analysis, South Florida ASR Regional Study" (Unpublished)

2004 Environmental Impact Statement and Pilot Project Design Report for CERP ASR Pilot Projects at Lake Okeechobee, Hillsboro Canal, and C-43 (Berry Groves)

2004 USACE report: “Water Quality Changes During Cycle Testing at Existing ASR Systems”

2005 USGS report: “Synthesis of Regional Hydrogeological Framework of the Floridan Aquifer”

2005 USACE report: “A Scientific Evaluation of Pressure Induced Constraints and Changes within the Floridan Aquifer System and the Hawthorn Group”

2005 USGS report: “Characterization of Native Microbial Communities in Waters Targeted for ASR”

2005 Consultant’s report: “Screening-Level Investigation of the Ecotoxic Effects of Recovered Water on Receiving Waters using Pilot Project Recovered Water – Phase 1”

2005 Hillsboro Aquifer Storage and Recovery Pilot Project, construction plans and specifications

2005 Kissimmee River Aquifer Storage and Recovery Pilot Project, construction plans and specs

2006 USACE report: “Geochemical Models of Water Quality Changes During ASR Cycle Tests, Phase 1: Models Using Existing Data”

2006 USACE report: “Development of an ASR Site Selection Suitability Index in Support of CERP”

2006 USACE report: “Groundwater Numerical Model Development Support and Data Collection Report”

2006 USACE report: “Bench-Scale Groundwater Flow Modeling for the ASR Regional Study”

2006 SFWMD construction and testing of FAS wells in Allapattah, Berry Groves, S-65A, S-65C, LaBelle, Clewiston, the L-8 Canal, and Port Mayaca to supplement and expand the regional FAS monitoring network

2006 USGS Report: “Hydrology and Aquifer Storage and Recovery Performance in the Upper Floridan Aquifer, Southern Florida”

2006 Consultant’s report: “Conversion of OKF-100 monitoring well”

2007 Consultant’s report: “Lake Okeechobee Marine Seismic Geophysical Investigation”

2007 Consultant’s report: “ASR Arsenic Surrogate Model”

2007 Consultant’s report: “Feasibility Assessment of Deep Well Injection to Assist in Management of Surface Water Releases from Lake Okeechobee to Estuaries”

2007 Consultant’s report: “Analysis and Interpretation of Cross-well Seismic and Well Logs for Estimating Lateral Porosity and Permeability Variations in the Inter-well Region at Port Mayaca, Florida”

2007 Consultant's report: "CERP ASR Baseline Environmental Monitoring Summary Report"

2007 Consultant's report: "Construction of an exploratory ASR test well at the Seminole Tribe Brighton Reservation"

2007 USGS report: "An Assessment of the Potential Effects of ASR on Mercury Cycling in South Florida"

2007 Consultant's report: "Phase 2 Report – Ecotoxic Effects of Recovered ASR Water, Mobile Bioconcentration Lab, Mesocosm Methods Evaluation, and Conceptual Ecological Model Development for the ASR Regional Study"

2007 FGS report: "Geochemical and Mineralogic Characterization of Potential ASR Storage Zones in the FAS"

2007 Port Mayaca Aquifer Storage and Recovery Pilot Site, construction plans and specifications

2007 Consultant's report: "MF-37 Dual-Zone Monitoring Well Conversion at Port Mayaca"

2007 Consultant's report: "Installation of MW-10 (350 ft Storage Zone Monitor Well at KRASR)"

2007 Consultant's report: "Modification and Testing of ASR Test Well LAB-PW at the Labelle ASR Test Site"

2007 Consultant's report: Installation of surficial aquifer monitoring wells at Kissimmee River and Port Mayaca ASR pilot projects"

2007 Consultant's report: "Rehabilitation and testing of the ASR test well at the L-2 Canal site, near Clewiston, FL"

2008 SFWMD construction of an exploratory test well and evaluation of a 10-well ASR system at Paradise Run

2008 SFWMD report: "2008 ASR Program Interim Report"

2008 USGS report: "Synthesis of the Hydrogeologic Framework of the FAS and Delineation of the Avon Park Permeable Zone in Central and Southeast Florida"

2008 Consultant's report: "Induced rock fracturing laboratory testing" data report

2009 Initiation of cycle testing at the Kissimmee and Hillsboro ASR pilot systems

2009 Consultant's report: Strategies to minimize arsenic mobilization during aquifer storage and recovery cycle testing – a desktop analysis"

2010 Florida Geologic Survey report: "Geochemical, Mineralogic and Petrographic Characterization of Rocks Comprising the upper FAS in south Florida"

2010 Consultant's report: "Construction of proximal monitor well MW-18, Kissimmee River ASR Pilot Site, FL"

2010 Consultant's report: "Construction of distal monitor well MW-19, Kissimmee River ASR Pilot Site, Florida"

2011 USACE report: "Final Groundwater Model Calibration Report – ASR Regional Modeling Study"

2011 Consultant's report: "Rehabilitation of ASR well EXKR-1 at Kissimmee River ASR Pilot Site, Florida"

2012 Consultant's report: "CERP ASR Lake Okeechobee Submerged Aquatic Vegetation Model: Enhancement and Application"

2012 Publication: "Hydraulic fracturing of the Floridan Aquifer from Aquifer Storage and Recovery operations"

2013 Completion of cycle testing at the Kissimmee and Hillsboro ASR pilot systems

2013 Publication of "Final Technical Data Report – CERP ASR Pilot Projects at Lake Okeechobee (Kissimmee) and the Hillsboro Canal"

2013 Consultant's report: "Everglades Landscape Sulfate Dynamics: Final Summary Evaluation of CERP ASR Alternatives"

2013 USACE report: "Regional ASR Groundwater Model Production Scenario Report"

2013 USACE report: "Local Scale Modeling Report for the Kissimmee River ASR Pilot Site"

2013 Publication: "Arsenic control during aquifer storage recovery cycle tests in the Floridan Aquifer"

2014 USGS report: "Survival of Bacterial Indicators and the Functional Diversity of Native Microbial Communities in the FAS, south Florida"

2014 USGS report: "Hydrogeologic framework and geologic structure of the Floridan Aquifer System and Intermediate Confining Unit is the Lake Okeechobee area, Florida"

2015 Publication of "Final Technical Data Report – ASR Regional Study"

2016 Publication: "Natural inactivation of Escherichia coli in anaerobic and reduced groundwater"

2019 USGS report: "Microbial Inactivation and Nutrient Cycling in Aquifer Zones Targeted for ASR"

2019 Consultant's report: "Application of High Definition 2D and 3D Seismic Tests for Characterization of the Floridan Aquifer System in the Lake Okeechobee Area"

2020 Publication: “Nutrient Removal and Uptake by Native Planktonic and Biofilm Bacterial Communities in an Anaerobic Aquifer”

2020 Consultant’s report: “SFWMD Lake Okeechobee Watershed Restoration Project (LOWRP) Aquifer Storage and Recovery (ASR) Wells L-63N MIT Evaluation Report”

2020 Consultant’s report: “Phase I C-38N and C-38S Site Evaluation Report”

2020 Consultant’s report: “Phase 1 L-63N, C-59, L-63S Site Evaluation Report”

2021 Consultant’s report: “Scoping for the Completion of the Revised Aquifer Storage and Recovery Quantitative Ecological Risk Assessment”

2021 Consultant’s report: “Ecological Risk-Based Analysis of Historical Bioconcentration and Toxicity Data for the Aquifer Storage and Recovery Quantitative Ecological Risk Assessment”

2021 Consultant’s report: “SFWMD Lake Okeechobee Watershed Restoration Project (LOWRP) Aquifer Storage and Recovery (ASR) Wells Water Treatment Technology Evaluation Technical Memorandum”

2021 Consultant’s report: “Aquifer Storage and Recovery (ASR) Ecological Risk Assessment (ERA) Mobile Laboratory Design and Cost Estimate”

2021 Consultant’s report: “L-63N Continuous Corehole”

2022 Consultant’s report: “Aquifer Storage and Recovery Programmatic Quality Assurance Plan”

2022 Publication: “Natural inactivation of MS2, poliovirus type 1 and *Cryptosporidium parvum* in an anaerobic and reduced aquifer”

2022 Consultant’s report: “Lake Okeechobee Watershed Restoration Project (LOWRP) Aquifer Storage and Recovery Wells Continuous Coring Program at L-63N Well Construction and Testing Report”

2022 Consultant’s report: “Draft Proof of Concept Testing Report”

APPENDIX B:
2022 AQUIFER STORAGE AND RECOVERY PEER REVIEW PANEL FINAL REPORT

Aquifer Storage and Recovery Peer Review Panel, 2nd Review

Final Report

Prepared by:

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Submitted to the South Florida Water Management District

September 5, 2022

Contents

Executive Summary

The ASR Review Panel is pleased with the progress made on the completion of various portions of the science plan produced after the last project review by the National Academy of Science and the Peer Review Panel report from 2020. The ASR team has developed and continues to improve a data repository that gives the project transparency and outside scientists and stakeholders the ability to review the data and progress of the project. The geological characterization and geochemical assessment of the aquifer system being completed using a series of deep cores has produced very important data. These efforts should continue and will be important in the design of the ASR wells (e.g., depths of casing and the thickness of the open hole). The Panel suggests that water quality assessments be continued on recovered water, including arsenic, molybdenum and others ions that may be leached from the aquifers during storage. A major concern of the Panel is the capital and operating costs of the pretreatment systems being evaluated. The Panel recommends taking an incremental approach to the design, construction and operation of a single low-capacity water treatment plant to evaluate the actual costs involved in meeting drinking water standards at the wellhead. If these costs are unacceptable, additional new strategies for the pretreatment and compliance to water quality standards in the two aquifers being evaluated may need to be considered. The Panel recommends the addition of a new Panel member that has a strong background in water treatment and economics of water treatment. A continuation of studies on the survival of bacteria and viruses in the storage aquifers is also recommended. The Panel also recommends the continuation of ecological studies involving the quality of the recovered water and its potential impacts on the fauna and flora in the canal and lake systems. Ecological risk assessment modeling should also be continued as suggested in the science plan. There are several comments and recommendations on the risk analysis part of the Science Plan that should be revised. The comments and recommendations contained in this report are the consensus opinions of the Panel. The review comments of the ASR are contained in the appendix of this report.

Introduction

Prior to meeting, the ASR Review Panel was provided copies of the draft 2022 Aquifer Storage and Recover draft Science Plan and the associated appendices. The draft Science Plan contained a detailed description of the accomplishments made in various scientific investigations that were recommended by the Natural Research Council committee on ASR (National Research Council, 2015) and in the first Peer Review Panel report (Arthur et al., 2020).

A meeting of the Peer Review Panel on ASR was convened online at 9 AM on June 15, 2022. A series of presentations were given by the ASR project team from the South Florida Water Management District and the U. S. Army Corps of Engineers, including consultants and subcontractors (Table 1). On July 16, 2022, a second meeting of the Panel was convened at the office of the South Florida Water Management District. Two members of the Panel attended live and the other two members were online. The Panel discussed the presentations made the previous day and asked questions in a discussion with the ASR project team. Following the meeting, two members of the Panel and several members of the ASR project team travelled to north of Lake Okeechobee to inspect the ASR site on the C-38 canal and two sites where coring and well construction were being conducted. The Panel was able to make comments and recommendation to members of the ASR project team in the field.

Table 1. Presentations made at the 2022 ASR Science Plan Peer Review Panel Meeting conducted on June 15, 2022

1. Progress since 2021
2. L63N corehole information
3. Geochemical analyses on core
4. Assessment of fracture porosity of the Floridan Aquifer System
5. Characterization of microbial and geochemical processes that contribute to nutrient reduction and potential clogging
7. Water treatment technology evaluation
8. Ecological risk assessment
10. Ecological risk assessment – ecological studies
11. ASR programmatic quality assurance plan
12. ASR projects in the Southwest Florida Water Management District
13. Expected progress over the next year

One very important piece of information presented to the Panel is the report card containing completed and projected scientific studies that were suggested in the 2015 National Research Council report on project uncertainties and the 2021 ASR Peer Review Panel recommendations (Figure 1). As explained to the Panel, many of the scientific investigations shown on the report card cannot be completed until cycle testing begins on various ASR wells. The results of these investigations will be used to refine future ASR well construction, aquifer data collection, water treatment, and guide what future scientific investigations are deemed necessary and important. This provides a phased approach to design and construction of the ASR systems in a manner that allows adaptive management as new information is obtained.

The Panel believes that this is the proper approach to take in a very complex and large-scale project.

2022 ASR Science Plan Report Card										
National Research Council Uncertainties and ASR Peer Review Panel Recommendations	% Progress Towards Adressing the Topic									
	10	20	30	40	50	60	70	80	90	100
2015 National Research Council Uncertainties										
Local scale information on atributes of APPZ										
Research Phosphorus removal mechanisms										
Reseach pathogen inactivation in the aquifer										
Couple pathogen inactivation with groundwater travel times	•									
Analysis of injection pressures for fracture potential	•									
Establish buffer zone										
Arsenic transport within aquifer using buffer zone										
Buffer zone usage to reduce sulfate concentrations										
Fate of sulftate in recovered water to form methylmercury										
Local scale model for heterogeneity/anisotropy/fracturing/travel times	•									
Pretreatment technologies to remove arsenic										
Analysis of wellfield cluster for spacing and optimal recovery efficiency										
Anisotropy analysis used for orienting wells										
Tracer studies for flow directions										
Cross-well tomography and geophysics										
Locate clusters near large water bodies										
Examine technologies to meet regulatory requirements										
Variability of gross alpha and radium in recovered water										
Examine source water effects on redox evolution of aquifer										
Improve/extend cycle tests										
Operate multi-well pairs and clusters										
Continue chronic toxicity testing at multiple ASR locations										
Long-Term ecological monitoring and bioconcentration studies, including examining community-level effects										
Probabilistic, quantitative ecological risk assessment										
2021 ASR Peer Review Panel Recommendations										
Develop ASR Programmatic Quality Assurance Plan										
Data Storage, Management, and Public Access										

Figure 1. Report card on scientific investigations suggested in the 2015 National Research Council report and in the 2021 ASR Peer Review Committee Report.

Comments and Recommendations

Response of the South Florida Water Management District and the U. S. Army Corps of Engineers to the 1st ASR Peer Review Panel Report in 2022 Aquifer Storage and Recovery Science Plan.

The Panel appreciates that the Draft 2022 ASR Science Plan is written specifically to address the high-priority actions identified in the 2015 NRC report and reiterated in the Peer Review Panel Final Report dated November 12, 2020 (Arthur et al., 2020). The Panel recommends that the ASR team continue with that plan structure throughout the ASR operations. The Panel also appreciates that the ASR team has adopted a phased approach to the implementation of ASR operations as recommended by the National Research Council (e.g. Figure 2-1 of the Draft 2022 ASR Science Plan). The Panel is full in agreement with such a phased approach. The progress made in the ASR operations in the last two years is impressive. The data presented in both the Draft 2022 ASR Science Plan as well as in the June 15, 2022 meeting were completed by the appropriate science experts and in a scientifically sound manner. All data collected to date are made available on an ASR operations dedicated website which is easily accessible. The Panel agrees with the ASR team on ensuring that recharge water meets EPA primary drinking water standards, as the UFA is a viable source of drinking water, particularly north of Lake Okeechobee. However, the selected pretreatment technology must be sufficiently economic to merit continuation of the ASR project. Therefore, the Panel recommended a phased approach to water treatment, similar to that used in analysis of the hydraulic and water quality aspects of ASR.

The approach described in the science plan has substantial merit for evaluating the potential risks from the ASR. The plan is focused on generating useful data and has been responsive to past comments. Useful data being generated include biological assessments from laboratory and field studies and chemical analyses. The assessment and monitoring are currently focused closer to the source which is a logical starting point

The ASR Project team responded to all of the comments and recommendations in a manner that transparently explains what specific scientific investigations have or will address the issues raised by the Panel. The Panel is pleased with the responses in the draft ASR Science Plan that specifically address the comments and recommendations of the ASR Peer Review Panel in the 2020 report.

The Science Plan describes the information that will be generated in the next year to address the NRC comments and progress that was made including through a report card format. An ecological risk assessment (ERA) work plan is being developed by a working group established in September of 2021. The Panel recommends that the working group also establish a system to implement and update the ERA with new information, conclusions, and information gaps annually. The interim work can be summarized each year, but longer-term or broader conclusions can be updated periodically with the information (e.g., every two years). This requires a robust problem formulation to be completed ahead of time.

Core collection and archiving of physical assets collected

A very important part of the ASR scientific research is the collection of 5 continuous cores from approximately 500 to 2100 feet below surface at five future ASR well cluster sites. Knowledge on the geology and hydrogeology at these sites was deemed to be insufficient to answer many of the questions related to the design of the ASR wells and how to predict future performance. The Panel believes that this information is very useful in terms of characterizing the geology, groundwater hydraulics, and water quality of the specific sites. The Panel recommends that all five sites be completed and the cores should be archived for future scientific studies by researchers.

Placement of markers in the core boxes to define missing section

It was observed by the Panel that there were gaps in the cores caused by inability to recover core material related to the presence of cavities or fractures and the removal of core for other studies (e.g., fracture testing, construction of thin sections, etc.). It is recommended that markers should be placed in the core boxes to note the gaps, the reason for the gaps, and the proper vertical location of remaining pieces of core within marked intervals. This can be accomplished using wooden blocks that contain depth notations similar to the system used by the Florida Geological Survey (2 x 2 x ¾ inch wooden blocks).

Archiving of thin sections collected from the cores

The Panel strongly recommends that thin sections constructed from the cores by third party consultants should be archived at the South Florida Water Management District or by the Florida Geological Survey. This refers specifically to the glass slides which should be placed in appropriate special boxes. These thin sections could be used in the future for further research on the geology of southern Florida.

Measurement of bulk chemistry and trace metals in cores

The Panel applauds the drilling crew on their high recovery of rock core during the most recent drilling operations. The trace metal and fracture analysis has produced some interesting results which should be incorporated into future well construction design, the water quality monitoring plan, and hydrologic modeling. In particular, the observance of high concentrations of metals (e.g. arsenic, mercury, nickel, molybdenum) in rock core retrieved from 1300 ft in core L63N, suggests that well casing should be placed to a depth beneath that unit (at least 25 ft or as determined by the aquifer thickness and distribution of hydraulic conductivity) to minimize the contact of recharge and discharge water with the upper portion of the APPZ. The occurrence of the "ash-layer" within the APPZ is also interesting and should be investigated further as it seems to be a unit of low permeability which divides the APPZ into two permeable units. The unit also has unusual mineral and organic matter content which may result in

previously unknown water quality conditions. Additionally, molybdenum was detected in the UFA and should be investigated during cycle testing and possibly geochemical modeling.

The Panel believes that the geochemical properties of the core material measured using a hand-held XRF unit at Florida Gulf Coast University has provided very useful information that has significant bearing on the design of the ASR wells. The Panel recommends that this scientific investigation be continued with the other cores to further characterize the two or three aquifers that will be used for ASR at sites north of Lake Okeechobee and at other in the future.

Pre-treatment of surface water prior to injection and storage

Water quality compliance dictated by the Underground Injection control rules for Class 5 injection wells mandates that injected water must meet primary drinking water standards for ASR wells that have a storage zone in an aquifer that contains drinking water (10,000 mg/L or less). The point of compliance is commonly the wellhead. The ASR test well site at the C-38 canal contains a pretreatment system that includes media filtration and UV disinfection to eliminate bacteria. The surface water source has high color and turbidity at various times of the year, particularly during the early part of the wet season during the "first flush" of storm-water discharge. The media filtration effectively removes turbidity from the water, but does not remove color. The UV disinfection is effective in elimination of coliform bacteria in most cases, but during some storm events, concentrations of coliform bacteria have been detected at the wellhead. During times when coliform bacteria were detected at the wellhead, they were not detected at the monitoring well located 300 feet from the injection well. Studies have shown that reduction in color and 100% removal of bacteria can be achieved using some type of combined pretreatment and membrane process train.

Proposed incremental approach to pretreatment evaluation

The Panel suggests using an incremental approach to the design, construction, and operation of the pretreatment of the water to be stored. It is suggested that a single water treatment facility be constructed and operated at some chosen capacity from 5 to 20 MGD to acquire real data on both construction and operating costs. The capacity of this test facility should be matched with a specific ASR multi-well site. If the costs are found to produce an unreasonable financial burden on the South Florida Water Management District and the U. S. Army Corps of Engineers, the pretreatment issue should be revisited with consideration of reduced water treatment based on a new point of compliance and a number of aquifer exemptions (see section above). Additional solute transport modeling could be conducted to determine if any private or public wells would have impacts that would be detrimental to their operation based on operation of a reduced degree of water treatment.

Concerns on pretreatment cost

The Panel has serious concerns with the cost of operating a more complex pretreatment system in future large-scale ASR implementation. The Panel recommends revisiting the point-of-

compliance issues with the regulatory agencies to both maintain high degrees of water quality in the storage aquifer, but to also save capital costs of building a large number of water treatment facilities with the associated costs of operation. Potential solutions include using a 300-foot distant monitoring well as a point of compliance or trickle chlorination below the wellhead to kill remaining bacteria. The Panel also recommends investigation of possible different pretreatment system design wherein the storage aquifer where it contains saline water which would require desalination before it could be used for drinking water.

Concern on cost of the ASR pretreatment causing project termination

The Panel is concerned that if the cost issue becomes an impediment to the construction and operation of the ASR system, the key benefits of the project to Lake Okeechobee will be lost. These benefits include maintenance of dry season lake levels and proper flows to the downstream estuaries and a reduction in the phosphate discharged into the lake.

Coagulant used with sand filtration

During the engineering investigation of the use of sand filtration, the coagulant aluminum chlorohydrate was tested to assess removal of turbidity and organic material before media filtration. This particular coagulant was not effective in providing the desired degree of treatment. Therefore, membrane filtration methods were evaluated which have a very high operating cost. The Panel recommends that other coagulants be tested before media filtration is abandoned as a potential treatment method. One rather effective coagulant is ferrate which was recently found to be more effective that ferric chloride to remove organic matter and suspended sediment in seawater reverse osmosis desalination systems (see Alshahri et al., 2022). It should be noted that there are other coagulants that could also be more effective than aluminum chlorohydrate.

Additional panel member in water treatment engineering

As the issues involved in the ASR project evolve more towards water treatment, the Panel recommends that a new Panel member be added that has a strong background in water treatment and economics of water treatment.

Reduce water quality impacts

Arsenic

Even though previous ASR testing has indicated arsenic retention after multiple cycle testing, a detailed plan of arsenic monitoring during all portions of the ASR operations, in particular during the early periods of recovery, needs to be developed. Although the green box in Figure 2-1 of the Draft 2022 ASR Science Plan includes arsenic in two bullet items, questions and omissions remain. For instance, does the item "Pretreatment technologies to remove arsenic" refer to recharge water or recovered water or both? It is still unclear how recovered water will

be stored or treated prior to release to the Everglades wetlands or canals if arsenic concentrations are found to exceed 10 micrograms/L. An additional bullet item recommended for that table would be "Logarithmic-type monitoring of arsenic during cycle testing". The Panel recommends the Science Plan include water quality sample collection during the recovery phases of the cycle testing in a logarithmic-type manner such that many water samples are collected from the recovered water during the beginning of the phase, and then fewer samples can be collected at later times. The Panel looks forward to reading a more detailed plan for water quality monitoring during cycle testing.

Calcium

Calcium seems to be omitted from Table 1-1 and/or Table 1-2 of the Appendices, even though calcium is listed as a constituent on Table 3-3 Toxicity Testing Values (TRVs). The Panel suggests that a check be done for all water quality parameters included in the ASR program such that they are included as appropriate in Tables 1-1 and/or Table 1-2.

Sulfate

Gypsum was observed in the core samples at several depths. As gypsum is a $CaSO_4$ mineral it could contribute sulfate to the stored water as the recharge water will most likely be undersaturated with respect to gypsum. Sulfate should continue to be monitored during all phases of ASR operations, as well as included in the geochemical modeling phase of the project.

Hydrologic modeling

The Panel agrees with the Hydrologic Modeling team on its use of SEAWAT to model the groundwater flow conditions before and during ASR operations. More explanation of the model layers would be appreciated, specifically a more detailed description of the "Flow Zone" indicated between the ICU and UFA layers on Table 6-1. Also, the Panel suggests that regional fracture and faulting patterns should be included in the hydrologic modeling, as higher permeable zones from fractures, faulting or karst layers can influence water storage, migration and recovery. A combination of identification of preferential flow paths with hydrological modeling should inform future monitoring well placement.

Ecotoxicology investigations

The ecotoxicology investigation is in a formative stage but the conceptual framework planned for the upcoming year is satisfactory. The Panel has no criticism of the plan to test source water and recovered water in the vicinity of proposed ASR wells or the proposed frameworks to test for direct toxicity or bioaccumulation.

This review is conducted based on Chapter 7 of the June 2022 draft report "2022 Aquifer Storage and Recovery Science Plan" (SFWMD 2022) and materials presented at the science plan panel public review on June 15, 2022. Other relevant supplementary components reviewed

included Appendix F "Scoping for the completion of the revised aquifer storage and recovery quantitative ecological risk assessment" and Appendix G "Ecological risk-based analysis of historical bioconcentration and toxicity data for the aquifer storage and recovery quantitative ecological risk assessment" of the draft report.

An ERA was completed in 2015 and described with a revised ERA in Appendix G, dated December of 2021. The ERA examined bioconcentration of recovered water in the lab and on field organisms from several cycles at a pilot ASR unit along with toxicity testing of the recovered water. Additional trophic accumulation risks and causal implications were evaluated in the 2021 revision using data collected from above. The original ERA contains work from 2004 to 2015 that was reviewed by the National Research Council (NRC), whose recommendations (NRC 2015) are a major part of the current science plan and expansion of the report. Chapter 7 of the 2022 Draft Science Plan contains four recommendations pertaining to ERA being currently addressed. The 2022 ASR Science Plan and presentations describe an ongoing and future work group ERA process (SFWMD 2022, page 52). This process is revising the prior ERA described above including the steps of problem formulation. Five meetings will be held by the working group to develop this information. The working group meetings will continue to be held so the final products are not available yet for review. The SFWMD (2022) report describes an environmental monitoring plan extending into 2023 for comment 7.3 from the NRC (2015). Monitoring will be conducted at several locations along the C-38 canal to capture two ASR wells on the canal and associated areas in Lake Okeechobee including preliminary efforts to understand the ecology of the system. The baseline assessment will begin in July of 2022. Multiple biotic components will be sampled along with water quality at a schedule described in Table 7-1 of SFWMD (2022). The monitoring of the ASR operations possibly begins in 2023.

Risk assessment

The analytical approaches for evaluating risks from ASR monitoring operations are not fully described in the current version of the plan in SFWMD (2022, pg. 49-50). The Panel recommends prioritizing the identification and inclusion of this information in future iterations for review and discussion. From the panel discussion, this is still in development with the working group. However, this is something that should be designed early, optimally.

The risk assessment process can help focus environmental science into information that can be used for decision making. When paired with a process that is responsive to decision making needs, the information generated by an ERA becomes especially useful. Appendix F states that risk management goals will be specified by the working group. Decisions to be supported by the ERA will be determined and the Science Plan notes the work plan will have clear risk management decisions supported by the ERA (SFWMD 2022 Page 52). Information should also be provided on how environmental information will be used to trigger additional studies when warranted to support decisions. For an example, the Panel recommends the Chapman and Anderson (2005) decision matrix therein.

The tie between the chemistry and water quality data (including probabilistic risk assessments with this data), the bioassays, bioaccumulation studies, and the ecological field studies should have a weight of evidence approach. The working group is currently developing this, from the panel discussion, so it is not included in the report. The weight of evidence

approach should be a focus and should help guide the information used for judging adverse effects. This weight of evidence should also be tied explicitly into recommendations for management decisions.

An adaptive management process is noted for preventing fish entrainment and impingement in SFWMD (2022) and was suggested by the NRC (2015, page 41). The Panel recommends a more detailed explanation of how this process is being used and planned to be put in use with the risk management goals and assessments for other stressors.

The plan is developing work to prevent a hindsight situation. If not already used, a scenario analysis may be a helpful exercise for assessors and managers to guide the problem formulation and determination of stressors, endpoints and ecosystems at risk. Considerations could include additional chemicals, receiving environments and media than already being assessed.

The ASR risk assessment is complex but focused. Past ERA work has been insightful and thoughtful and logical in its progression. The amendments and the science plan build on past work but would benefit from a process for considering multiple ecosystem types and potential stressors. The risk assessment process should have an adaptive management framework in place that clearly specifies how management and information collection decisions are being made. The process should also clearly update the components of the risk assessment such as the conceptual model with new information. A weight of evidence approach is needed for multiple lines of evidence (e.g., lab, field, chemistry) that address a single risk question. A robust overall framework in development will continue to help incorporate new information and update the risk assessment for communication to managers, stakeholders and reviewers each year with the science plan.

Risk assessment methods

As described in Appendix F, the risk characterization used hazard quotients but will there be more advanced methods used in the future? Quotients are suitable for screening level risk assessments or hazard assessments so advanced methods should be used along with the quotients. The advanced methods may also be screening-level depending on which ones are chosen or the information used with them. For example, probabilistic risk assessment is frequently a screening level approach using existing toxicity data with measured or modeled environmental concentration data that is less informative than a risk assessment that incorporates ecology. For analyzing and characterizing risks, the Panel recommends the use of Bayesian networks in a risk assessment framework if useful and appropriate to the quantitative work. The Bayesian networks can be used for probabilistic calculations but also for causal predictive risk models capturing the information from the operational studies and capturing the structure of the conceptual models. Examples of Bayesian networks with risk quotients that may be useful are provided in Carriger and Barron (2020) and Mentzel et al. (2022) but more advanced methods are found in approaches used by Wayne Landis and colleagues with the relative risk model.

Comments on exposure analysis

In Table 7-1 of SFWMD (2022), it is not clear about what water quality components will be analyzed in the recovered water. The contaminants screened should be broad enough to encompass a possible suite of contaminants, including organic contaminants that could potentially be found in the source and recovered water. Additional chemicals may need to be screened beyond the current list in Table 3-3 of Appendix G if not already done so. This step should be communicated.

In Appendix F, Section 2.4, Risk Analysis- it should be clarified whether the exposure values will be from monitored data or model output or both here and how the data will be aggregated and summarized. The treatment of non-detects in data analysis needs to be clearly specified for the use of monitored and in situ data.

The plan describes a process to gauge localized impacts, ostensibly where the contaminant levels are highest. However, the plan should examine risks to estuarine, riparian, and wetland receiving environments more closely. The Lake Okeechobee water can influence other distinct regions. These environments are considered for salinity changes in other sections by the ASR but will have different susceptibilities to different stressors. For example, saltwater species can have different susceptibilities from exposure to metals and organic contaminants than freshwater species. Likewise, in the appendices, sediment and potentially affected soils are not listed and should be considered. Over time, soils and sediments can be repositories for metal contaminants which could expose biota through ingestion, resuspension, and pore water exposures. For receiving environments that may only be affected when the ASR program is scaled up, fate and transport and predictive modeling for media quality and exposure changes should be considered.

The conceptual models are informative but should be developed to contain more exposure routes, stressors, speciation, and media. Having one conceptual model may be difficult. Separate but interconnected conceptual models should include information from ecosystems at risk and stressor types and hypothesized exposure scenarios and interactions within the systems. An example of a division between a logic and analytical framework that can be helpful for complex conceptual models is described in Carriger et al. (2018). The conceptual models should be used to guide the analysis and updated with better understanding over time.

Comments on effects analysis

The risk questions/hypotheses should be clearly stated and should be used to guide the goals of the science plan, the information needs and long- and short-term studies. In Appendix F, assessment endpoints should reflect components of value that are susceptible to the stressors. As such, they should communicate how they cover a range of hierarchical potential effects from susceptible populations to risk to communities and large ecosystem functions. Measurement endpoints and measures of exposure should also be clearly aligned and delineated to clarify how the assessment endpoints will be examined. The endpoints should be incorporated into the conceptual models.

Tiered assessments may be helpful for focusing data collection efforts and needs from conservative to more realistic assumptions. For selenium, a past tiered framework for assessment has been recommended that may be considered in the refined assessment

(McDonald and Chapman 2007). Augmenting the ecological observations of the test system with bioassays is ideal and may continue to help focus on what aspects may be causing adverse effects, if they appear, for higher tier work. The bioassay work should include a toxicity identification framework when toxic effects are found like was conducted in the recent ERA. The Panel recommends going beyond the standard effect metrics to examine effects to populations, communities and landscapes and indirect effects from food web interactions (e.g., loss of prey or predator species) when indicated this may be useful from the screening-level work.

Temperature is a potential issue with the ASR and toxicity test of waters and species tested should be native species adapted to temperatures in the environments of concern. Native species should be tested with site water for better evaluating ASR risks.

In Appendix F, Section 204- what is meant by hierarchy of effects-based toxicity benchmarks?

Chapter 7, ASR report- the Panel recommends that the Science Plan focus on clarifying how the components of the questions are being addressed and how additional questions will be addressed. From the replies to the NRC questions, it is not clear how longer storage times and recovery volumes, and hardness adjustments in the environment are being examined with the planned experimental work.

The recent risk assessment usefully examines bioconcentration and critical body residue values in a secondary analysis of the data. For the fish and oysters, this is appropriate for chemicals that exert toxicity from bioaccumulation but other chemicals that exert a mode of action that would not be reflected in the body residue values such as gill damage, should be noted. Care should be taken for including future toxic effects that will not be detected in tissue concentrations, especially given uncertainties with multiple species. The modes of action should be used to help identify the best approaches for measuring effects and assessing risks in future work at higher tiers.

The bioconcentration studies should examine the steady state assumptions in the test design, potentially with interim sampling in the study design. Additional methods should be considered for the bioconcentration analysis if the data are found to potentially not meet assumptions depending on how the data are used in the future (i.e., with risk models).

The mobile lab for future on-site bioconcentration and toxicity studies would benefit from proficiency tests and accreditation with the state of Florida. Culture methods and cross-contamination prevention measures between test and culture facilities if both are onsite should be included in the plan as well as how the requirements are being met with the design and operation described in Section 8.1 of Appendix C.

Ichthyoplankton studies

With regard to the ichthyoplankton studies, the Panel supports the proposal to sample upstream, at, and downstream of proposed intake sites at multiple depths in the water column. The Panel suggests that the ichthyoplankton study should expand the season during which sampling is proposed. The current schedule indicates March through June. Presumably that is going to be a time of recovery more often than recharge such that entrainment may be less of an issue. Also, many species such as Largemouth Bass and Black Crappie are likely to be spawning as early as December and with intensity during January and February. It may be

important to characterize the ichthyoplankton risk during the months and water levels when recharge activity is most likely as well.

Fish community metrics

The proposed fish community metrics to be applied are good. Diversity and evenness with use of tools like Analysis of Similarity to compare across time and/or space are well established methods to characterize faunal communities. The Panel only cautions that sampling gears, seasons, and site selection need to be adequate to capture a full representation of the fish community with consideration for the limitations, such as selectivity and catchability differences of various species in different gear types ranging from electrofishing to trawls, to various open water and littoral zone entrapment gears. For the most part the Panel believes that pre and post-operational monitoring that is proposed is good.

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Biographical Sketches of ASR Peer Review Panel Members

Thomas M. Missimer, Chair

Dr. Thomas Missimer is Executive-in-Residence and Professor in the U. A. Whitaker College of Engineering at Florida Gulf Coast University. He is a fellow of the Geological Society of America and the winner of several international awards in technical communication. He is the author or co-author of 11 books (one book on aquifer storage and recovery), more than 140 peer-reviewed journal papers, 47 book chapters, and over 300 other publications including conference papers and abstracts. He practiced as a consultant for 35 years and founded three companies that specialized in providing services in the fields of hydrogeology, geology, and various sub-disiplines in geological engineering. He served as the permanent Chairman of the Technical Advisory Committee for the Governor's Commission for a Sustainable South Florida Technical Advisory Committee (1995-1999) during the time leading up to the adoption of CERP. He currently serves as Chair of the National Water Research Institute Science Peer Review Panel on the Anne Arundel County, Maryland Managed Aquifer Recharge Project. He was visiting professor of hydrogeology at the King Abdullah University of Science and Technology in Saudi Arabia (2011-2014), where he did research in desalination intake design (subsurface) and arid lands hydrology. He has advised thesis research work as Committee Chair for two PhD students and ten MS students. He received his B.A. in geology from Franklin & Marshall College, his M.S in geology from Florida State University, and his Ph.D. in marine geology and geophysics from the University of Miami. He has 49 years of experience in the field of hydrogeology.

John F. Carriger, Jr.

John Carriger is a Research Physical Scientist with the U. S Environmental Protection Agency (CESER) in Cincinnati, Ohio. He has performed risk assessment investigations in various habitats around the United States. In 2020, he won the Level III Scientific and Technological Achievement Award (STAA) from the EPA for contributions to the MOATox investigation group that examined chemical characteristic relationships to toxic mode of action for fishes. He is the author of numerous international journal publications, many of which are on the subject of modeling ecological risk. He has more than 15 years of professional experience. He has a B.S. in environmental studies with a minor in chemistry from Florida International University, an M.S. in environmental science from Florida International University, and a Ph.D. in marine science from the College of William & Mary/Virginia Institute of Marine Science.

Reid Hyle

Reid Hyle is a project leader for the Freshwater Fisheries Research Field Office of the FWC Fish and Wildlife Research Institute. He oversees long term monitoring of fish populations and fisheries in the upper St. Johns River and a project on the restored sections of the Kissimmee River that is investigating the response of fish populations to the restoration and hydrologic management. He also serves as the Florida representative to the Atlantic States Marine Fisheries Commission (ASMFC) Shad and River Herring Technical Committee which provides

technical guidance for fishery management plans and stock assessments for anadromous shad and herring along the Atlantic Coast. His primary expertise is in fish population dynamics and fish ecology. He received his B.S in fishery science from Virginia Tech and M.S in marine science from the College of William and Mary Institute of Marine Science. He has 18 years of experience with fishery research and monitoring on the Florida Peninsula.

René M. Price

Dr. René M. Price is a Professor and former chair of the Department of Earth and Environment at Florida International University. Dr. Price is a chemical hydrogeologist who has conducted numerous hydrogeochemical investigations in the Everglades and in carbonate environments around the world. Her research interests include groundwater and surface water interactions, ecohydrology, karst hydrogeology, seawater intrusion and sea level rise. She supervised and published with a Ph.D. student on the fate and transport of deep injection water into the Boulder Zone in Miami-Dade County. She has served as a science advisor on several Everglades Restoration science advisory boards, including the National Research Council review of the Everglades Aquifer Storage and Recovery Regional Study and more recently serves as a member of the Technical Advisory Committee to the Florida Keys National Marine Sanctuary Water Quality Protection Program. Dr. Price holds a B.S degree in geology from Rensselear Polytechnic Institute, An M.S in Environmental Sciences from the University of Virginia, and a Ph.D. in Marine Geology and Geophysics from the University of Miami. She has been elected as a Fellow by the Geological Society of America.

Appendix A

John F. Carriger Disclaimer

This review is based on my opinions as a Panel Reviewer and does not prescribe regulatory advice for the aquifer storage and recovery (ASR) program nor supersede any regulations pertaining to the activities covered in the science plan. Any conflicts with regulations from the US EPA or any other agency are unintended. This review was internally reviewed and cleared by my division and was reviewed by the US EPA Region 4 Water Division for conflicts with ongoing regulatory guidance. The opinions expressed are my own and not of my agency or any of the reviewers. It was noted in the report that toxicity tests may be required for permits (page 47, SFWMD 2022). These and other regulatory requirements supersede any suggestions for test improvements provided below.

Appendix B. ASR Team Review Comments on the Panel Report

#	TOPIC	PRP COMMENTS AND RECOMMENDATIONS	ASR SCIENCE PLAN TEAM RESPONSE
1	Water Treatment	PRP is concerned about the capital and operating costs of the pretreatment systems. Panel recommends taking an incremental approach to the design, construction and operation of a single low-capacity water treatment plant to evaluate the actual costs involved in meeting drinking water standards at the wellhead. Costs are unacceptable, additional new strategies for the pretreatment and compliance to water quality standards in the two aquifers	The project team is considering an incremental approach to the water treatment system design, construction and evaluation. A small-scale "demonstration" facility (on the order of 5 to 10 mgd) is currently envisioned for the first few ASR wells that are constructed, to be operated for one to three years pending water availability and site conditions, to evaluate the capital and operational costs of a "full-sized" system. A panel member with treatment expertise will be added to the PRP for the 2023 Science Plan update.

		being evaluated may need to be considered. The Panel recommends the addition of a new Panel member that has a strong background in water treatment and economics of water treatment	
2	Water Treatment	The Panel suggests using an incremental approach to the design, construction, and operation of the pretreatment of the water to be stored. It is suggested that a single water treatment facility be constructed and operated at some chosen capacity from 5 to 20 MGD to acquire real data on both construction and operating costs. The capacity of this test facility should be matched with a specific ASR multi-well site. If the costs are found to produce an unreasonable financial burden on the South Florida Water Management District and the U. S. Army Corps of Engineers, the pretreatment issue	The project team is proceeding in an incremental approach to the water treatment system design, construction and evaluation. After evaluation of many treatment alternatives in 2019, based on preliminary cost estimates and dependability of the treatment train alternatives, it was determined to further explore the Media filter/UV and Membrane trains using source water from the C-38 Canal. A proof of concept factility was set up at the KRASR and a three month evalaution was conducted. The Treatment Technology Proof of Concept report was released for review in the summer of 2022 and the report is in the process of being finalized. The team is now considering a small-scale "demonstration" facility (on the order of 5 to 10 mgd) for the first few ASR wells that are constructed, to be operated for one to three years pending water availability and site conditions, to further evaluate the capital and operational costs prior to moving into a "full-sized" system. FDEP UIC Permit states that the Permit conditions must be met at the well head and with the regulatory environment, exemptions are increasingly difficult to obtain.

		should be revisited with consideration of reduced water treatment based on a new point of compliance and a number of aquifer exemptions (see section above). Additional solute transport modeling could be conducted to determine if any private or public wells would have impacts that would be detrimental to their operation based on operation of a reduced degree of water treatment.	
3	Water Treatment	The Panel has serious concerns with the cost of operating a more complex pretreatment system in future large-scale ASR implementation. The Panel recommends revisiting the point-of-compliance issues with the regulatory agencies to both maintain high degrees of water quality in the storage aquifer, but to also save capital costs of building a large number of water treatment facilities with the associated costs of operation.	The regulatory point of compliance is the wellhead at this time. Requesting a waiver of this could cause unforeseeable delays to the project and may not ultimately yield the desired regulatory exemption or change to the point of compliance. Trickling chlorine below the wellhead would introduce an oxidizer to the aquifer, which was ruled out during previous evaluations due to the potential for arsenic mobilization. Using a storage zone with saline water could affect the amount of water that could be recovered. With a very large recharge volume over many cycles, % recovery would presumably improve. It is not a direction that we have pursued because at present, the most brackish aquifers that we deal with are > 10,000 mg/L TDS . But theoretically recharging a saline aquifer is an option.

		Potential solutions include using a 300-foot distant monitoring well as a point of compliance or trickle chlorination below the wellhead to kill remaining bacteria. The Panel also recommends investigation of possible different pretreatment system design wherein the storage aquifer where it contains saline water which would require desalination before it could be used for drinking water.	
4	Water Treatment	The Panel is concerned that if the cost issue becomes an impediment to the construction and operation of the ASR system, the key benefits of the project to Lake Okeechobee will be lost. These benefits include maintenance of dry season lake levels and proper flows to the downstream estuaries and a reduction in the phosphate discharged into the lake.	The cost for treatment is to meet either primary or secondary drinking water standards to meet regulatory requirements. The team currently is evaluating ways to reduce construction and operations costs.

5	Water Treatment	During the engineering investigation of the use of sand filtration, the coagulant aluminum chlorohydrate was tested to assess removal of turbidity and organic material before media filtration. This particular coagulant was not effective in providing the desired degree of treatment. Therefore, membrane filtration methods were evaluated which have a very high operating cost. The Panel recommends that other coagulants be tested before media filtration is abandoned as a potential treatment method. One rather effective coagulant is ferrate which was recently found to be more effective that ferric chloride to remove organic matter and suspended sediment in seawater reverse osmosis desalination systems (see Alshahri et al., 2022). It should be noted that there are other coagulants that could	To clarify, it was not the coagulant that was not effective, but rather the pore size of sand media a not remove coagulated DOC, the particle sizes are 10-100 x smaller than could be captured by sand media. Ferrate is a strong oxidizer with a redox potential of 2.2V (stronger than Ozone - 2.08V). Disinfection by oxidizer was ruled out during the Water Treatment Technology Evaluation due to the increased potential for arsenic liberation. Ferrate can be particularly challenging for operators to generate onsite because the wet synthesis involves subsequent processes to precipitate, wash and dry to form a stable product, and the dry synthesis at high temp (370 C) has a risk of explosion. Electrochemical synthesis appears to be a less risky method but could require significant energy consumption (https://www.intechopen.com/chapters/70285). Aluminum salt coagulants appeared more favorable than Ferric-based coagulants since the median Iron concentratioion in raw water the Kissimmee was 285 ug/L, and the secondary DW standard is 300. Membrane suppliers were allowed to select their preferred coagulant between ACH and PACl for testing, which was optimized for dose during the initial runs.

		also be more effective than aluminum chlorohydrate.	
6	Water Treatment	As the issues involved in the ASR project evolve more towards water treatment, the Panel recommends that a new Panel member be added that has a strong background in water treatment and economics of water treatment.	A panel member with treatment expertise will be added to the PRP for the 2023 Science Plan update. Including a water treatment professional will bring value to the evaluation of water treatment alternatives and economics. It would be greatly beneficial to the District and Stakeholders,
7	WQ	Water quality assessments should be continued on recovered water, including arsenic, molybdenum and others ions that may be leached from the aquifers during storage	A cycle testing plan for the first demonstration ASR system (likely C38S) will soon be developed (2022-2023). A robust groundwater monitoring plan is necessary to characterize metals mobilization, particularly in the APPZ where no data exist. Molybdenum mobilization in the APPZ is likely, (Koopman et al. 2022; https://doi.org/10.1021/acs.est.2c04142), as well as arsenic. Groundwater quality data also will be required to charactrerize the "buffer (mixing) zones" between recharge and native

			groundwater, and also to detect upconing from the APPZ if it occurs.
8	WQ/Arsenic	The Panel recommends the Science Plan include water quality sample collection during the recovery phases of the cycle testing in a logarithmic-type manner such that many water samples are collected from the recovered water during the beginning of the phase, and then fewer samples can be collected at later times. The Panel looks forward to reading a more detailed plan for water quality monitoring during cycle testing.	A detailed cycle testing plan will soon be developed for testing at the initial/demonstration ASR systems. Each cycle testing plan will be informed by aquifer performance testing of the new ASR well pairs and the results of operational scenarios via the groundwater flow model to be completed in the first half of 2023, and will be included in the 2023 Science Plan. Using a "log-type" sampling schedule is an interesting proposal to characterize stored water quality close to the ASR well, and may result in early detection of upconing from the APPZ if it occurs. There are other objectives for the cycle testing data set, including mixing zone characterization, and water-rock characterization at distal wells. The team will develop a list of cycle testing objectives, and will use these to define the cycle testing plan at each ASR system.
9	WQ/Calcium	Calcium seems to be omitted from Table 1-1 and/or Table 1-2 of the Appendices, even though calcium is listed as a constituent on Table 3-3 Toxicity Testing Values (TRVs). The Panel suggests that a check be done for all	Concur. Analyte lists will be rechecked and revised for consistency.

		water quality parameters included in the ASR program such that they are included as appropriate in Tables 1-1 and/or Table 1-2.	
10	WQ/Sulfate	Gypsum was observed in the core samples at several depths. As gypsum is a CaSO4 mineral it could contribute sulfate to the stored water as the recharge water will most likely be undersaturated with respect to gypsum. Sulfate should continue to be monitored during all phases of ASR operations, as well as included in the geochemical modeling phase of the project.	Concur. Sulfate will definitely be a routine analyte in both surface and groundwater. We also will investigate using "semi-conservative" sulfate as a tracer for mixing and recovery efficiency calculations.

11	Hydrological Modeling	More explanation of the model layers would be appreciated, specifically a more detailed description of the “Flow Zone” indicated between the ICU and UFA layers on Table 6-1. Also, the Panel suggests that regional fracture and faulting patterns should be included in the hydrologic modeling, as higher permeable zones from fractures, faulting or karst layers can influence water storage, migration and recovery. A combination of identification of preferential flow paths with hydrological modeling should inform future monitoring well placement.	A scope of work for the local scale groundwater flow modeling effort for C-38S has been expedited and is attached. Models developed by the SFWMD and USACE for the previous peer-reviewed CERP Regional ASR Study will be the "starting points" for the new modeling effort. The CERP regional groundwater models incorporated evaluations of aquifer anisotropy. The new modeling effort will integrate data from the continuous cores and test ASR wells from the recent LOWRP ASR program. The USGS currently is evaluating fracture patterns in the L-63N continuous core, and will initiate analysis of the C-38S continuous core when it is available. Also, optical borehole images of the continuous core boreholes provide additional data for fracture evaluation, karst structures, and other features that will affect permeability. The flow zone between the ICU and UFA is a regional feature that has been identified in many USGS papers by Ron Reese and Emily Richardson. At KRASR, flow logs suggest that 60 percent of the UFA flow occurs at this unconformable interval. Geophysical logging at each new ASR or monitoring well will be used to further characterize flow zones in the UFA and APPZ.
12	ERA	The analytical approaches for evaluating risks from ASR monitoring operations are not fully described in the current version of the plan in SFWMD (2022, pg. 49-50). The Panel recommends	Analytical approaches will be described in details in the ERA Work Plan that is currently being developed. Once completed, the ERA Work Plan with detailed descriptions of the approaches will be included as an Appendix in the next (2023) versions of the ASR Science Plan.

		prioritizing the identification and inclusion of this information in future iterations for review and discussion. From the panel discussion, this is still in development with the working group. However, this is something that should be designed early, optimally.	
13	ERA	Information should also be provided on how environmental information will be used to trigger additional studies when warranted to support decisions. For an example, the Panel recommends the Chapman and Anderson (2005) decision matrix therein.	The ERA Work Plan is currently being developed within a working group setting. A methodology for making decisions based on the data (decision-making framework) will be included in the ERA Work Plan. The information in Chapman and Anderson (2005) will be considered in the development of the ERA Work Plan.
14	ERA	The tie between the chemistry and water quality data (including probabilistic risk assessments with this data), the bioassays, bioaccumulation studies, and the ecological field studies should have a weight of evidence approach. The working group is currently developing	The ERA Work Plan is currently being developed within a working group setting. A weight-of-evidence approach has been discussed within the working group and will be incorporated into the ERA Work Plan.

		this, from the panel discussion, so it is not included in the report. The weight of evidence approach should be a focus and should help guide the information used for judging adverse effects. This weight of evidence should also be tied explicitly into recommendations for management decisions.	
15	ERA	An adaptive management process is noted for preventing fish entrainment and impingement in SFWMD (2022) and was suggested by the NRC (2015, page 41). The Panel recommends a more detailed explanation of how this process is being used and planned to be put in use with the risk management goals and assessments for other stressors.	A more detailed explanation of how an adaptive management process is being used and planned to be put in use with the risk management goals and assessments for other stressors will be included in the Work Plan that is currently being developped and in the future versions (2023) ASR Science Plan.

16	ERA	The plan is developing work to prevent a hindsight situation. If not already used, a scenario analysis may be a helpful exercise for assessors and managers to guide the problem formulation and determination of stressors, endpoints and ecosystems at risk. Considerations could include additional chemicals, receiving environments and media than already being assessed.	The data collected in support of the 2015 ASR ERA and the conclusions reached in that assessment are being considered in the revised ASR ERA and have been carefully incorporated into the current Science Plan to prevent a hindsight situation to the extent possible. The ASR ERA Work Plan is being developed based on the most likely operational scenarios and it is expected that both localized and larger scale modeling will be conducted prior to well construction. The Work Plan will include provisions for change where appropriate should those conditions change between the preparation of the Work Pland and the construction of the ASR Wells.
17	ERA	The amendments and the science plan build on past work but would benefit from a process for considering multiple ecosystem types and potential stressors. The risk assessment process should have an adaptive management framework in place that clearly specifies how management and information collection decisions are being made. The process should also clearly update the components of the risk assessment such as the conceptual	The ASR ERA Work Plan is currently in process and will include a weight-of-evidence approach and a framework for decision making. The assessment will be tiered with the first Tier looking at risks closest to the discharge points. The ASR ERA Work Plan will include a decision making process to determine which, if any, stressors and assessment endpoints require consideration beyond the initial Tier. Since it is currently unknown what stressors and/or assessment endpoints will require assessment beyond the first Tier of assessment, details for how to address the higher Tiers of assessment will need to be developed on a case-by-case basis following the completion of the first Tier of the ERA.

		model with new information. A weight of evidence approach is needed for multiple lines of evidence (e.g., lab, field, chemistry) that address a single risk question. A robust overall framework in development will continue to help incorporate new information and update the risk assessment for communication to managers, stakeholders and reviewers each year with the science plan.	
18	ERA	As described in Appendix F, the risk characterization used hazard quotients but will there be more advanced methods used in the future? Quotients are suitable for screening level risk assessments or hazard assessments so advanced methods should be used along with the quotients. The advanced methods may also be screening-level depending on which ones are chosen or the information used	As indicated in the previous response, the ASR ERA will be completed on a Tiered basis. The first Tier of assessment will be based on both highly conservative screening-level approaches and more detailed modelling risk approaches where necessary. Details of the assessment of higher Tiers in the ERA will be discussed in the ASR ERA Work Plan, but will not be fully developed or implemented until the completion of the initial Tier of the assessment. This can include the use of Bayesian networks and/or other relevant approaches where appropriate. A clear decision framework for moving beyond the first Tier of assessment will be developed and provided in the ASR ERA Work Plan.

		with them. For example, probabilistic risk assessment is frequently a screening level approach using existing toxicity data with measured or modeled environmental concentration data that is less informative than a risk assessment that incorporates ecology. For analyzing and characterizing risks, the Panel recommends the use of Bayesian networks in a risk assessment framework if useful and appropriate to the quantitative work. The Bayesian networks can be used for probabilistic calculations but also for causal predictive risk models capturing the information from the operational studies and capturing the structure of the conceptual models. Examples of Bayesian networks with risk quotients that may be useful are provided in Carriger and Barron (2020) and Mentzel et al. (2022) but more	

		advanced methods are found in approaches used by Wayne Landis and colleagues with the relative risk model.	
19	ECO	In Table 7-1 of SFWMD (2022), it is not clear about what water quality components will be analyzed in the recovered water. The contaminants screened should be broad enough to encompass a possible suite of contaminants, including organic contaminants that could potentially be found in the source and recovered water. Additional chemicals may need to be screened beyond the current list in Table 3-3 of Appendix G if	A list of water quality components that will be collected during the monitoring will be added to the ASR Science Plan. The chemicals analyzed and assessed in the ASR ERA will be those directly related to the ASR storage and discharge of stored water. The ASR ERA is not intended to be an assessment of risk to ecological receptors from the water within the C-38 canal (or other waterbodies). It is intended to address only the risks associated with water storage and the release of that water.

		not already done so. This step should be communicated.	
20	ERA/ECO	In Appendix F, Section 2.4, Risk Analysis- it should be clarified whether the exposure values will be from monitored data or model output or both here and how the data will be aggregated and summarized. The treatment of non-detects in data analysis needs to be clearly specified for the use of monitored and in situ data.	A clarification will be included in the Science Plan on the source of the exposure values. Non-detects will be treated in the analysis as half the laboratory detection limit.
21	ERA	The plan describes a process to gauge localized impacts, ostensibly where the contaminant levels are highest. However, the plan should examine risks to estuarine, riparian, and wetland receiving environments more closely. The Lake Okeechobee water can influence other distinct regions. These environments are considered for	The ASR ERA Work Plan is currently being developed as a Tiered assessment. The first Tier of assessment will be to assess localized impacts. If no risks to the stressors are predicated on a localized scale, risks to far field ecosystems are highly unlikely. The ASR ERA Work Plan will include a decision making process for determining which stressors and endpoints should be considered at higher Tiers. In those cases, risks to far field endpoints can/will be considered as appropriate. Details for how those risks will be assessed will be developed following the completion of the first Tier of the ASR ERA.

		salinity changes in other sections by the ASR but will have different susceptibilities to different stressors. For example, saltwater species can have different susceptibilities from exposure to metals and organic contaminants than freshwater species. Likewise, in the appendices, sediment and potentially affected soils are not listed and should be considered. Over time, soils and sediments can be repositories for metal contaminants which could expose biota through ingestion, resuspension, and pore water exposures. For receiving environments that may only be affected when the ASR program is scaled up, fate and transport and predictive modeling for media quality and exposure changes should be considered.	

22	ERA	The conceptual models are informative but should be developed to contain more exposure routes, stressors, speciation, and media. Having one conceptual model may be difficult. Separate but interconnected conceptual models should include information from ecosystems at risk and stressor types and hypothesized exposure scenarios and interactions within the systems. An example of a division between a logic and analytical framework that can be helpful for complex conceptual models is described in Carriger et al. (2018). The conceptual models should be used to guide the analysis and updated with better understanding over time.	Revised conceptual models are being developed in the ASR ERA Work Plan to support the assessment of risk in the first Tier of the ASR ERA. Additional conceptual models can be developed as appropriate in higher Tiers if they are necessary. The information in Carriger et al. (2018) will be reviewed as part of those potential model developments.

23	ERA	In Appendix F, assessment endpoints should reflect components of value that are susceptible to the stressors. As such, they should communicate how they cover a range of hierarchical potential effects from susceptible populations to risk to communities and large ecosystem functions. Measurement endpoints and measures of exposure should also be clearly aligned and delineated to clarify how the assessment endpoints will be examined. The endpoints should be incorporated into the conceptual models.	Measurement endpoints are being developed in the ASR ERA Work Plan which will be provided as part of the next (2023) ASR Science Plan upon completion.

24	ERA	Tiered assessments may be helpful for focusing data collection efforts and needs from conservative to more realistic assumptions. For selenium, a past tiered framework for assessment has been recommended that may be considered in the refined assessment (McDonald and Chapman 2007). Augmenting the ecological observations of the test system with bioassays is ideal and may continue to help focus on what aspects may be causing adverse effects, if they appear, for higher tier work. The bioassay work should include a toxicity identification framework when toxic effects are found like was conducted in the recent ERA. The Panel recommends going beyond the standard effect metrics to examine effects to populations, communities and landscapes and	As discussed in several of the responses, the ASR ERA Work Plan is developing a Tiered assessment as discussed in the comment.

		indirect effects from food web interactions (e.g., loss of prey or predator species) when indicated this may be useful from the screening-level work.	
25	ECO/ERA	Temperature is a potential issue with the ASR and toxicity test of waters and species tested should be native species adapted to temperatures in the environments of concern. Native species should be tested with site water for better evaluating ASR risks.	Standardized tests do exist that include species that are native to the Lake Okeechobee watershed (e.g., bannerfin shiner). Additional native species will be considered for bioconcentration studies and toxicity testing studies.
26	ERA	In Appendix F, Section 204- what is meant by hierarchy of effects-based toxicity benchmarks?	The ASR ERA Work Plan will provide a hierarchy that will be used to obtain benchmarks (water, tissue, sediment, etc.) for use in the ASR ERA. The sources of benchmarks will be ranked on quality and relevance to the assessment.
27	ECO	Chapter 7, ASR report- the Panel recommends that the Science Plan focus on clarifying how the components of the questions are being addressed and how additional questions will be	Effects of longer storage times and recovery volumes will be assessed by conducting bioconcentration/toxicity/in-situ monitoring at various times during the recovery phase of extended longer ASR cycles. More chronic bioaccumulation and toxicity tests will be conducted (organisms will be exposed to recovered and recharge waters for a longer period of time). Effects of changes in water

		addressed. From the replies to the NRC questions, it is not clear how longer storage times and recovery volumes, and hardness adjustments in the environment are being examined with the planned experimental work.	hardness on the key soft water Everglades species will be assessed via experimental work.
28	ECO	The recent risk assessment usefully examines bioconcentration and critical body residue values in a secondary analysis of the data. For the fish and oysters, this is appropriate for chemicals that exert toxicity from bioaccumulation but other chemicals that exert a mode of action that would not be reflected in the body residue values such as gill damage, should be noted. Care should be taken for including future toxic effects that will not be detected in tissue concentrations, especially given uncertainties with multiple species. The modes of action should be used to help identify the best	The potential for toxic effects will be evaluated for each assessment endpoint using a range of lines-of-evidence. A range of bioconcentration tests, toxicity tests, comparison of exposure media to effects-based-benchmarks, etc. will be used in the ASR ERA.

		approaches for measuring effects and assessing risks in future work at higher tiers.	
29	ECO	The bioconcentration studies should examine the steady state assumptions in the test design, potentially with interim sampling in the study design. Additional methods should be considered for the bioconcentration analysis if the data are found to potentially not meet assumptions depending on how the data are used in the future (i.e., with risk models).	Interim sampling can certainly be incorporated. Additionally, during the longer cycles, multiple studies can be conducted along the gradient of recovered water discharge to capture how effects may change over the cycle period.
30	ECO	The mobile lab for future on-site bioconcentration and toxicity studies would benefit from proficiency tests and accreditation with the state of Florida. Culture methods and cross-contamination prevention measures between test and culture facilities if	The toxicity studies will be conducted by a commercial, NELAP certified laboratory. On-site bioconcentration studies will be conducted in collaboration with that laboratory and audits will be conducted to ensure cross contamination does not occur. Additionally, when samples are collected, equipment blank will be collected to assess whether cross contamination has occurred.

		both are onsite should be included in the plan as well as how the requirements are being met with the design and operation described in Section 8.1 of Appendix C.	
31	ECO	The Panel suggests that the ichthyoplankton study should expand the season during which sampling is proposed. The current schedule indicates March through June. Presumably that is going to be a time of recovery more often than recharge such that entrainment may be less of an issue. Also, many species such as Largemouth Bass and Black Crappie are likely to be spawning as early as December and with intensity during January and February. It may be important to characterize the ichthyoplankton risk during the months and water levels when recharge activity is most likely as well.	Expanding the ichthyoplankton monitoring period will be discussed with the experts (e.g., FWC, SFWMD experts) during the upcoming Working Group meeting in September.

32	ECO	Fish Community Metrix. The Panel only cautions that sampling gears, seasons, and site selection need to be adequate to capture a full representation of the fish community with consideration for the limitations, such as selectivity and catchability differences of various species in different gear types ranging from electrofishing to trawls, to various open water and littoral zone entrapment gears.	The bias of the chosen sample methodology is noted and was considered when developing the program. The intent of this sampling will be to determine changes in communities that are collected through the chosen method as opposed to provide a full characterization of the C-38 fish community. As well, this methodology is effective at providing the necessary tissues for analytical assessment.
33	ECO	The Panel recommends the continuation of ecological studies involving the quality of the recovered water and its potential impacts on the fauna and flora in the canal and lake systems	The overall plan of the ERA ecological studies is to continue the assessment of communities within the receiving water body before ASRs become operational and during the cycle testing (long-term Pre- and Post-Operational studies)
34	ECO	Ecological risk assessment modeling should also be continued as suggested in the science plan.	Agree. Thank you for you comment.

35	ECO	The Panel recommends that the Working Group also establish a system to implement and update the ERA with new information, conclusions, and information gaps annually. The interim work can be summarized each year, but longer-term or broader conclusions can be updated periodically with the information (e.g., every two years). This requires a robust problem formulation to be completed ahead of time.	The ASR ERA Team will establish a system to implement and update the ERA. The frequency of the updates will depend on available new information relevant to ERA.
36	Continuous Cores /Geology	Knowledge on the geology and hydrogeology at 5 clusters sites where cores are collected was deemed to be insufficient to answer many of the questions related to the design of the ASR wells and how to predict future performance. The Panel recommends that all five sites be completed and the cores should be archived for future scientific studies by researchers.	Two of the five coreholes have been completed (L63N and C38S). The third corehole is underway (L63S). Approval for the C40/C41 and C59 coreholes is pending.

37	Continuous Cores /Geology	It was observed by the Panel that there were gaps in the cores caused by inability to recover core material related to the presence of cavities or fractures and the removal of core for other studies (e.g., fracture testing, construction of thin sections, etc.). It is recommended that markers should be placed in the core boxes to note the gaps, the reason for the gaps, and the proper vertical location of remaining pieces of core within marked intervals. This can be accomplished using wooden blocks that contain depth notations similar to the system used by the Florida Geological Survey (2 x 2 x ¾ inch wooden blocks).	Concur. Markers will be placed in core boxes where there are gaps.
38	Continuous Cores /Geology	The Panel strongly recommends that thin sections constructed from the cores by third party consultants should be archived at the South Florida Water Management District or by the Florida Geological Survey.	Concur. Thin sections for core holes will be archived with Florida Geological Survey in Tallahassee.

		This refers specifically to the glass slides which should be placed in appropriate special boxes. These thin sections could be used in the future for further research on the geology of southern Florida.	
39	Continuous Cores /Geology	The trace metal and fracture analysis has produced some interesting results which should be incorporated into future well construction design, the water quality monitoring plan, and hydrologic modeling. In particular, the observance of high concentrations of metals (e.g. arsenic, mercury, nickel, molybdenum) in rock core retrieved from 1300 ft in core L63N, suggests that well casing should be placed to a depth beneath that unit (at least 25 ft or as determined by the aquifer thickness and distribution of hydraulic conductivity) to minimize the contact of recharge and discharge water with the upper portion of	FGCU are preparing a proposal for analysis of the second core hole (C38S). A work order will be issued once the next SOW has gone through DrChecks process. Depending on the thickness and vertical extent of permeable zones in the APPZ, the casing may be seated deeper than the 1,300 ft level, or the borehole will be backfilled above 1,300 ft to avoid potential groundwater quality issues between recharge water and lithologies showing high metals concentrations. As mentioned in the response to comment 1, molybdenum will be included in the cycle testing analyte list.

		the APPZ. The occurrence of the "ash-layer" within the APPZ is also interesting and should be investigated further as it seems to be a unit of low permeability which divides the APPZ into two permeable units. The unit also has unusual mineral and organic matter content which may result in previously unknown water quality conditions. Additionally, molybdenum was detected in the UFA and should be investigated during cycle testing and possibly geochemical modeling. The Panel believes that the geochemical properties of the core material measured using a hand-held XRF unit at Florida Gulf Coast University has provided very useful information that has significant bearing on the design of the ASR wells. The Panel recommends that this scientific investigation be continued with the	

		other cores to further characterize the two or three aquifers that will be used for ASR at sites north of Lake Okeechobee and at other in the future.	

APPENDIX C:
AQUIFER STORAGE AND RECOVERY PROGRAMMATIC QUALITY ASSURANCE PLAN

Aquifer Storage and Recovery

Programmatic Quality Assurance Plan

South Florida
Water Management District

Version: 1.0
Date Prepared: January 2022
Effective Date: Upon Final Approval

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This document entitled Aquifer Storage and Recovery Programmatic Quality Assurance Plan was prepared by Stantec Consulting Services Inc. for the South Florida Water Management District.

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Appendix

Acronyms and Abbreviations

±	plus or minus
<, ≤	less than, less than or equal to
>	greater than
µS/cm	microSiemen(s) per centimeter
°C	degree(s) Celsius
%D	percent difference
%R	percent recovery
APPZ	Avon Park Permeable Zone
ASR	Aquifer Storage and Recovery
bls	below land surface
CAP	Corrective Action Plan
CCB	continuing calibration blank
CCV	continuing calibration verification
CERP	Comprehensive Everglades Restoration Plan
CFR	Code of Federal Regulations
cm	centimeter(s)
COC	chain of custody
CTL	Cleanup Target Level
CWA	Clean Water Act
DO	dissolved oxygen
DQI	data quality indicators
DQO	data quality objective
DUS	data usability summary
DW	drinking water
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FSM	Field Sampling Manual
GW	groundwater
IC	initial calibration
ICP	inductively coupled plasma
ICS	interference check standard
ICV	initial calibration verification
ITR	independent technical review
KRASR	Kissimmee River Aquifer Storage and Recovery

LCS	laboratory control spike
LOEM	Lake Okeechobee Environmental Model
LOWRP	Lake Okeechobee Watershed Restoration Project
MCL	maximum contaminant level
MDL	method detection limit
mf/L	million fibers per liter
MGD	million gallons per day
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
MRDL	Maximum Residual Disinfection Level
MS	matrix spike
MSD	matrix spike duplicate
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
ng/g	nanogram per gram
NIST	National Institute of Standards and Technology
NTU	nephelometric turbidity unit
NPDES	National Pollution Discharge Elimination System
NRC	National Research Council
O&M	operations and maintenance
OP	orthophosphate
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PDS	post digestion spike
PDT	Project Delivery Team
PE	performance evaluation
PM	Project Manager
PQAP	Programmatic Quality Assurance Plan
PQL	Practical Quantitation Limit
project	Lake Okeechobee Watershed Restoration Project
QA	quality assurance
QAOT	Quality Assurance Oversight Team
QASR	Quality Assurance System Requirements
QC	quality control
QM	Quality Manual
RFI	Request for Information
RL	reporting limit
RPD	relative percent difference

SD	serial dilution
SFWMD	South Florida Water Management District
SOP	Standard Operating Procedure
SVOC	semi-volatile organic compound
SW	surface water
TDR	Technical Data Report
TDS	total dissolved solids
TKN	total Kjeldahl nitrogen
TN	total nitrogen
TNI	The NELAC Institute
TP	total phosphorus
UFA	Upper Floridan Aquifer
ug/L	microgram per liter
UIC	Underground Injection Control
U.S.	United States
USACE	United States Army Corps of Engineers
USDW	underground source of drinking water
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WET	whole effluent toxicity

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1 PROJECT MANAGEMENT

1.1 INTRODUCTION

The United States (U.S.) Congress passed the Water Resources and Development Act of 2000, Title VI, Comprehensive Everglades Restoration, which authorizes the U.S. Army Corps of Engineers (USACE) to implement the Comprehensive Everglades Restoration Plan (CERP). CERP addresses the cause of declining ecosystem health and provides solutions for restoration of the Everglades. CERP consists of multiple projects implemented as a joint effort between the USACE and local sponsors, such as the South Florida Water Management District (SFWMD). One CERP project, the Lake Okeechobee Watershed Restoration Project (LOWRP or project), is designed to help improve water levels in Lake Okeechobee; improve the quantity and timing of discharges to the St. Lucie and Caloosahatchee estuaries; increase the spatial extent and functionality of wetlands; and improve water supply for existing legal water users. A component of the LOWRP is an Aquifer Storage and Recovery (ASR)[1] program that includes construction of an ASR wellfield and water treatment systems located at various locations throughout the Lake Okeechobee watershed.

The Quality Assurance System Requirements (QASR) document is an overarching quality assurance/quality control (QA/QC) plan for CERP that provides a system of practices, requirements, and standard operating procedures (SOP) related to implementation of the CERP QA program. The CERP QASR manual was developed using numerous sources. For water quality, the main sources were Code of Federal Regulations (CFR) Title 40; Chapter 62-160 of the Florida Administrative Code (F.A.C.); and USACE, Florida Department of Environmental Protection (FDEP), and SFWMD SOPs.

SFWMD and USACE prepared the 2021 Aquifer Storage and Recovery Science Plan to identify future plans of study to address uncertainties described in the National Research Council's (NRC) review of the ASR Regional Study Technical Data Report (2015). As part of the ASR Science Plan, it was recognized that a project-specific QA/QC plan was needed for the LOWRP ASR program (herein referred to as the Programmatic Quality Assurance Plan [PQAP]) to ensure that data collected and analyzed, field tests conducted, and systems modeled, designed, and constructed are of acceptable and verifiable quality. This PQAP is intended to supplement, rather than supplant, the CERP QASR.

This PQAP has been developed based on the current understanding of the activities and studies associated with the LOWRP ASR program. This PQAP covers the following aspects of the ASR program:

[1] ASR is a mechanism for storing water underground through an injection (recharge) well to be withdrawn in the future for beneficial purposes. Water is stored during times of excess supply and then recovered back to the surface water system to sustain water levels during the dry season.

- Water Quality Sampling, Analysis, and Assessment
- Well Construction and Testing
- Engineering and Design Services
- Hydrogeologic Evaluations
- Ecological Evaluations
- Construction Observations
- Cycle Testing
- ASR System Operation
- Data Management

The PQAP is a living document and will need to be updated as specific needs of the program and new tasks are refined or identified. Also, specific SOPs may be developed in the future that provide greater detail on approach and methods. Refinements to this document may be needed to reflect new approaches or lessons learned as the ASR program evolves. In the event revisions are required, these updates will be incorporated in a subsequent version of the PQAP. In addition, the PQAP outlines QA/QC procedures and approach for field test data, local-scale hydrogeologic modeling, engineering design, and construction. This PQAP has been prepared using the most recent SOPs, standards, rules, guidelines, and procedures. In many instances, SOPs may not exist and a general approach or standard industry practices are summarized to ensure activities follow consistent procedures and the results yield their intended quality objectives.

This PQAP and all pertinent project documents are required reading for all staff participating in the program. All individual Work Plans developed for the program must include a signature page that states all pertinent parties have read this PQAP and the Work Plan, and will follow all requirements therein. Appropriate portions of this PQAP will be in the possession of all project team members, contractors, and laboratories performing work for the project. All contractors and subcontractors will be required to comply with the applicable procedures documented in this PQAP and the individual project plans to ensure that comparability and representativeness of the data produced is maintained; quality of work produced undergoes QA/QC; and constructed systems meet appropriate standards and their intended purposes. All laboratory process sample analysis by standard methods for water quality parameters must be accredited by the National Environmental Laboratory Accreditation Program (NELAP) for the matrix and method of analysis.

All contractors and subcontractors operating under this PQAP are responsible for notifying SFWMD regarding potential inconsistencies between the identified procedures and procedures to be conducted under this PQAP.

1.2 PROJECT ORGANIZATION

According to the QASR, the ultimate responsibility for oversight of the QA program for CERP rests with the Quality Assurance Oversight Team (QAOT). The QAOT is responsible for establishing and setting guidance, ensuring compliance, reviewing data quality, and ensuring data integrity is maintained.

The USACE and SFWMD, as lead agencies in the implementation and adherence of the CERP projects, are tasked with assuring the data meet or exceed each project's data quality objectives (DQO) and that the work adheres to acceptable practices, required standards, and guidelines. FDEP will participate, advise, and provide guidance to the SFWMD to support the ASR QA process. Each project will have a Project QA Manager to oversee or respond to QA audits, and to assure that QA processes are followed for quality and reviews are conducted and documented. The implementation of the QA process and review of designs and associated deliverables will be conducted by technical and management staff as part of QC that will include an interagency Project Delivery Team (PDT) and consultant team, which will be established on a project-by-project basis. The focus of QC is on the product for an ASR well project including, but not limited to, work plans, reports, technical memorandums, design submittals, and constructed system.

1.3 PROJECT OVERVIEW AND ASR DESCRIPTION

The purpose of the ASR program, as described in Section 9.1.2.1 of the C&SF Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement (Restudy [USACE 1999]) is to:

- Provide additional regional storage while reducing both evaporation losses and the amount of land removed from current land use that would normally be associated with construction and operation of aboveground storage features;
- Increase the lake's water storage capability to better meet regional water supply demands for agriculture, lower east coast urban areas, and the Everglades;
- Manage a portion of regulatory flows from the lake primarily to improve Everglades hydropatterns, and to meet supplemental water supply demands of the lower east coast;
- Reduce regulatory flows to the St. Lucie and Caloosahatchee estuaries; and
- Maintain and enhance the existing level of flood protection.

The recommended plan for the ASR program in *The Lake Okeechobee Watershed Restoration Project Final Integrated Project Implementation Report and Environmental Impact Statements* (USACE and SFWMD 2020) includes 55 ASR wells with 5 million gallons per day (MGD) capacity per well. These wells are proposed in clusters in various locations throughout the Lake Okeechobee watershed (Figure 1-1). The well clusters will include a combination of wells that will utilize either the Upper Floridian Aquifer (UFA) or the Avon Park Permeable Zone (APPZ) for storage and recovery. These aquifers/zones vary from approximately 700 feet below land surface (bls) or the UFA to greater than 1,200 feet bls for the APPZ wells (Figure 1-2). Proposed ASR cluster locations are based upon the findings of the 2015 CERP ASR Regional Study; however, these locations are conceptual and may be adjusted based on the results of exploratory testing. Additionally, due to the uncertainties regarding the scale of the proposed ASR well cluster implementation, the construction of the ASR well systems will be implemented in a phased approach, and studies and monitoring will be conducted as recommended by the NRC of

the National Academies of Sciences, which conducted its review of the CERP ASR Regional Study.

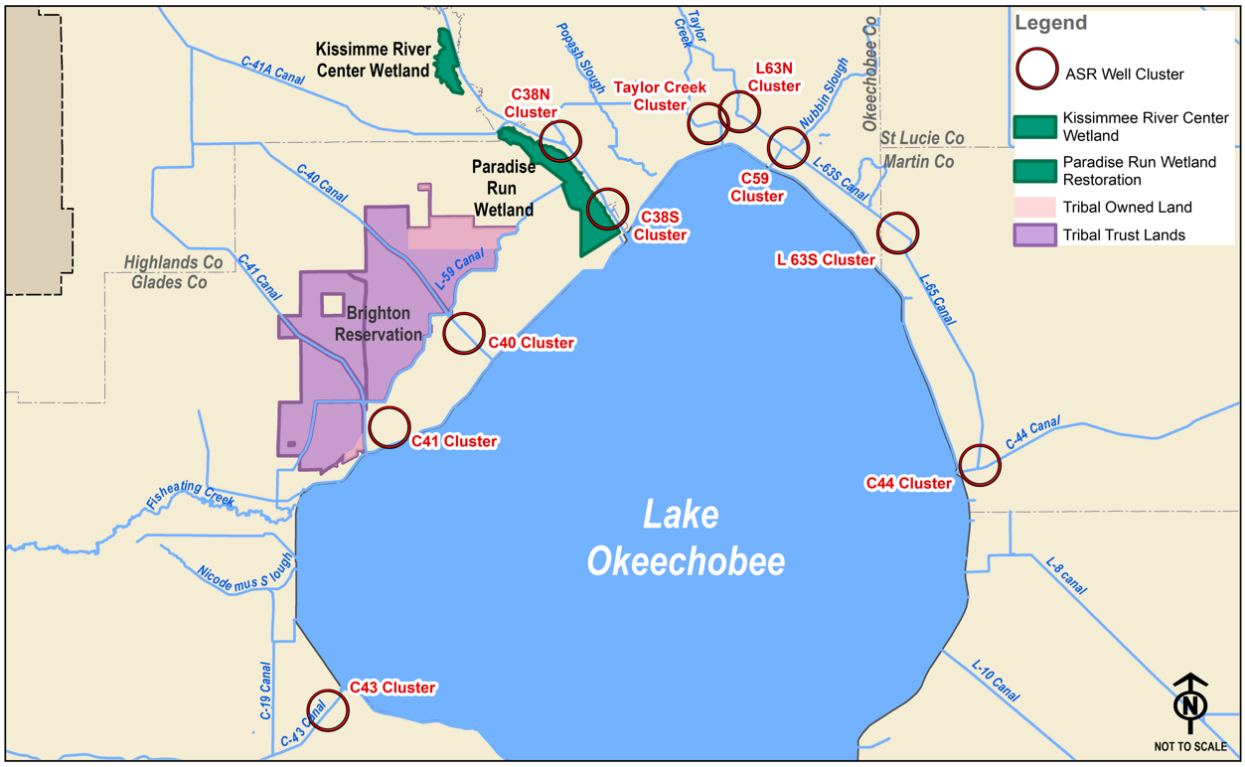

Figure 1-1. ASR Wellfields and Treatment System Locations

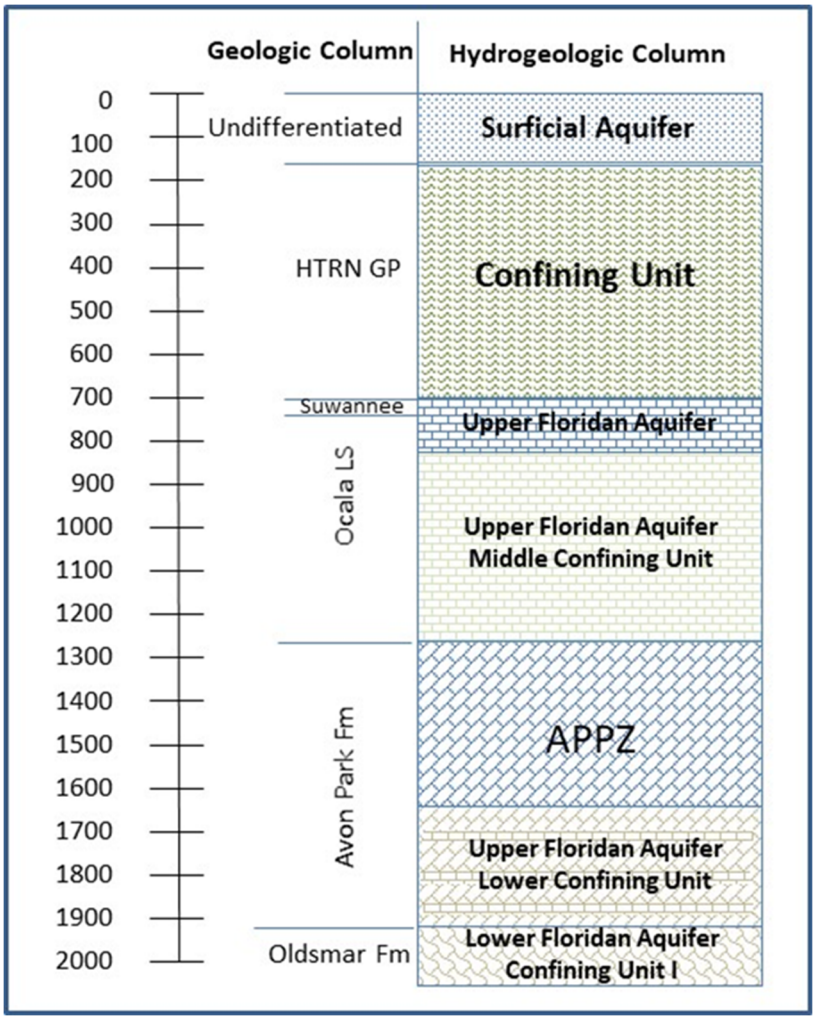

Figure 1-2. Generalized Geologic/Hydrogeological Column

The ASR wells are intended to pump excess surface water and then store that water in the UFA or APPZ aquifers until needed during drier periods. The source water is from the local canals and rivers, and will be treated to primary and secondary drinking water standards prior to recharging the aquifers. Recovered water will be discharged via a cascade aeration system to the same water body as the original source water. Recharge periods are generally planned for high stage periods within the river/canal adjacent to the ASR wellfield. The stored water can then be recovered during periods of low stage in the river. The recharge, storage, and recovery periods will be defined by FDEP Underground Injection Control (UIC), SFWMD, and the USACE.

ASR wells are constructed, tested, and operated under permits issued by the FDEP Aquifer Protection Program UIC program. The UIC program permits the lawful option of injection of appropriately treated fluids via underground injection wells, while protecting Florida's underground sources of drinking water (USDW). A USDW is an aquifer that supplies drinking water for human consumption; it has a total dissolved solids (TDS) concentration of less than 10,000 milligrams per liter (mg/L). The construction, operation, permitting, and closure (plugging and abandonment) activities for injection wells are administered in accordance with

Chapter 62-528, F.A.C. This code contains stringent requirements to prevent the degradation of the existing water quality of the aquifers overlying the injection zone.

ASR wells are Class V injection wells; Major Class V wells are permitted through the FDEP's Tallahassee office. According to UIC injection well classification, Class V wells are used for the storage or disposal of fluids into or above a USDW. The ASR program will be recharging and recovering water from each Class V well and will not be utilizing the wells for disposing of fluids. The fluid injected must meet appropriate criteria as determined by the classification of the receiving aquifer. In the case of the ASR program, the source water will be surface water systems (rivers and canals) to the north and west of Lake Okeechobee. This water will be treated to Drinking Water Standards before injecting into either the UFA or APPZ aquifers.

There are two types of wells that will be constructed as part of the ASR well program. These are ASR wells and associated monitoring wells. Monitoring wells will be completed with two types of construction: single zone monitoring wells and dual zone monitoring wells. Dual zone monitoring wells are generally constructed with monitoring intervals open to separate aquifer systems. In this case, the upper monitoring zone will be open to the UFA and the lower monitoring zone will be open to the APPZ.

At each wellfield, a treatment plant, intake, and outfall structure will be design and constructed. While these and other components make up the entire ASR system, the focus of this PQAP is on the construction and operation of the ASR wells and treatment systems, and on water quality and ecological monitoring.

To implement the LOWRP ASR program, a variety of sampling, monitoring, geologic coring, testing, engineering design, modeling, and construction oversight activities will be required. Groundwater sampling will be conducted, along with long-term monitoring, to assess baseline conditions, monitor changes in the aquifer water quality, and track compliance with FDEP groundwater standards. Surface water sampling will be conducted to assess the quality of water before treatment and prior to being pumped into the aquifer following treatment. Surface water quality and ecological monitoring and studies also will be necessary to assess: (1) the characteristics of the stored water before it is recovered and discharged back into local surface waters, and (2) its impact on the aquatic system.

1.4 PROGRAMMATIC QUALITY ASSURANCE PLAN DEVELOPMENT DOCUMENTS

In addition to input from SFWMD and USACE staff, the following PQAP procedures and guidelines were used in the development of this document's structure and content:

- U.S. Environmental Protection Agency (USEPA) Requirements for Quality Assurance Project Plans, Final, EPA QA/R-5 (EPA, latest version)
- USEPA Guidance for Quality Assurance Project Plans, Final, EPA QA/G-5 (EPA, latest version)
- FDEP Chapter 62-160.600, F.A.C.

The PQAP incorporates specific QA/QC requirements from the following documents, including, but not limited to, the following:

- FDEP Chapter 62-160, F.A.C.
- 40 CFR Chapter 1, Subchapter D, Part 136 and Part 141
- The 2003 National Environmental Laboratory Accreditation Conference (NELAC) Standard, EPA/600/R-04/003, June 2003 or the NELAP standard 2016 revision, as applicable
- USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (USEPA SW-846, most recent updates)
- USEPA Methods for Chemical Analysis of Water and Wastes, revised March 1983 EPA-600/4-79-020
- Standard Methods for the Examination of Water and Wastewater methods
- American Society of Testing Materials (ASTM) Methods
- QASR manual and CERP Guidance Memorandums
- FDEP regulatory requirements included in DEP-QA-002/02 *Requirements for Field and Analytical Work* and DEP-EA 001/07 *Process for Assessing Data Usability*, and the SOPs included in DEP-SOP001/01 (FDEP SOPs)
- SFWMD requirements, including SFWMD Water Quality Monitoring Section's Field Sampling Manual (FSM) (SFWMD-FIELD-FSM-001) and associated SOPs
- USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review (USEPA, latest versions)

1.5 DATA QUALITY OBJECTIVES

DQOs are established at the beginning of a project. The process details the intended use of the data, including the types of decisions that will be made based on the results of the project, and the project requirements to meet the stated goals. Refer to QASR Section 2.5 for a summary of the DQO development process. Data quality indicators (DQIs) include precision, accuracy, representativeness, completeness, consistency, and sensitivity. Specific DQOs and DQIs are addressed throughout this PQAP for different aspects of the ASR program. The following is a summary of the DQIs.

Precision

Precision is a measure of mutual agreement between duplicate or co-located sample measurements of the same analyte. The closer the numerical values of the measurements are to each other, the more precise the measurement. Precision for a single analyte will be expressed as a relative percent difference (RPD) between results of co-located field samples or laboratory duplicate samples or matrix spike duplicates (MSD).

As a rule, for the ASR projects, a field duplicate will be collected for every 20 actual samples. Precision will be determined for field duplicates, laboratory duplicates, and laboratory MSDs, and must meet the goals established in this PQAP or determined in the individual Work Plans.

Accuracy

Accuracy is the measure of bias in a measurement system. The closer the value of the measurement agrees with the true value, the more accurate the measurement. This will be expressed as the percent recovery (%R) of a surrogate, laboratory control spike (LCS), or matrix spike analyte or, if applicable, of a standard reference sample, also known as a performance evaluation (PE) sample, or Standard Reference Material.

Accuracy of spiked sample analyses will be determined for no less than one sample in 20 samples collected. Accuracy will be determined for LCS, MS, PE, and laboratory MSDs, and must meet the goals established in the individual monitoring plans.

Analytical Sensitivity

Analytical sensitivity is expressed by the method detection limit (MDL). MDLs are set such that the minimum concentration of an analyte is reported with a 95% percent confidence that the analyte concentration is greater than zero. MDLs are determined using the method specified in 40 CFR Part 136, Appendix B, and meet The NELAC Institute (TNI) requirements for the determination of the limit of detection. The recommended project required MDLs, for methods in which MDLs are determined using 40 CFR Part 136, Appendix B, are specified in Tables 1-1 and 1-2 of this PQAP.

Completeness

Completeness is a measure of the number of valid measurements obtained in relation to the total number of measurements planned. The closer the numbers are, the more complete the measurement process. Completeness will be expressed as the percentage of valid or usable measurements to planned measurements. This will be achieved by obtaining samples for all types of analyses required at each individual location, a sufficient volume of sample material to complete the analyses, samples that represent all possible situations and conditions, and samples at critical data locations, such as background and control samples.

The completeness goal for water quality measurements is 95%, but for all other data-gathering activities the completeness goal is 90%.

Representativeness

Representativeness is the degree to which data for a sampled source accurately and precisely represents a characteristic or variation of the sampled source in terms of a measured analyte or parameter. The design of and rationale for the sampling program (in terms of the purpose for sampling, selecting the sampling locations, the number of samples to be collected, the ambient conditions for sample collection, the frequencies and timing for sampling, and the sampling techniques) assures that the environmental condition has been sufficiently represented.

The characteristic of representativeness is difficult to quantify. The following subjective factors must be taken into account:

- Degree of site homogeneity

- Degree of homogeneity of a sample taken from one point on a site
- Available information on which the sampling plan was based

To maximize representativeness of results, sampling techniques and locations are carefully chosen so that they provide samples and/or measurements that are representative of both the site and the specific area. The methods and approaches used to satisfy the representativeness criterion must be included in the individual method SOP and station descriptions in the Work Plan.

Field quality control blanks are collected to monitor the sample collection process, decontamination procedures, quality of sample preservatives, and sample storage and transport conditions, to help assure that samples are representative of the sampling source and have not been artificially contaminated by the sample collection and laboratory processes.

Within the laboratory, precautions are taken to extract from the sample bottle an aliquot representative of the whole sample and must be included in the laboratories' Quality Manual (QM) and SOPs. These precautions include premixing the sample in the sample container and excluding sampled elements that are not a part of the target matrix (e.g., discarding large pebbles from soil samples).

Comparability

Comparability is a qualitative parameter expressing the confidence with which one set of data can be compared to another. Data sets will be considered comparable only when precision and accuracy are considered acceptable during data validation. Comparability will be maintained by consistency in sampling conditions, selection of sampling procedures, sample preservation methods, analytical methods, and data reporting units. Each analytical procedure selected from among the acceptable options will be used for all analyses of that analyte unless a rationale is provided for any alteration.

1.6 WORK PLAN DEVELOPMENT REQUIREMENTS

Throughout the life of the project, a variety of projects, activities, and studies will need to be developed and implemented. This PQAP has been developed to provide guidance and references for standard procedures, requirements, and activities anticipated to be performed.

Work Plans must be developed using the guidance in the CERP QASR Section 2.7 and USACE CGM 40, Section 2.1. Work Plans that address water quality, biological, and ecological data collection and management must:

- Include signature page stating all parties have reviewed and will follow the requirements of the PQAP and Work Plan
- Define project scope and purpose
- Reference standardized procedures and guidelines when available
- Provide a work schedule
- Justify design strategy and sampling locations

- Discuss DQOs for representativeness, completeness, comparability, detection limits, precision, and accuracy of the plan
- List minimum qualifications and special training for personnel
- Reference or define as necessary maximum holding times by parameter and method
- Reference or define as necessary methods for sample collection (for matrix and technique)
- Reference or define as necessary equipment material and construction by parameter
- Reference or define as necessary equipment decontamination procedures
- Reference or define as necessary sample processing (homogenization, filtration, splitting, or compositing)
- Describe and justify required non-standard analytical or sampling methods (non-standard methods must be approved by FDEP and SFWMD prior to use)
- Identify chain of custody (COC) procedures
- Reference or define as necessary all relevant field forms, including sample custody forms
- Identify the data repository including procedures for archiving

For elements that have options detailed in the PQAP (i.e., groundwater sampling), the specific procedure must be defined in the individual Work Plan. For situations where a procedure, device, or requirement is not described or referenced in this PQAP, the Work Plan must detail or reference all procedures, devices, or requirements that may be needed to complete the specific project. Complete descriptions and supporting information must be provided for an accurate and thorough review prior to SFWMD approval for implementation.

1.7 POTENTIAL MONITORING PARAMETERS AND CRITERIA

During the implementation and operation of the ASR Science Plan, a variety of measurements and matrices will be collected and evaluated to meet project DQOs. Each project conducted for the Science Plan will detail the specific parameters, applicable criteria and, when applicable, the analytic methods and required MDLs needed to meet the project DQOs. Groundwater and surface water will be monitored for parameters of interest that are applicable to a project and have established federal or State water criteria, or other project-specific criteria. Table 1-1 below summarizes the USEPA national primary and secondary drinking water parameters and standards as well as the corresponding Florida water quality criteria. Florida drinking water standards, monitoring, and reporting requirements are detailed in Chapter 62-550, F.A.C., while contaminant Cleanup Target Levels (CTLs) for groundwater and surface water are detailed in Chapter 62-777, F.A.C. The recommended project MDLs listed in Tables 1-1 and 1-2 below may need to be adjusted to meet project-specific requirements. Any alternative MDLs specified for a project must be detailed in the individual Work Plan. Given that values between the MDL and the Practical Quantitation Limit (PQL) are qualified as estimated and may have a high associated

uncertainty, project managers should attempt to set the MDL below standards and criteria when possible.

Table 1-1. ASR Science Plan Groundwater and Surface Water Parameters and Applicable Criteria

Parameter	FDEP DW MCLs[1]	FDEP CTLs (ug/L)[2]		USEPA Drinking Water Standards (ug/L)[3]	Recommended Project MDL (ug/L)
		GW	SW (fresh)	Primary	
Volatile Organic Compounds (VOCs)					
Benzene	1	1	71.28	5	1
Carbon tetrachloride	3	3	4.42	5	3
Chlorobenzene	100	100	17	100	17
1,2-Dibromo-3-chloropropane	--	0.2	--	0.2	0.2
1,2-Dichlorobenzene (o-DCB)	600	600	99	600	99
1,4-Dichlorobenzene (p-DCB)	75	75	3	75	3
1,1-Dichloroethane	--	70	--	--	70
1,1-Dichloroethylene	7	7	--	7	7
1,2-Dichloroethane	3	3	37	5	3
cis-1,2-Dichlorethylene	70	70	--	70	70
trans-1,2-Dichlorethylene	100	100	11000	100	100
Dichloromethane (methylene chloride)	5	5	1580	5	5
1,2-Dichloropropane	5	5	14	5	5
Ethylbenzene	700	30	610	700	30
Ethylene dibromide (1,2-dibromomethane)		0.02		0.05	0.02
Styrene (vinyl benzene)	100	100	460	100	100
Tetrachloroethylene (PCE)	3	3	8.85	5	3
Toluene	1000	40	480	1000	40
1,2,4- Trichlorobenzene	70	70	23	70	23
1,1,1-Trichloroethane	200	200	270	200	200
1,1,2-Trichloroethane	5	5	16	5	5
Trichloroethylene (TCE)	3	3	80.7	5	3
Vinyl chloride	1	1	2.4	2	1
Xylenes (total)	10,000	20	370	10,000	20
Semivolatile Organic Compounds (SVOCs)					
Benzo(a)pyrene	0.2	0.2	*	0.2	0.2
Acenaphthylene	--	210*	**	--	210
Benzo(a)anthracene	--	0.05*	**	--	0.05
Benzo(b)fluoranthene	--	0.05*	**	--	0.05
Benzo(g,h,i)perylene	--	210*	**	--	210
Benzo(k)fluoranthene	--	0.5*	**	--	0.5
Chrysene	--	4.8*	**	--	4.8
Dibenzo(a,h)anthracene	--	0.005*	**	--	0.005
Indeno(1,2,3-cd)pyrene	--	0.05*	**	--	0.05
Phenanthrene	--	210*	**	--	210
Bis(2-ethylhexyl) adipate (Di(2-ethylhexyl) adipate)	--	400	33	400	33
Bis(2-ethylhexyl) phthalate (Di(2-ethylhexyl) phthalate)	6	6	2.2	6	2.2
Dioxin (as 2,3,7,8-TCDD equivalents)	0.00003	0.00003	0.000000005	0.00003	0.000000005
Hexachlorobenzene	1	1	0.0003	1	0.0003
Hexachlorocyclopentadiene	50	50	3	50	3

Parameter	FDEP DW MCLs[1]	FDEP CTLs (ug/L)[2]		USEPA Drinking Water Standards (ug/L)[3]	Recommended Project MDL (ug/L)
Pentachlorophenol	1	1	8.2	1	1
Metals					
Aluminum		200	200		200
Antimony	6	6	4300	6	6
Arsenic (total and inorganic)	10	10	10	10	10
Barium	2000	2000	--	2000	2000
Beryllium	4	4	0.13	4	0.13
Cadmium	5	5		5	5
Chromium (total)	100	100	11	100	11
Copper	--	1000	--	1300	1000
Iron	--	300	1000	--	300
Lead	15	15	--	15	15
Manganese	--	50	--	--	50
Nickel	100	100	--	--	100
Silver	--	100	--	--	100
Selenium	50	50	5	50	5
Sodium	160,000	160,000	--	--	10000
Thallium	2	2	6.3	2	2
Zinc	--	5000	--	--	5000
Mercury (total by CVAA)	2	2	0.012	2	0.0005
Chromium (hexavalent)	--	--	11	--	11
Cyanide (free)	200	200	5.2	200	5.2
Anions					
Chloride	--	250,000	--	--	10000
Fluoride	4,000	2000	10,000	4,000	2000
Sulfate	--	250,000	--	--	10000
Nutrients					
Nitrate (as N)	10,000	10,000	--	10,000	1000
Nitrite (as N)	1,000	1,000	--	1,000	1000
Total nitrate/nitrite (as N)	10,000	10,000	--	--	1000
Disinfection Byproducts					
Bromate	10	0.05	--	10	0.05
Chloramines	4,000	--	--	MRDL=4000	4000
Chlorine	4,000	700	10	MRDL=4000	10
Chlorine dioxide	800	--	--	MRDL=800	800
Chlorite	1,000	210	29	1000	29
Haloacetic acids (HAA5)	60	--	--	60	60
Total Trihalomethanes (TTHM)	80	--	--	80	80
Radiological					
Alpha particles / Gross Alpha		15 (pCi/L)	15 (pCi/L)	15 (pCi/L)	3 (pCi/L)
Beta particles / Gross Beta		4 millirems/ year	--	4 millirems/year	4 millirems or 4 pCi/L
Iodine-131		--	--	--	1 (pCi/L)
Radium-226		--	--	--	1 (pCi/L)
Radium-228		--	--	--	1 (pCi/L)
Radium 226,228 combined		5 (pCi/L)	5 (pCi/L)	5 (pCi/L)	1 (pCi/L)
Strontium-89		--	--	80 (pCi/L)	10 (pCi/L)
Strontium-90		--	--	8 (pCi/L)	2 (pCi/L)
Tritium		--	--	20,000 (pCi/L)	1000 (pCi/L)
Uranium-234		30	--	30	1

Parameter	FDEP DW MCLs[1]	FDEP CTLs (ug/L)[2]		USEPA Drinking Water Standards (ug/L)[3]	Recommended Project MDL (ug/L)
Pesticides					
Alachlor	2	2	0.5	2	0.5
Atrazine	3	3	1.9	3	1.9
Carbofuran	40	40	0.1	40	0.1
Tech. Chlordane (alpha and beta)	2	2	0.00059	2	0.00059
2,4-Dichlorophenoxyacetic acid (2,4-D)	70	70	80	70	70
Dalapon (2,2-Dichloropropionic acid)	200	200	5000	200	200
Dinoseb	7	7	5.9	7	5.9
Diquat	20	20	1.5	20	1.5
Endothall	100	100	110	100	100
Endrin	2	2	0.0023	2	0.0023
Glyphosate	700	700	120	700	120
Heptachlor	0.4	0.4	0.00021	0.4	0.00021
Heptachlor epoxide	0.2	0.2	0.00004	0.2	0.00004
Lindane (Hexachlorocyclohexane, gamma-)	0.2	0.2	0.063	0.2	0.063
Methoxychlor	40	40	0.03	40	0.03
Oxamyl (vydate)	200	200	8.5	200	8.5
Picloram	500	500	70	500	70
Silvex (2,4,5-TP; Trichlorophenoxy propionic acid)	50	--	--	50	50
Simazine	4	4	7.3	4	4
Toxaphene	3	3	0.0002	3	0.0002
PCBs	--	0.5	0.000045	0.5	0.000045
Biological					
Cryptosporidium	--	--	--	99.9% removal	NA
Giardia lamblia	--	--	--	99.9% removal	NA
Heterotrophic plate count (HPC)	--	--	--	<500 bacteria colonies/mL	NA
Total coliforms	--	<5% samples positive	--	<5% samples positive	1 colony/100 mL
E. coli	--	0	--	--	NA
Fecal coliform	--	0	--	--	1 colony/100 mL
Viruses (enteric)	--	--	--	99.99% removal	NA
Additional					
Acrylamide	--	0.008	0.3	0.05% dosed at 1 mg/L (or equivalent)	0.008
Asbestos (>10u)	--	7 mf/L		7 mf/L	1 mf/L
Foaming Agents	--	500			500
Epichlorohydrin	--	3.5	130	0.01% dosed at 20 mg/L (or equivalent)	3.5
Color	--	15 color units	--	--	NA
Odor	--	3 (threshold	--	--	NA

Parameter	FDEP DW MCLs[1]	FDEP CTLs (ug/L)[2]		USEPA Drinking Water Standards (ug/L)[3]	Recommended Project MDL (ug/L)
		odor number)			
pH	--	6.5-8.5	--	--	NA
TDS	--	500,000	--	--	1000
Turbidity	--	--	--	1 NTU	NA

Notes:
All units in ug/L, unless otherwise noted
1 = Chapter 62-550, F.A.C., Drinking Water Standards, Monitoring, and Reporting
2 = Chapter 62-777, F.A.C., Table 1, Groundwater Clean-up Target Levels
3 = USEPA National Drinking Water Regulations

Italicized SVOCs above are necessary if Benzo(a)pyrene toxic equivalent calculations are needed

* = Groundwater CTLs for class C carcinogens with no cancer slope factor were developed using the reference dose divided by a factor of 10, as described in the February 2005 Final Technical Report: Development of Cleanup Target Levels (CTLs) for Chapter 62-777, F.A.C.
** = There are no surface water standards for these individual polycyclic aromatic hydrocarbons. Per Chapter 62-302, F.A.C., the surface water criterion for Polycyclic Aromatic Hydrocarbons (PAHs) shall apply to the total concentration of these PAHs

Key:
CTL = Cleanup Target Level
DW = drinking water
FDEP = Florida Department of Environmental Protection
GW = groundwater
MCL = maximum contaminant level
mf/L = million fibers per liter
mg/L = milligrams per liter
ml = milliliter
MRDL = Maximum Residual Disinfection Levels
NTU = nephelometric turbidity unit
pCi/L = picocuries per liter
SW = surface water
ug/L = microgram per liter
USEPA = U.S. Environmental Protection Agency

In addition to the drinking water parameters detailed in Table 1-1, the ASR Science Plan projects may be required to analyze for the list of municipal wastewater indicator parameters detailed in the UIC Permit. Some of these parameters may also be selected for monitoring to achieve specific project objectives without a permit requirement. Table 1-2 below summarizes the applicable FDEP CTLs for each parameter. As with Table 1-1, the recommended project MDLs listed in Table 1-2 below may need to be adjusted to meet project-specific requirements. Any alternate MDLs specified for a project must be detailed in the associated Work Plan. Given that values between the MDL and the PQL are qualified as estimated and may have a high associated uncertainty, project managers should attempt to set the MDL below standards and criteria when possible.

Table 1-2. Potential Additional Parameters and Applicable Criteria

Parameter	FDEP CTLs (ug/L)		Recommended Project MDL (ug/L)
	GW	SW (fresh)	
VOCs			
Chloroethane	12	--	12
Chloroform	70	470.8	70
1,4-Dichlorobenzene	75	3.0	3.0
1,2-DCE*	63	7000	63
SVOCs			
Anthracene	2100	0.3	0.3

Parameter	FDEP CTLs (ug/L)		Recommended Project MDL (ug/L)
Butylbenzylphthalate	140	26	26
Dimethylphthalate	70000	1400	1400
Naphthalene	14	26	14
2-Chlorophenol	35	130	35
Phenol	10	6.5	6.5
2,4,6- trichlorophenol	3.2	6.5	3.2
Metals			
Molybdenum	35	--	10
Methyl Mercury	0.07		0.00002
Cations			
Sodium	160,000	--	1000
Magnesium	--	--	1000
Potassium	--	--	1000
Pesticides			
Aldrin	0.002	0.00014	0.00014
Dieldrin	0.002	0.00014	0.00014
Ethion (OP Pest 8141B)	3.5	0.007	0.007
Bromacil (ON 525.2)	70**	97	70
Ametryn (525.2)	63	6.2	6.2
Haxazinone (525.2)	230	25000	230
Nutrients			
Ammonia	2800	20	20
Nitrogen (organic)	--	--	20
TKN	--	--	20
TP	--	--	20
OP	--	--	20
TN	--	--	20
Total carbon	--	--	20
Additional Analytes			
Biological Oxygen Demand (BOD)	--	--	2000
Chemical Oxygen Demand (COD)	--	--	TBD
Total Suspended Solids (TSS)	--	--	TBD
Total Organic Carbon (TOC)	--	--	TBD
Dissolved Organic Carbon (DOC)	--	--	TBD
Sulfide	--	--	TBD
Dissolved sulfide	--	--	TBD
Bromide	--	--	TBD
Alkalinity (total, bicarbonate, and carbonate)	--	--	TBD
Biological			
Enterococci	--	--	NA
Coliphage	--	--	NA
Clostridium perfringens	--	--	1 colony/100mL

Notes:
* = 1,2-DCE criteria are for the mixture of *cis*- and *trans*- isomers. Refer to Table 1 of Chapter 62-777, F.A.C. for criteria for these isomers if required for the project.
Key:
CTL = Cleanup Target Level, Table 1 of Chapter 62-777, F.A.C.
FDEP = Florida Department of Environmental Protection
GW = groundwater
MDL = method detection limit
SW = surface water
TBD = to be determined (based on analytical method selected to meet project needs).
ug/L = microgram per liter

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2 FIELD SAMPLING

2.1 DATA COLLECTION

The following sections outline the procedures to be followed during field activities associated with water, sediment, and tissue sampling for the ASR Science Plan to assure project DQOs are met. The projects associated with the ASR Science Plan implementation range from permit compliance to an experimental nature. This chapter focuses on groundwater, surface water, sediment, and tissue sampling procedures, and requirements that are anticipated to be performed during the course of the ASR project.

The FDEP and SFWMD SOPs and QC procedures in this chapter follow requirements described in the CERP QASR Chapter 3, Water Quality Sampling Procedures. In addition to general sampling requirements for CERP projects, the CERP QAPP Chapter 3 provides guidance on federal and state regulations, personnel responsibilities and training, health and safety, DQOs, and sampling strategy development. This document and the FDEP and SFWMD SOPs referenced therein should be reviewed and incorporated into future Work Plans developed for the ASR program.

2.2 RECORDING OF FIELD DATA

Before starting field activities, field notebooks, and data forms shall be set up to ensure organized data collection. Hardcopy as well as electronic forms may be utilized to record data. Daily logs and data forms are necessary to provide sufficient data to enable participants to reconstruct events that occurred during the project and to refresh the memory of the field personnel. Documentation of field sampling procedures and field-testing data will be recorded as applicable in accordance with FDEP SOP FD 1000 and Rule 62-160.240, F.A.C.

All daily logs will be kept in a waterproof notebook containing numbered pages. All entries will be made in waterproof ink. Per FDEP Rule 62-160.240, F.A.C., at the beginning of each day, the project name and number, the date that the entries were recorded, and weather conditions will be recorded at the top of each page of the logbook. If corrections are necessary, they must be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside or below. The correction must be initialed and dated. To prevent entries being added at a later date, unused portions of the notebook pages for each day will be struck through and include the statement "no further entries this date" or words similar.

Drilling and well construction documentation requirements are detailed in the following sections associated with these activities.

2.2.1 Sampling Records

The field records shall include, but not be limited to, the following:

- Name of person making the entry
- Name of team members, subcontractors, and visitors on site
- Weather conditions
- Description of activities to performed/objectives that day
- Equipment/materials to be used that day

Documentation on samples taken shall include:

- Sampling location
- Sample matrix
- Sampling depth for subsurface and surface water samples
- Sample identification number
- Sampling date, time, and personnel
- Equipment used
- Type of sample (e.g., grab, composite, QC)
- Quantity of each aliquot (if sample is a composite)
- Required analyses, sample preservation (including lot number and expiration date) and verification of preservation
- The type and source (and lot if available) of water used for decontamination or blank preparation
- Types of field QC samples, including when and where they were collected

2.2.2 Sampling Data Sheets

Sampling data sheets shall be created for each sample location. Minimal guidelines for these sheets are found in FDEP SOP FD 1000 (in particular FD 5000) and FS 2200. Requirements for documentation of biological samples are detailed in FDEP SOP FD 5300. The records should include at a minimum:

- Project name
- Date and time of measurement or test
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number, or other description)
- Latitude and longitude of sampling source location (if not specified in the monitoring plan)
- Analyte or parameter measured
- Measurement or test sample value (if performed in the field)
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)
-
- Equipment used
- Field measurements (temperature, dissolved oxygen (DO), specific conductance, turbidity, and pH)
- Specific to groundwater sampling:

- Depth to water, total well depth, sampling depth
- Calculations used for volume purged
- Flow rate of water from well
- Volume purged
- Length of purge time
- Date and time well was purged (start and end times)

2.2.3 Calibration Log

All field instruments will be calibrated in accordance with FDEP SOP FT 1000 and will be documented in accordance with FDEP SOP FD 4000. The documentation will include, but is not limited to, the documentation of standards, reagents, and field instrument calibration documentation. The calibration log will also include a summary indicating the acceptable calibration criteria and acceptable ranges for each parameter.

The following information shall be recorded in the log concerning standards and reagents:

- Date opened and expiration date
- Manufacturer
- Standard description
- Lot number
- Concentrations

Calibration documentation shall include:

- Vendor certifications
- The instrument identification (make, model, serial numbers)
- Time and date of calibration (whether initial calibration, initial calibration verification, or continuing calibration verification)
- Instrument reading
- Person(s) performing the calibration
- Result of calibration or calibration verification (detail acceptance criteria and whether pass or fail

2.2.4 Maintenance Logs

All inspection, cleaning, and maintenance activities for both field sampling and testing equipment will be recorded in a maintenance log for the purpose of validating field data. Each log shall include, at a minimum, the applicable items specified in FDEP SOP FD 3000:

- Inspection notes
- Cleaning activities
- Date(s) problem was fixed
- Date(s) instrument was not functioning
- Description of the problem
- Description of the solution

- Names of personnel involved
- Name of specific instrument
- Vendor service records, if applicable
- Date of instrument calibration, including a description of all issues encountered, as applicable

2.3 FIELD EQUIPMENT REQUIREMENTS AND CALIBRATION

Field parameter measuring equipment includes instruments used during the manual collection of surface water or groundwater samples to identify physical/chemical characteristics of the samples that are representative of field conditions as they exist at the time of sample collection. They are also used during the purging of a monitoring well prior to the collection of groundwater samples. The use of all instruments must follow a basic format to imply consistency of use. Regardless of the brand of meter used, all meters shall be properly maintained and operated in accordance with the manufacturers' instructions, and calibrations shall be verified prior to and following use.

2.3.1 Field Instruments Minimum Requirements

The field parameters listed in Table 2-1 will be measured during groundwater and surface water sampling events. Table 2-1 describes the performance criteria for the selection of monitoring equipment. The accuracy of the instrument employed must meet or exceed the criteria specified. These criteria, as well as the other field measurement specifications below, are in accordance with FDEP-SOP FT 1000 General Field Testing and Measurement and the SFWMD FSM.

Table 2-1. Field Parameters and Instrument Minimum Specifications

Parameter	FDEP SOP	Reporting Units	Instrument Sensitivity	WQ Acceptance Criteria*
pH	FT 1100	pH Units	0.01 units	± 0.2 pH units
DO	FT 1500	mg/L	0.01 mg/L	± 0.3 mg/L of saturation chart at temp
Specific Conductance	FT 1200	µS/cm	1 µS/cm	± 5% of the true value of KCl standard
Temperature	FT 1400	ºC	0.01 °C	± 0.5ºC
Turbidity	FT 1600	NTU	0.1 NTU	0.1-10 NTU: ± 10% of standard value 11-40 NTU: ± 8% of standard value 41-100 NTU: ± 6.5% of standard value >100 NTU: ± 5% of standard value
Residual Chlorine	FT 2000	mg/L	0.1 mg/L	± 10 % of standard value

Note:
*Acceptance criteria taken from FDEP SOP Table FT 1000-1 and FSM, Section 6

Key:
ºC = degrees Celsius
DO = dissolved oxygen FDEP = Florida Department of Environmental Protection

mg/L = milligrams per liter
NTU = nephelometric turbidity unit
KCl = potassium chloride
SOP = Standard Operating Procedure
uS/cm = microSiemens per centimeter
WQ = water quality

2.3.2 Field Instrument Calibration Requirements

The specifications for calibration of monitoring equipment in FDEP SOP FT 1000, applicable FT series SOPs, and the SFWMD FSM, Section 6, will be followed. The procedures specified below are essential calibration requirements that must be performed on field monitoring equipment for each field parameter:

- Initial Calibration (IC): The probes are adjusted (manually or automatically) to a theoretical value (e.g., DO saturation) or a known value of a calibration standard.

- Initial Calibration Verification (ICV): The probe is checked or verified directly following initial calibration by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria listed in the FDEP SOP.

- Continuing Calibration Verification (CCV): The probe is checked or verified by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria listed in the SOP.

- Chronological Calibration Bracket: The interval of time between verifications within which environmental sample measurements must occur. This time interval shall be consistent with manufacturers' recommendations for each type of probe used and initially set not to exceed 24 hours. If historically generated data demonstrate that a specific

instrument remains stable for longer or shorter periods of time, the time interval will be adjusted based on the shortest interval the instrument remains stable.

- Quantitative Calibration Bracket: The probe is calibrated or verified at a minimum of two known values that encompass the range of observed environmental sample measurement(s).

Initial calibration and verification checks shall be within stated calibration acceptance criteria in Table 2-2. If an initial calibration or verification fails to meet the acceptance criteria during a calibration, the probe will be immediately re-calibrated following a specific initial calibration procedure or removed from service. Any affected field test data must be qualified with a 'J' qualifier (refer to Section 4 for details).

For probes that are calibrated by the manufacturer, only verification is performed. Verification failures will be documented in the comment section of the field log with discussion of which parameter failed and corrective actions taken. Verification failures for parameters calibrated by the manufacturer require the instrument be returned to the manufacturer for re-calibration.

Table 2-2. Field Instrument Calibration Requirements

Parameter	Initial Calibration	Initial Calibration Verification (ICV)	Continuing Calibration Verification (CCV)
pH	• Use at least 2 standards: pH 7 and then pH 4 and/or 10 • Conduct daily prior to use for grab sample collection or if CCV fails	• Read a standard as a sample immediately following IC • Must read within ±0.2 standard pH units of calibration buffer true value	• Read daily, no later than 24 hrs after ICV or previous CCV • Read as a sample • Two buffers that bracket the sample value range. Preferably use the pH 7 and one other pH 4 or 10 • Must read within ± 0.2 standard pH units of calibration buffer true value
Specific Conductance	• Use 1 standard at the upper end of expected sample reading range but no less than 720 µS/cm • Conduct daily prior to use for grab sample collection or if CCV fails	• Read a standard as a sample immediately following IC at the low end of the expected sample reading range but no less than 100 µS/cm • Must be within ± 5% of true value	• Read daily, no later than 24 hrs after ICV or previous CCV. • Read as a sample • Two standards that bracket the sample value range. • Must be within ± 5% of true value
Temperature	• Verify against NIST-traceable thermometer prior to use at several temperatures within the expected sample range. • Must be within ± 0.5ºC of NIST traceable readings	--	• Monthly verification against NIST-traceable thermometer prior to collection and at the end of each sampling event. • CCVs must bracket the sample temperature range • Must be within ± 0.5ºC of NIST traceable readings

Parameter	Initial Calibration	Initial Calibration Verification (ICV)	Continuing Calibration Verification (CCV)
DO	• Calibrate under water-saturated atmosphere • Reading must be within ± 0.3 mg/L of expected soluble oxygen (in water saturated air) value at that water temperature • Conduct daily prior to use for grab sample collection or if CCV fails	• Read under water-saturated atmosphere immediately following IC • Reading must be within ± 0.3 mg/L of expected soluble oxygen (in water saturated air) value at that water temperature	• Read daily, no later than 24 hrs after ICV or previous CCV. • Read under water saturated atmosphere • Reading must be within ± 0.3 mg/L of expected soluble oxygen (in water saturated air) value at that water temperature
Residual Chlorine	• Use 2 primary standards and a blank bracketing the expected sample reading range • Conduct daily prior to use for grab sample collection or if CCV fails*	• Read a primary standard as a sample immediately following IC • Must be within ± 10% of true value	• Read secondary standard daily, no later than 24 hrs after ICV or previous CCV • Read secondary standard as a sample • Two standards that bracket the sample value range • Must be within ± 10% of true value
Turbidity	• At least two primary standards used to calibrate, bracketing the expected sample range. • Conduct IC at least quarterly • Standard value = 0.1-10 NTU: the response must be within 10% of the standard. • 11-40 NTU: 8% • 41-100 NTU: 6.5% • >100 NTU: 5%	• One primary standard read as a sample for verification immediately following IC. • Standard value = 0.1-10 NTU: the response must be within 10% of the standard. • 11-40 NTU: 8% • 41-100 NTU: 6.5% • >100 NTU: 5%	• Two secondary standards read as a sample for verification. • The two secondary standards must bracket the range of values read for the day. • Read daily, no later than 24 hrs after ICV or previous CCV • Standard value ≤ 0.1 NTU: the response must be within 0.02 NTUs. • 0.1-10 NTU: the response must be within 10% of the standard. • 11-40 NTU: 8% • 41-100 NTU: 6.5% • >100 NTU: 5%

* = IC frequency for Residual Chlorine may be instrument dependent. Some instruments can only be calibrated by the manufacturer.
Key:
ºC = degree(s) Celsius
DO = dissolved oxygen
mg/L = milligrams per liter
NIST = National Institute of Standards and Technology
NTU = nephelometric turbidity unit
µS/cm = microSiemens per centimeter

Calibration and verification for each instrument and field parameter must be linked with all sample measurements from that site. If any calibration verification fails to meet the acceptance criterion outlined in Table 2-2 in the field and it is not possible to reanalyze or resample the sample(s), the comment "Calibration verification failed for parameter X" will be placed in the comment field of the field sampling or calibration log with discussion of which parameter failed

and corrective actions taken. Data collected with an instrument that fails the IC, ICV, or CCV will be qualified as estimated with a 'J' qualifier.

2.4 FIELD QUALITY CONTROL REQUIREMENTS

The following section outlines field QC samples to be collected in accordance with DEP-SOP-001/01 – FQ 1000 Field QC Requirements. Individual Work Plans may include or require additional or more stringent requirements. Assessment of the field QC elements below are detailed in Section 4.2.

2.4.1 Field QC Blanks

Field QC blanks are collected to demonstrate the collected samples have not been contaminated by the sampling environment, sampling equipment, or sample containers and preservatives during storage and transportation or during laboratory processes. Field QC blanks are collected for organic, inorganic, and radiological analyses but not typically required for biological or toxicity analyses. Analyte-free water shall be used to prepare all field QC blanks. With the exception of trip blanks, all field QC blanks will be prepared on-site in the field.

At a minimum, prepare and submit a field QC blank for every 20 samples collected. Collect at least one blank for each reported test result/matrix combination each year for each project.

If more stringent validation is required, as determined in the Work Plan development and detailed in the Work Plan, collect a field QC blank daily. In order to claim that a positive result is due to external contamination sources during sample collection, transport, or analysis, at least one field-collected blank (excludes trip blanks) must have been collected on the same day the samples were collected and analyzed with the same sample set.

2.4.1.1 Equipment Blanks

An equipment blank, or "EB," is a sample of analyte-free water poured into, over, or through the sampling device, collected in a sample container, and transported to the laboratory for analysis. Equipment blanks monitor the on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, sample transport and storage conditions, and laboratory processes for water, waste, soil, or sediment samples. Equipment blanks will be collected as a single pre-cleaned equipment blank at the start of the event according to FQ 1000. Equipment blanks will be collected each day new equipment is used prior to sampling and analyzed for all laboratory analyses requested for the environmental samples collected at the site according to FQ 1000. "New" equipment refers to materials that either have never been used before (i.e., new lot of tubing) or equipment cleaned at the base of operations. If equipment is cleaned in the field, a field-cleaned equipment blank, referred to as an "FCEB," is collected following procedures in the same FDEP SOP.

2.4.1.2 Field Blanks

Field blanks are not required if an equipment blank has been collected. Field blanks consist of analyte free water poured into sample bottles on-site in the field and analyzed for all applicable

parameters for that specific sampling day. Field blanks monitor the on-site sampling environment, sample container cleaning, the suitability of sample preservatives and analyte-free water, sample transport and storage conditions, and laboratory processes.

2.4.1.3 Trip Blanks

Trip blanks monitor volatile constituents (e.g., VOCs, methyl mercury, etc.) for sample storage and transport conditions. The laboratory performing the analysis shall provide prepared VOC vials with analyte-free water. It is important to not open these vials. They are labeled and kept with the VOC samples throughout the sampling event and returned for analysis with the collected samples. See FQ 1213 for frequency, preparation, and handling requirements.

2.4.2 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field but will not be identified as duplicate samples (blind duplicate) on the COC record. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection. Duplicate sample results are used to assess the precision of the sample collection process and for evaluating the homogeneity of composite samples. Field duplicates will be collected at a frequency of one for every 20 samples collected or one per sampling event, whichever is more frequent, for each analysis.

2.4.3 Field Splits

A field split sample is a single sample that is homogenized and divided into two equal parts for analysis. The sample containers are assigned an identification number in the field, such that they cannot be identified as split samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field split samples prior to the beginning of sample collection. Split sample results are used to assess laboratory analysis precision, and/or the performance between two or more laboratories. Field split samples will be collected if SFWMD or FDEP require split samples for analysis by different laboratories for comparison purposes.

2.5 DECONTAMINATION REQUIREMENTS

Sampling equipment decontamination procedures will follow DEP-SOP 001/01 FC 1000 *Field Decontamination*.

The cleaning/decontamination procedures must assure that all equipment that contacts a sample during sample collection is free from the analytes of interest and constituents that would interfere with the analytes of interest. The cleaning reagents and other cleaning supplies cannot contribute analytes of interest or interfering constituents unless these are effectively removed during a subsequent step in the cleaning procedure. The effectiveness of any cleaning procedure (including all cleaning reagents) must be supported by equipment blanks with reported non-detected values. A single source of water shall be used to perform decontamination.

FC 1000 should be reviewed prior to an event or project to determine the appropriate decontamination procedures as the specifics are very dependent on the sample collection method(s) and analytes to be sampled for. FC 1100 addresses sampling equipment and FC 1200 addresses field instruments and drilling equipment. The general equipment cleaning procedure is as follows:

1. Rinse equipment with analyte-free water.
2. Soak equipment in a sudsy water solution (Luminox® or equivalent).
3. Use a brush to remove particulate matter or surface film.
4. Rinse thoroughly with analyte-free water.
5. If metals are being collected, and equipment is not stainless steel, rinse with appropriate acid (FC 1001, Section 4). If VOCs or SVOCs are being collected, rinse with isopropanol.
6. Triple-rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water.
7. Allow to completely air dry.
8. Place clean sampling equipment in a new plastic bag for storage.

Note that hot water is preferred for cleaning procedures if available, although ambient temperature water is acceptable.

2.5.1 Sample Containers

Containers used for sample collection should always be new. However, if reusing sample containers is necessary, follow the container decontamination procedures based on analyte group detailed in Table 2-3 below.

Table 2-3. Container Decontamination Procedures

Parameter / Class	Decontamination Procedures
VOCs, SVOCs	1, 2, 4, 6 (not required if Luminox (or equivalent is used), (5 and 7 optional), 11 1, 2, 4, (6 optional, methanol only), 7
Metals	1, 2, 3, 4, 8, 11 ** **Procedures to clean containers for ultra-trace metals are found in FS 8200
Inorganic non-metalics, Pesticides, Radiological, Nutrients	1, 2, 3*, 4, 8, 11 * For nutrients, replace nitric acid with hydrochloric acid, or use a hydrochloric acid rinse after the nitric acid rinse; see FC 1001, Section 4
Microbiological	1, 2, 4, 8, 9, 11
Toxicity / Bioassay	1, 2, 10, 2, 4, 6.1, (10 optional), 11

Source: FC 1000 – Table 2
Notes:
Steps 1 and 2 may be omitted when cleaning new, uncertified containers.
1. Wash with hot tap water and a brush using a suitable laboratory-grade detergent:
   - Volatile and Extractable Organics: Luminox, Liquinox, Alconox or equivalent;
   - Inorganic nonmetallics: Liquinox or equivalent;
   - Metals: Liquinox, Acationox, Micro or equivalents:
   - Microbiologicals (all): Must pass an inhibitory residue test.
2. Rinse thoroughly with hot tap water.
3. Rinse with 10% nitric acid solution.
4. Rinse thoroughly with analyte-free water (deionized or better).
5. Rinse thoroughly with pesticide-grade methylene chloride.
6. Rinse thoroughly with pesticide-grade isopropanol, acetone or methanol. For bioassays, use only acetone, and only when containers are glass.
7. Oven dry at 103°C to 125°C for at least 1 hour. VOC vials and containers must remain in the oven in a contaminant-free environment until needed. They should be capped in a contaminant-free environment just prior to dispatch to the field.
8. Invert and air-dry in a contaminant-free environment.
9. Sterilize containers:
   - Plastic: 60 min at 170°C, loosen caps to prevent distortion.
   - Glass: 15 min at 121°C.
10. Rinse with 10% hydrochloric acid.
11. Cap tightly and store in a contaminant-free environment until use. Do not use glass if collecting samples for boron or silica.

2.5.2 New Tubing

As a general rule, new tubing may be used without preliminary cleaning if an equipment blank is collected using that tubing. Protect new tubing from potential environmental contamination by sealing it in new untreated plastic bags or keep the tubing in the original sealed packaging until use. If new tubing is exposed to potential contamination, rinse the exterior and interior tubing surfaces with hot tap water followed by a thorough rinse with analyte-free water. If new tubing is to be used to collect samples, thoroughly rinse the tubing with sample water (i.e., pump sample water through the tubing) before collecting samples. Refer to FDEP SOP FC 1160 or treat tubing according to the procedures outlined in Section 2.5.1 above for cleaning various types of tubing if the tubing is to be reused for a project or activity.

2.5.3 Shipping Containers

Reusable ice chests and shipping containers shall be washed with laboratory detergent, rinsed with tap water, and air dried after each use as described in FDEP SOP FC 1190.

2.6 FIELD SAMPLE COLLECTION

Field sample collection conducted during the ASR program shall follow FDEP SOPs in conjunction with the SFWMD FSM (as appropriate). FDEP SOP FS 1000 *General Sampling Procedures* contains information on equipment selection, appropriate equipment construction materials, holding times and preservation, and analyte group compatibility for a variety of matrices.

During the development of individual projects, the Work Plans must include details of or references to the sampling procedures and requirements depending on the analytes to be tested for and sampling techniques employed (see Section 1.6). The methods selected must be evaluated by the project team to determine the best method to achieve the project DQOs and, if applicable, permit requirements.

2.6.1 Groundwater Sampling

Groundwater well purging and sampling will be conducted in accordance with FDEP SOP FS 2000 *General Water Sampling* and FS 2200 *Groundwater Sampling*. The procedures and requirements in these SOPs are intended to ensure the collected samples will be representative of water in the aquifer or target formation, and that the samples have not been altered or contaminated by the sampling and handling procedures.

To ensure a representative sample, wells must be purged prior to sampling. The well purging technique employed will be determined based on the well and groundwater characteristics. Figure FS 2200-2 in the SOP provides a flow chart to assist in selecting appropriate techniques and stabilization requirements for a variety of purging situations. The project anticipates two primary purging techniques: purging wells with plumbing (e.g., pumps, piping) permanently installed and wells without plumbing (i.e., requires portable pump). DEP Form FD 9000-24 Groundwater Sampling Log must be used for documenting the purging and sampling of groundwater.

FS 2213 *Purging Wells Without Plumbing (Monitoring Wells)* details purging procedures for monitoring wells using portable pumps (e.g., peristaltic, variable speed submersible). When the depth of the well screen interval is known, the screen is <10 feet, and the screen is completely submerged, the preferred variation of this method is the minimum volume purge (i.e., low-flow) procedure. The pump or bottom of the tubing will be placed in the middle of the well screen and purged at a rate of <0.1 gallons per minute until the water quality parameters stabilize. The first set of stabilization readings will be taken as soon as the purge rate equal to the well recovery rate is established and an additional three equipment volumes (i.e., volume of tubing and flow cell) of water have been purged.

If the well screen interval is unknown or the well is an open borehole, the conventional purge method is performed using a variable speed submersible pump. In this method, the pump or tubing intake will be placed at the top of the water column. The well will be pumped until the purge rate equals the recovery rate. Then, a minimum of one well volume will be removed from the well before the first set of stabilization readings can be collected. A minimum of one-fourth of the well volume will be removed between subsequent readings.

FS 2215 *Purging Wells with Plumbing* details purging procedures for wells with pumps installed and equipped with sampling ports or spigots (i.e., ASR wells). For pumps operating intermittently, the spigot is opened and flushed with enough volume until the purge completion criteria are met. If the pumps are continuously running, water quality parameters are measured but stabilization verification is not required.

It should be noted that ASR wells will be operated with flow occurring in either recharge mode or in recovery mode. When ASR wells are operating in recovery mode, samples will be treated as groundwater and sampled accordingly. Conversely, if the ASR wells are operating in recharge mode, samples must be collected following the surface water sampling procedures detailed in Section 2.6.2 below.

Whether purging with or without plumbing, FS 2212 details water level measurement, equipment and well volume determination, and purge completion determination. For the procedures above, excluding the continuous running permanent pump configuration, the purge is complete when three sets of readings are within the required limits shown below:

- Temperature ±0.2°C
- pH ±0.2 standard units
- specific conductance ±5% of reading
- DO ≤20% saturation
- Turbidity ≤20 NTU

Stabilization readings will be taken no sooner than two minutes apart until three sets of readings are within the required limits. If five readings are taken and stabilization has not occurred, sampling will proceed according to FDEP SOP FS 2212 *Well Purging Techniques* subsection 3.6, and this will be documented in the field notes and data usability summary (DUS). Purge records will be kept on the well sampling data sheet (see Section 2.1). Samples will be collected immediately after the well purge is complete.

Refer to the FDEP SOP FS 2212 if the well screen interval is unknown, partially submerged, an open borehole for additional procedures that should be incorporated, or referenced in the work plan.

Groundwater sampling techniques are detailed in FS 2220. Once purging is complete, samples will be collected directly from the portable pump tubing or spigot into appropriate sample containers; intermediate containers should not be used. The sample stream flow rate should be within 100 to 400 milliliters per minute.

The collection of VOCs from portable pumps has specific requirements to reduce loss of target compounds. If VOCs are to be collected, refer to FDEP SOP FS 2221 for specific procedures.

Sample preservation must be conducted within 15 minutes of sample collection. Refer to Table 2-4 and Table 2-5 for sample container and preservation requirements and analytical holding times. Refer to Section 2.6.5 if samples require filtration. Refer to Section 2.7 for sample handling and custody procedures.

The analytical methods listed below in Tables 2-4 and 2-5 are listed in 40 CFR Part 136 and should be applicable to the majority of project parameters and detection limits. These methods should be used to ensure comparability of data gathered from different projects conducted over the course of the ASR program. However, it should be noted 40 CFR Part 136 (and Part 141 for drinking water) lists multiple method options for most parameters. Project managers must evaluate specific project needs; and if a different 40 CFR–listed method is required to meet project objectives for a particular parameter, the method and associated DQOs (i.e., detection limits) must be specified in the project Work Plan and must be approved by the PM. If a project requires the use of a method not listed in 40 CFR, the PM shall follow Chapter 62-160.330 F.A.C., *Approval of Alternative or Modified Laboratory Methods*, to obtain approval. SFWMD and FDEP must approve any alternative methods prior to approval of the associated Work Plan.

Table 2-4. Summary of Analytical Methods, Containers, Preservation, and Holding Times for Aqueous Analytes in Table 1-1

Analyte / Class	Analytical Method	Container	Preservation	Holding Time
VOCs (see Table 1)	624.1	G, FP-lined cap	<6°C, HCl to pH 2, headspace-free, if residual chlorine present, add 0.008% $Na_2S_2O_3$	14 days
SVOCs (see Table 1)	625.1	AG, FP-lined cap	<6°C, store in dark, if residual chlorine present, add 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
Metals				
Metals (see Table 1)	200.7 / 200.8	P, FP, G	HNO_3 to pH <2, or at least 24 hours prior to analysis	6 months
Mercury	245.1 / 1631	P, FP, G	HNO_3 to pH <2	28 days
Chromium VI	218.6	P, FP, G	<6°C, pH = 9.3-9.7	28 days if preserved; 24 hrs if not
Cyanide	SM 4500-CN	P, FP, G	<6°C, NaOH to pH >10	14 days
Anions				
Anions (see Table 1)	300	P, G	<6°C	28 days
Pesticides				
Organochlorine Pesticides / PCBs	608.3	G, FP-lined cap	<6°C, pH 5-9	7 days until extraction, 40 days after extraction
Chlorinated Herbicides	615	G, FP-lined cap	<6°C	7 days until extraction, 40 days after extraction
Carbofuran & oxamyl	632	G, FP-lined cap	<6°C	7 days until extraction, 40 days after extraction
Diquat	549.2	P, AG	<6°C, H2S to pH 2, headspace-free, if residual chlorine present, add 0.008% $Na_2S_2O_3$	7 days until extraction, 21 days after extraction

Analyte / Class	Analytical Method	Container	Preservation	Holding Time
Endothall	548	AG, FP-lined cap	<6°C, HCl to pH 2, headspace-free, if residual chlorine present, add 0.008% $Na_2S_2O_3$	7 days until extraction, 14 days after extraction
Glyphosate	547	G, FP-lined cap	<6°C, if residual chlorine present, add 0.008% $Na_2S_2O_3$	14 days
Picloram	8151A	AG	<6°C	7 days until extraction, 40 days after extraction
Nutrients				
Nitrate (as N)	353.2 Rev 2	P, G	<6°C, H_2SO_4 to pH <2	48 hrs
Nitrite (as N)	353.2 Rev 2	P, G	<6°C, H_2SO_4 to pH <2	48 hrs
Total nitrate/nitrite (as N)	353.2 Rev 2	P, G	<6°C, H_2SO_4 to pH <2	28 days
Radiological				
Radiological	900	P, FP, G	HCl or HNO_3 to pH <2	6 months
Radium-226, 228, total	903	P, FP, G	HCl or HNO_3 to pH <2	6 months
Strontium-89	905	P	HCl or HNO_3 to pH <2	6 months
Strontium-90	905	P	HCl or HNO_3 to pH <2	6 months
Tritium	906	G	None	6 months
Uranium-234	EML HASL-300 Method U-02-RC	P	HCl or HNO_3 to pH <2	6 months
Disinfection				
Bromate	321.8	P	NaOH to pH 10	NA
Chloramines	127	AG	Headspace-free	15 min (conducted in the field)
Chlorine	SM 4500-Cl	AG	Headspace-free	15 min (conducted in the field)
Chlorine dioxide	327	G	Headspace-free	4 hrs
Chlorite	327	G	Headspace-free	4 hrs
Haloacetic acids (HAA5)	552.3	AG, FP-lined cap	<6°C, 5mg NH3Cl	14 days
Trihalomethanes & TTHM	624.1	G, FP-lined cap	<6°C, HCl to pH 2, headspace-free, if residual chlorine present, add 0.008% $Na_2S_2O_3$	14 days
Biological				
Coliforms (E. coli & Fecal coliform)	1604 / SM 9223B	PA, G	<10°C, 0.008% $Na_2S_2O_3$	48 hrs
Cryptosporidium & giardia lamblia	1623	LDPE; field filtration	<10°C	96 hrs
Viruses (enteric)	SM 9230	P, G	<10°C	48 hrs
Heterotrophic plate count	SM 9215	P, G	<10°C	24 hrs

Analyte / Class	Analytical Method	Container	Preservation	Holding Time
Additional Analytes				
Acrylamide	8316	G, FP-lined cap	<6°C	7 days until extraction, 40 days after extraction
Asbestos (>10u)	100.2	P, G	<6°C	48 hrs
Foaming Agents	SM 5540 C	P	<6°C	48 hrs
Epichlorohydrin	None approved			
Color	110.2	P, G	<6°C	48 hrs
pH	SM 4500 H	P, G	<6°C	15 min
Odor	SM 2150 B	P, G	<6°C	24 hrs
TDS	SM 2540 C	P	<6°C	7 days
Turbidity	SM 2130 B	P	<6°C	48 hrs

Source: 40 CFR Part 136, FDEP SOP FS 1000, and/or specific method requirements
Note: All methods referenced are EPA methods unless otherwise stated.
Key:
A = amber
FP = fluoroplastic, teflon
P = plastic, HDPE
G = glass

Table 2-5. Summary of Analytical Methods, Containers, Preservation, and Holding Times for Aqueous Analytes in Table 1-2

Analyte / Class	Analytical Method	Container	Preservation	Holding Time
VOCs1 (See Table 2)	624.1	G, FP-lined cap	<6°C, HCl to pH 2, headspace-free, if residual chlorine present, add 0.008% $Na_2S_2O_3$	14 days
SVOCs2 (see Table 2)	625.1	AG, FP-lined cap	<6°C, store in dark, if residual chlorine present, add 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
Metals				
Mercury (total)	245.1 / 1631	P, FP, G	HNO_3 to pH <2	28 days
Methyl Mercury	1630	P	HCl to pH <2	6 months
Pesticides				
Aldrin, Dieldrin	608.3	G, FP-lined cap	<6°C, pH 5-9	7 days until extraction, 40 days after extraction
Ethion (OP Pest 8141B)	8141B	G, FP-lined cap	<6°C	7 days until extraction, 40 days after extraction
Bromacil, Ametryn, Haxazinone	525.2	P, AG	<6°C, HCl to pH 2, headspace-free, if residual chlorine present, add 0.008% Na_2SO_3	14 days until extraction, 30 days after extraction

Analyte / Class	Analytical Method	Container	Preservation	Holding Time
Nutrients				
Ammonia	SM 4500-NH3 G	P	≤6°C, H_2SO_4 to pH<2	28 days
TKN	EPA 351.2	P	≤6°C, H_2SO_4 to pH<2	28 days
TP	EPA 365.1	P	≤6°C, H_2SO_4 to pH<2	28 days
OP	SM 4500-P E	P	≤6°C, 0.45µm filtered	48 hrs
Nitrogen (organic)	calculation			
TN	calculation			
Additional Analytes				
BOD	SM 5210 B	P	≤6°C	24 hrs
COD	410.4 Rev 2.0	P, G	≤6°C, H_2SO_4 to pH<2	28 days
DOC	EPA 9060A	G	≤6°C, HCl to pH<2, 0.45µm filtered	28 days
Sulfide	EPA 376.2	P	≤6°C, NaOH to pH>9, 2 mL zinc acetate	7 days
TSS	SM 2540 C	P	≤6°C, 0.45µm filtered	7 days
Total dissolved sulfide	SM 2540 C	P	≤6°C	7 days
Bromide	300	P	≤6°C	28 days
Alkalinity (total, bicarbonate, and carbonate)	SM 2320 B	P	≤6°C	14 days
Biological				
Enterococci	SM 9222	AP, G	<10°C, 0.008% $Na_2S_2O_3$	48 hrs
Coliphage	1602	P	<6°C, if residual chlorine present, add 0.008% Na_2SO_3	48 hrs
Clostridium perfringens	None approved			

Key:
A = amber
FP = fluoroplastic, teflon
P = plastic, HDPE
G = glass

2.6.2 Surface Water Sampling

Surface water samples shall be collected using the operating procedures described in DEP-SOP FS 2000 *General Water Sampling* and FS 2100 *Surface Water Sampling*. These SOPs describe a variety of techniques and devices that can be used for surface water sample collection. For the project, it is anticipated that two types of surface water samples will be collected, surface grab samples and depth grab samples.

Surface grab samples are collected from the top 12 inches of the water column. Avoid skimming the surface of the water during collection unless specifically required by the sampling plan. Make sure to not disturb sediments during collection when in shallow water bodies. Where

practical, use the actual unpreserved sample container as the collection device. Sample containers attached to poles are also considered direct grabs. In any case, it is essential that the bottle be held neck down such that no air leaves the bottle until it is at the sampling depth.

For samples collected from a specific depth, there are several options to consider: Niskin or Van Dorn type devices, or pump and tubing. See FS 2000 for proper collection procedures for extractable organics and volatile organic compounds. If a Van Dorn device is used, the device will be lowered to the depth required and the sample collected in accordance with FS 2110. Ensure enough water is collected to completely fill each required sampling container. If a tubing setup is used, the tubing will be attached to a pole or weighted line so that the sample can be collected from the required depth.

Sampling must be performed so that samples are neither contaminated nor altered from improper handling, and disturbing sediments in the vicinity of the sampling location is to be avoided. When taking samples in a boat, samples must be taken near the bow, away and upwind from any gasoline outboard engine. The vessel must also be oriented so that the bow is positioned in the up-current direction. When sampling while wading, samples shall be taken up-current from the body. Provisions must also be made so that sediments are not disturbed in the immediate area.

Compositing buckets will be used when the total volume of sample water required from a sample site exceeds the volume of a single grab of the sampling equipment. Compositing the sample in a bucket prior to pouring into individual sample bottles will assure that all water samples from a particular site are homogenized. Samples collected in the sampling device that do not require compositing will be shaken prior to pouring to assure homogeneity.

Refer to Table 2-4 and Table 2-5 above for sample container and preservation requirements and analytical holding times. Refer to Section 2.6.5 if samples require filtration. Refer to Section 2.7 for sample handling and custody procedures.

The analytical methods listed in Tables 2-4 and 2-5 are listed in 40 CFR Part 136 and should be applicable to the majority of project parameters and detection limits. These methods should be used to ensure comparability of data gathered from different projects conducted over the course of the ASR program. However, it should be noted 40 CFR Part 136 (and Part 141 for drinking water) lists multiple method options for most parameters. Project managers must evaluate specific project needs; and if a different 40 CFR–listed method is required to meet project objectives for a particular parameter, the method and associated DQOs (i.e., detection limits) must be specified in the project Work Plan and must be approved by the PM. If a project requires the use of a method not listed in 40 CFR, the PM shall follow Chapter 62-160.330 F.A.C., *Approval of Alternative or Modified Laboratory Methods*, to obtain approval. SFWMD and FDEP must approve any alternative methods prior to approval of the associated Work Plan.

2.6.3 Sediment Sampling

Sediment samples shall be collected using the operating procedures described in FDEP SOP FS 4000 *Sediment Sampling*. Sediment samples must be collected using one of three different types of equipment: scoops, corers and dredges, or grab samplers. The selection of equipment will be based on the site characteristics. Table FS 4000-1 *Summary of Bottom Sampling Equipment*

(from ASTM 1391-94) describes the approved devices for sediment sampling for various types of sample types/locations and details the advantages and disadvantages of each. This SOP also provides guidance and describes procedures for sampling interstitial or pore water samples if necessary for a project or study.

2.6.4 Tissue Sampling

Tissue samples shall be collected using the operating procedures described in FDEP SOP FS 6000 *General Biological Tissue Sampling*. This SOP describes equipment, procedures, field measurement, and storage and shipping of shellfish and finfish. Table FS 6100-1 *Summary of Shellfish Sampling Equipment* and Table FS 6200-1 *Summary of Fish Sampling Equipment* summarizes the approved sampling techniques for each tissue type. The procedures described in the shellfish FDEP SOP FS 6100 may also be adapted for collection of tissues from shrimp, scallops, crabs, crayfish, spiny or clawed lobsters, and turtles.

2.6.5 Sampling for Dissolved Constituents

Water samples collected for analysis of dissolved constituents will be field-filtered in accordance with FDEP SOP FS 2000 *General Water Sampling*. Tables 2-4 and 2-5 lists parameters requiring sample filtration. When filtering groundwater samples, a disposable, one-piece, molded construction 0.45-micron filter for non-metal parameters (1-micron filters for metals) will be placed at the outfall of the pump tubing or spigot. Position the filter with the outfall facing up and flush with sample water until all air is expelled before collecting samples. Filtered sampling must begin within 15 minutes of collection of the non-filtered sample from the same location using the same sampling methodology selected for the non-filtered sample. Filters shall be purchased from the same manufacturer consistently throughout the project, if possible.

2.7 SAMPLE HANDLING AND CUSTODY

2.7.1 Chain of Custody

The primary objective of the COC procedures is to provide an accurate written or computerized record that can be used to trace the possession and handling of a sample from the receipt of precleaned sample bottles through completion of all required analyses. A sample is “in custody” if it is:

- In a team member’s physical possession
- In a team member’s view
- Locked up
- Kept in a secured area that is restricted to authorized personnel

The COC record must be completed by the field personnel designated by the Project Manager (PM) as responsible for sample shipment to the appropriate laboratory for analysis. The COC will include, but will not be limited to, all samples collected, including QC, sampling dates, matrix, preservation, and requested analyses as detailed in FDEP SOP FD 5000. In addition, if samples are known to require rapid turnaround in the laboratory because of project time constraints or analytical concerns (e.g., extraction time or holding time limitations) a

representative from the laboratory will be notified. The custody record must also indicate any special preservation techniques necessary. Copies of the COC records are maintained with the project file.

The coolers in which the samples are packed must be accompanied by a COC record. When transferring samples, the individuals relinquishing and receiving them must sign, date, and note the time on the COC record. If samples require shipping to a laboratory, the shipping containers (coolers or boxes) are sealed in as many places as necessary to ensure security. Upon receipt at the laboratory, the custodian must check that seals or taping on boxes and/or coolers are intact.

2.7.2 Sampling Forms

Upon completion of a sampling event, the sample collection team shall provide the laboratory all field sampling forms and/or other water quality data. Groundwater quality data will be collected using the FDEP Form FD 9000-24 (Appendix A). When applicable, water quality data collected during the sampling of surface water or wells with plumbing shall be provided to the lab. The sample collection team must review all forms for completeness and accuracy prior to submittal. This data shall be used by the laboratory to generate the field data ADaPT file used during validation and usability assessment described in Section 4.3.1.

2.7.3 Preservation and Holding Times

Sample container type, preservation, and holding times shall follow the requirements in FS 1000, 40 CFR Part 136, or the specific analytical method. The laboratory must be consulted on the volume of sample required for analysis. Summaries of analytical method, container, preservation, and holding times for various potential aqueous analyses are specified in Table 2-4 and

Table 2-5 above. Similar tables addressing analytes for sediment and tissue samples are specified below in Table 2-6 and Table 2-7, respectively. Samples requiring preservation must be preserved within 15 minutes of sample collection. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete.

As noted in Section 2.6.1, the analytical methods listed below in Tables 2-6 and 2-7 are listed in 40 CFR Part 136 and should be applicable to the majority of project parameters and detection limits. These methods should be used to ensure comparability of data gathered from different projects conducted over the course of the ASR program. Project managers must evaluate specific project needs and if a different 40 CFR listed method is required to meet project objectives for a particular parameter, the method and associated DQOs (i.e., detection limits) must be specified in the project Work Plan and must be approved by the PM. If a project requires the use of a method not listed in 40 CFR, the PM shall follow Chapter 62-160.330 F.A.C., *Approval of Alternative or Modified Laboratory Methods* to obtain approval. SFWMD and FDEP must approve any alternative methods prior to approval of the associated Work Plan.

Table 2-6. Summary of Analytical Methods, Containers, Preservation, and Holding Times for Sediment Samples

Analyte / Class	Analytical Method*	Container	Preservation	Holding Time
VOCs	8260	See Table FS 1000-7	See Table FS 1000-7	See Table FS 1000-7
SVOCs	8270,	Glass, 8 oz wide-mouth with Teflon® - Lined lid	Cool ≤6°C **	14 days until extraction, 40 days after extraction
Metals	6010 / 6020	Glass or plastic 8 oz wide mouth	None	6 months
Mercury	7471	Glass or plastic 8 oz wide mouth	Cool ≤6°C **	28 days
Chromium VI	7196 / 7197	Glass or plastic, 8 oz wide mouth	Cool ≤6°C **	1 month until extraction, 4 days after extraction
Pesticides				
Organochlorine Pesticides1 / PCBs	8081	Glass, 8 oz wide-mouth with Teflon® - Lined lid	Cool ≤6°C **	14 days until extraction, 40 days after extraction
Chlorinated Herbicides2	8051	Glass, 8 oz wide-mouth with Teflon® - Lined lid	Cool ≤6°C **	14 days until extraction, 40 days after extraction
Carbofuran & oxamyl	8318	Glass, 8 oz wide-mouth with Teflon® - Lined lid	Cool ≤6°C **	14 days until extraction, 40 days after extraction

Source: Table FS 1000-6
* = Additional methods and analyte capabilities are detailed in Table FS 1000-6.
** = Keep soils, sediments and sludges cool at ≤6°C from collection time until analysis. No preservation is required for concentrated waste samples.

Table 2-7. Summary of Analytical Methods, Containers, Preservation, and Holding Times for Fish and Shellfish Samples

Analyte / Class	Matrix	Analytical Method	Sample Container	Field Preservation	Maximum Shipping Time (Transport to Lab)	Laboratory Storage	Laboratory Holding Time
—	Whole Organism (Fish, shellfish, etc.	—	Foil-wrap each organism (or composite for shellfish) and transport in waterproof plastic bag	Cool in wet ice or freeze on dry ice	24 hours or 48 hours	-	-
Organics	Tissue (fillets and edible portions, homogenates)	8270	Borosilicate glass, PTFE, quartz, aluminum foil	Cool in wet ice or freeze on dry ice	24 hours or 48 hours	Freeze at <-20°C	1 year

Metals	Tissue (fillets and edible portions, homogenates)	6010 / 6020	Plastic, borosilicate glass, quartz, PTFE	Cool in wet ice or freeze on dry ice	24 hours or 48 hours	Freeze at <-20°C	6 months
Mercury	Tissue (fillets and edible portions, homogenates)	7473	Plastic, borosilicate glass, quartz, PTFE	Cool in wet ice or freeze on dry ice	24 hours or 48 hours	Freeze at <-20°C	1 year
Dioxin	Tissue (fillets and edible portions, homogenates)	8290 / 1613B	Amber containers: Borosilicate glass, PTFE, quartz, aluminum foil	Cool in wet ice or freeze on dry ice	24 hours or 48 hours	Freeze at <-20°C	30 days until extraction, 15 days after extraction

Source: EPA Methods specified state they are appropriate for tissue sample.

2.7.4 Sample Storage and Shipping

The transportation and handling of samples must be accomplished in a manner that protects the integrity of the samples. Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the laboratory at proper temperatures. The following sample packaging requirements will be followed:

- All sample lids must stay with the original containers
- If the sample height does not reach the neck of the bottle, a waterproof marker will be used to show sample level; this will help the laboratory determine if any leakage occurred during shipping
- Samples shall be submersed in ice immediately after collection
- Shipping coolers must be partially filled with packaging materials and ice (when required) to prevent the bottles from moving during shipment
- Wet ice will be used to cool samples during shipping
- A duplicate custody record must be placed in a plastic bag and taped to the inside of the cooler lid
- Custody seals are affixed to the sample cooler by the laboratory shipping agent

3 CHEMICAL ANALYSIS

3.1 LABORATORY REQUIREMENTS

Projects conducted during the course of the ASR project for permit compliance or monitoring must comply with QA Rule Chapter 62-160, F.A.C. Chemical analysis must be performed by laboratories with TNI certification for a specific matrix, method, and analyte.

Laboratories performing analyses for CERP projects are required to maintain a QM documenting the quality systems according to applicable TNI standards, Chapter 64E-1, F.A.C., Chapter 62-160, F.A.C., and the CERP QASR.

Some projects or studies may require an analyte or test for which TNI certification is not available. Follow guidance provided in Rule 62-160.600, F.A.C., Research Field and Laboratory Procedures. Even if a certification is not available, laboratories must meet all requirements for laboratories specified in Chapter 62-160, F.A.C. Exceptions to the laboratory certification requirement must be documented in the Work Plan and approved by the SFWMD prior to implementation.

Any laboratory conducting sample analysis is responsible for reviewing this PQAP to ensure that they can generate data that will meet the project DQOs. The laboratory shall notify SFWMD immediately when any TNI certification applicable to this project has been lost or revoked. The laboratory or contractor performing the work will inform SFWMD, and steps will be taken immediately to subcontract another TNI laboratory certified for the analysis if the current laboratory cannot obtain recertification prior to the next scheduled sampling.

The QM, applicable laboratory SOPs, MDL studies, or Performance Evaluation studies shall be provided to SFWMD upon request. Laboratory audits performed by SFWMD (or their designee) will be allowed for any facility analyzing samples from the ASR projects and will respond to the recommended corrective actions in a timely manner.

The laboratory manager, technicians, and analysts are responsible for ensuring compliance with the laboratory QM, the analytical method procedures and requirements, and all applicable standards and practices throughout the laboratory process. The laboratory's QA Officer has overall responsibility for compliance with all QA requirements.

Laboratories shall securely maintain all associated records for a period of at least five years or as otherwise directed by SFWMD.

3.2 LOGGING AND STORAGE OF SAMPLES

The laboratory QM and associated laboratory SOPs will specify the laboratory sample handling and custody requirements to be followed. These requirements will be consistent with the TNI

standard and 40 CFR Part 136, as well as 40 CFR Part 141, where drinking water methods are prescribed. In addition, the following procedures will be adhered to:

- Once the samples reach the laboratory, they will be checked for anomalies against information on the COC form accompanying the samples. Each cooler containing samples must have a COC seal and tape. The receiving laboratory will reject any sample cooler that shows evidence of tampering with the COC seal and tape.

- The condition, temperature, and appropriate preservation of samples will be checked and documented on the COC form. Appropriate measuring methods include measurement of a temperature blank contained in the cooler. Infrared temperature measurement of an aqueous sample is also acceptable. For samples that are delivered to the lab on the same day they are collected, if ice is present in the cooler upon receipt, the lab will note this on the COC form and accept the samples, even if the sample temperatures are above the acceptance criterion of 6°C. Checking an aliquot of the sample using pH paper is an acceptable procedure for checking acid/base preservation. The occurrence of any anomalies in the received samples and the resolution of these anomalies will be documented in laboratory records, a sample receipt log, and the case narrative submitted with the laboratory data package.

- While in the laboratory, samples will be stored in limited-access, temperature-controlled areas. Refrigerators, coolers, and freezers will be monitored for temperature daily. The acceptance criterion for the temperatures of the refrigerators and coolers is 0.1 to 6°C. Acceptance criteria for the temperatures of the freezers will be less than 0°C. All cold storage areas will be monitored by thermometers or other temperature monitoring devices that have been calibrated against a National Institute of Standards and Technology (NIST)-traceable thermometer. As indicated by the findings of the calibration, correction factors will be applied to each thermometer. Records that include acceptance criteria will be maintained. All samples will be stored separately from standards.

- Samples will be stored after analysis until they can be disposed of in accordance with applicable local, state, and federal regulations. Prior to disposal, the laboratory will contact SFWMD for approval. Project managers must communicate with the laboratories on minimum time frames the sample will be stored to meet project needs. Disposal records will be maintained by the laboratory.

3.3 LABORATORY QUALITY CONTROL REQUIREMENTS

The following are definitions of typical laboratory QC elements that may be employed if required by the analytical method. Additional QC elements may be required for certain analyses; refer to each analytical method for details.

3.3.1 Method Detection Limits and Reporting Limits

The laboratory data package shall include the MDLs and reporting limits (RL) (also known as PQL) for each analyte reported. The laboratory must follow the process outlined in 40 CFR for determining MDLs when applicable to a specific method and parameter. The MDL is the lowest concentration of an analyte measured by a specific method in a specific matrix that can be reported as "detected." The RL is typically 3 to 10 times the MDL for the majority of target analytes and has a higher degree of confidence. See Tables 1-1 and 1-2for MDL requirements related to the ASR projects.

Laboratory data packages must report non-detect results as the value of the MDL (qualified as "U"). Results reported as detected between the MDL and RL are qualified as estimated ("I"). Results reported above the PQL are not qualified with an "I" or a "U".

There may be certain projects conducted during the course of the project where analyte MDLs may need to be lower than those stated in Tables 1-1 and 1-2. Each Work Plan must detail these requirements and provide information regarding alternative methods that may be needed to meet the lower MDLs. In addition, given that values between MDL and PQL are qualified as estimated and may have a high associated uncertainty, project managers should attempt to set the MDL below standards and criteria when possible.

3.3.2 Instrument Calibration Data

The laboratory data package shall include initial and continuing calibration supporting data, when applicable, according to the analytical method or laboratory SOP. This will include a copy of the results for each level of calibration, the linear range, and the correlation coefficient or response factor. It must be clear as to which standards (files) were used in the calibration, the number of standards, and if any points were deleted to attain an acceptable correlation coefficient. The equations presented shall be complete and use enough significant figures to reproduce the analytical results during data validations.

3.3.3 Surrogate and Internal Standard Data

Depending on the analytical method requirements, a surrogate may be used to determine preparation/extraction efficiency while an internal standard is used to determine analytical efficiency. The surrogate or internal standard shall be a compound similar to but not a contaminant of concern is added to each analytical sample during the preparation phase. Test reports for methods using surrogates and/or internal standards shall include the concentration of the surrogate or standard added, the amount observed, the calculated percent recovery (%R), and the lab QC limits for %R.

3.3.4 Laboratory Blank Data

Laboratory blank samples consist of all reagents and materials used for a particular sample analysis and run throughout the entire method procedure. The laboratory data package shall include test reports or summary forms for all blank samples (e.g., method and preparation blanks) pertinent to the sample analyses. If a target analyte was detected in any of the blanks

associated with an analytical and/or preparation batch that includes samples from the project, the type of blank, the level of the contamination, the environmental samples affected, and the potential effect on the associated data will be described in the case narrative. Blank sample test reports will contain all of the information required for sample test reports (e.g., surrogate recoveries). Sample data shall not be blank corrected. Results for blank analyses for which the blank does not go through the method preparation and extraction procedures, such as solvent blanks, system blanks, calibration blanks, etc., may be reported on blank summary forms instead of on test reports.

3.3.5 Laboratory Control Spike Data

The laboratory data package shall include the LCS test reports or LCS results summary forms. The LCS will be taken through the entire preparation, cleanup and analysis procedure. The LCS samples shall contain all chemicals of concern identified in the site-specific work order. The LCS test report, or LCS results summary form shall include the amount of each analyte added to the sample, the amount measured during the analysis, the %R between the amount added and the amount measured, and QC limits for each analyte in the LCS. The form shall also include the laboratory batch number and the identification number of the sample spiked. If applicable to the laboratory's QA plan and/or SOPs, the %R and RPD data for each analyte in the laboratory control sample duplicate (LCSD) will be reported.

3.3.6 Matrix Spike Data

The laboratory data package shall include all MS result summary forms. Certain project samples may be designated on the COC for matrix spike (MS) analysis. Additional sample volume may be required depending on the analysis. The PM should consult with the laboratory prior to sampling to determine if additional volume is required. The MS project samples shall be spiked with all chemicals of concern identified in the site-specific work order. The MS test reports or results summary forms will include identification of the compounds in the spike solution, the amount of each compound added to the MS and the MSD, the parent sample concentration, the concentration measured, the calculated %R, and the QC limits for %R. The form shall also include the laboratory batch number and the identification number of the sample spiked. If applicable to the laboratory's QA plan and/or SOPs, the %R and RPD data for each analyte in the MSD will be reported.

3.3.7 Laboratory Duplicate Data

If an analytical duplicate (or laboratory duplicate) sample is analyzed, the laboratory data package shall include the duplicate sample test report or analysis summary form. The duplicate sample test report or analysis summary form shall include the calculated RPD between the sample and the sample duplicate results and the QC limits for the RPD. The test report or summary form shall also include the laboratory batch number and the identification number of the sample duplicate. The laboratory data package will include an easy means by which the samples associated with that particular duplicate analysis can be identified.

The following (Sections 3.3.8, 3.3.9, and 3.3.10) are typical of, but not limited to, Inductively Coupled Plasma (ICP) methods by atomic emission spectroscopy using EPA methods 200.7 and 6010, and by mass spectrometry using 200.8 or 6020.

3.3.8 Interference Check Standards

The mixed element interference check standard (ICS) solution is used daily to check that the instrument is free from interference from elements typically observed in high concentrations and to check that interference corrections applied are still valid. The laboratory data package shall include ICS analysis results when applicable. The ICS results will include all analytes in the standard and their respective %R. The applied method contains the QC acceptance criteria for ICS results.

3.3.9 Serial Dilution Data

If the analyte concentration is within the linear range of the instrument and sufficiently high (minimally, a factor of 25 times greater than the lower limit of quantitation), an analysis of a 1:5 dilution should agree to within ± 20% of the original determination. If not, then a chemical or physical interference effect should be suspected. The MS is often a good choice of sample for the dilution test, since reasonable concentrations of most analytes are present. Elements that fail the dilution test are reported as estimated values.

3.3.10 Post Digestion Spike Data

If a high concentration sample is not available for performing the dilution test, then a post-digestion spike (PDS) must be performed. The test only needs to be performed for the specific elements that failed original MS limits, and only if the spike concentration added was greater than the concentration determined in the unspiked sample. The recovery of the PDS should fall within a ± 25 % acceptance range, relative to the known true value, or otherwise within the laboratory derived acceptance limits. If the PDS recovery fails to meet the acceptance criteria, the sample results must be reported as estimated values.

3.3.11 Laboratory Data Qualifier Codes

The following table of data qualifier codes and descriptions is from Rule 62-160.700, F.A.C. Laboratories will apply these qualifier codes to data that have not met method or laboratory QC requirements. Table 3-1 below details the FDEP approved qualifier codes used for various deficiencies. Qualifier codes and definitions for field related activities are detailed in Table 4-1.

Table 3-1. Laboratory Data Qualifier Codes and Definitions

Qualifier	Definition
A	Value reported is the arithmetic mean (average) of two or more determinations. This code shall be used if the reported value is the average of results for two or more discrete and separate samples. These samples shall have been processed and analyzed independently. Do not use this code if the data are the result of replicate analysis on the same sample aliquot, extract or digestate.
F	When reporting species: F indicates the female sex.
H	Value based on field kit determination; results may not be accurate. This code shall be used if a field screening test (i.e., field gas chromatograph data, immunoassay, vendor-supplied field kit, etc.) was used to generate the value and the field kit or method has not been recognized by the Department as equivalent to laboratory methods.
I	The reported value is greater than or equal to the laboratory method detection limit but less than the laboratory practical quantitation limit.
J	Estimated value. A “J”–qualified sample value shall be accompanied by a detailed explanation to justify the reason(s) for designating the value as estimated. When possible, the organization shall report whether the actual sample value is estimated to be less than or greater than the reported value, to assist data users in any evaluation of the usability of the sample value. A “J” data qualifier code shall not be used as a substitute for G, K, L, M, S, T, V, or Y; however, if additional reasons exist for identifying the value as an estimate (e.g., laboratory control spike or matrix spike failed to meet acceptance criteria), the “J” code may be added to a G, K, L, M, T, U, V, or Y qualifier. Examples of situations in which a “J” code must be reported include instances in which: a quality control item associated with the reported value failed to meet the established quality control criteria (the specific failure must be identified); the sample matrix interfered with the ability to make any accurate determination; data are questionable because of improper laboratory or field protocols (e.g., composite sample was collected instead of a grab sample); the analyte was detected at or above the method detection limit in an analytical laboratory blank other than the method blank (such as a calibration blank), and the blank value is greater than 10% of the associated sample value; or the field or laboratory calibrations or calibration verifications did not meet calibration acceptance criteria, including quantitative or chronological bracketing requirements for field testing data.
K	Off-scale low. Actual value is known to be less than the value given. This code will be used if: 1.The value is less than the lowest calibration standard and the calibration curve is known to be non-linear; or 2.The value is known to be less than the reported value based on sample size, dilution or some other variable. This code will not be used to report values that are less than the laboratory practical quantitation limit or laboratory method detection limit.
L	Off-scale high. Actual value is known to be greater than value given. To be used when the concentration of the analyte is above the acceptable level for quantitation (exceeds the linear range or highest calibration standard) and the calibration curve is known to exhibit a negative deflection.
M	When reporting chemical analyses: presence of material is verified but not quantified; the actual value is less than the value given. The reported value will be the laboratory practical quantitation limit. This code will be used if the level is too low to permit accurate quantification, but the estimated concentration is greater than the method detection limit. If the value is less than the method detection limit use "T" below.

Qualifier	Definition
N	Presumptive evidence of presence of material. This qualifier shall be used if: 1. The component has been tentatively identified based on mass spectral library search; or 2. There is an indication that the analyte is present, but quality control requirements for confirmation were not met (i.e., presence of analyte was not confirmed by alternative procedures).
O	Sampled, but analysis lost or not performed
Q	Sample held beyond the accepted holding time. This code will be used if the value is derived from a sample that was prepared or analyzed after the approved holding time restrictions for sample preparation or analysis.
T	Value reported is less than the laboratory method detection limit. The value is reported for informational purposes only and shall not be used in statistical analysis.
U	Indicates that the compound was analyzed for but not detected. This symbol will be used to indicate that the specified component was not detected. The value associated with the qualifier will be the laboratory method detection limit.
V	Indicates that the analyte was detected at or above the method detection limit in both the sample and the associated method blank and the value of 10 times the blank value was equal to or greater than the associated sample value. Note: unless specified by the method, the value in the blank shall not be subtracted from associated samples. V qualifier applied to method blanks only; J qualifier applies to all other blanks.
Y	The laboratory analysis was from an improperly preserved sample. The data may not be accurate
?	Data are rejected and should not be used. Some or all of the quality control data for the analyte were outside criteria, and the presence or absence of the analyte cannot be determined from the data
*	Not reported due to interference

3.4 LABORATORY REPORTING REQUIREMENTS

Upon completion of the analyses, the laboratory shall compile the results in a data package to be submitted to SFWMD. The data package will contain the case narrative and required reportable data described in Rule 62-160.340, F.A.C. The data package will be submitted in hard copy or Adobe Acrobat electronic copy along with the required electronic data deliverables (EDD). All files associated with the deliverable shall be transferred to SFWMD by the laboratory via the web portal or ftp site. The laboratory shall notify SFWMD when the upload is complete.

It is anticipated that several laboratories will be required to meet all the analytical requirements of the project. If the primary laboratory is authorized to subcontract certain analyses, the primary laboratory compiling the final deliverables submitted to SFWMD shall identify all subcontracted laboratories providing results for the project. NELAP accreditation shall be provided for

subcontracted labs performing methods certified to the TNI standard. The original reports from the subcontracted laboratories will be provided in the final deliverable for review.

Two levels of reporting requirements are detailed below, depending on the level of data review and validation being performed. A Level 2 laboratory data package shall include at a minimum:

- Signed and dated laboratory data package
- Identification of all laboratories providing results to the data package
- Client site name and project number
- Case narrative detailing problems and/or anomalies observed by the laboratory
- Completed COC documentation
- Sample identification cross-reference
- Sample receipt information
- Analytical results for environmental samples and field QC samples
- Preparation date, method, batch
- Analytical data, method, batch
- Dilution factors applied
- Data qualifiers applied
- MDL/PQL data
- Laboratory QC data
- Laboratory blank sample data
- LCS/LCSD data
- MS/MSD data
- Laboratory duplicate data
- ICS, PDS) data, and/or serial dilution (SD) results (if applicable)

If provided to the laboratory, the data package and associated ADaPT files must include any water quality sampling data and forms used to collect the samples being analyzed.

When required as part of a project detailed below or upon request of SFWMD, a Level 4 data package will be issued and will include all information described in the Level 2 data package above in addition to the following:

- Standard certificates of analysis
- Instrument calibration data
- Batch CCV and CCB data
- Original analysis records (raw data), including, but not limited to, preparation logs, batch summaries, analysis sequences, chromatograms, etc.

3.4.1 Electronic Data Deliverables

Electronic records that provide input to data validation may be referred to as EDDs. For the ASR program, the data will be provided in two electronic forms; a laboratory report in pdf format and an ADaPT file. All results shall be reported to three digits but only two may be significant. Each laboratory shall provide its ADaPT library to the SFWMD PM, which must contain the analyte list, methods of analysis, and detection limits for each analyte. It must define the QC

requirements, frequency, and acceptance criteria for blanks, laboratory control standards, matrix spikes, surrogates, and sample duplicates. The ADaPT EDD shall include three text files: the laboratory analytical data, the laboratory receipt data, and the field data. A detailed table of laboratory and field EDD requirements and protocols are provided in CERP Appendix 5-A. The ADaPT file will be used by the SFWMD-designated data validator to generate an EDD with the final qualifiers applied for upload to DBHYDRO (detailed in Chapter 4).

3.5 LABORATORY DATA REVIEW

The laboratory shall perform reviews of the following three elements: the data package, the EDDs, and the data upload.

The initial review of the data package is to verify the correctness and completeness of the data. The laboratory will evaluate the quality of the analytical data based on an established set of laboratory guidelines (laboratory QA plan and SOPs) and this PQAP. The laboratory will review the data packages to confirm the following:

- Sample login is correct and complete
- Sample preparation information is correct and complete
- Analysis information is correct and complete
- Appropriate SOPs have been followed
- Analytical results are correct and complete
- QC sample results are within established control limits
- Blank results are below detection limits
- Analytical results for QC sample spikes, sample duplicates, initial and continuous calibration verifications of standards and blanks, standard procedural blanks, laboratory control samples, and ICP interference check samples are correct and complete
- Tabulation of reporting limits related to the sample is correct and complete
- Documentation is complete (all anomalies in the preparation and analysis have been documented; holding times are documented; qualifiers have been added where appropriate)

The laboratory shall perform the in-house analytical data reduction and QA review under the direction of the laboratory manager or designee. The laboratory is responsible for assessing data quality and advising of any data that were rated "preliminary" or "unacceptable," or other notations that would caution the data user of possible unreliability. Data reduction, QA review, and reporting by the laboratory will include the following:

- Raw data produced by the analyst will be processed and reviewed for attainment of QC criteria as outlined in this PQAP, the laboratory QA Plan, and/or established USEPA methods and for overall reasonableness.

- The data reviewer will check all manually entered sample data for entry errors and will check for transfer errors for all data electronically uploaded from the instrument output into the software packages used for calculations and generation of report forms and will decide whether sample re-analysis is required.

- The laboratory will review initial and continuing calibration data, and calculation of response factors, surrogate and internal standard recoveries, LCS recoveries, MS recoveries, PDS and SD recoveries, sample results, and other relevant QC measures.

- Upon acceptance of the preliminary reports by the laboratory data reviewer, the laboratory QA officer (or their designee) will review and approve the data packages prior to the final reports being generated. The data reduction and the QC review steps will be documented, signed, and dated by the analyst.

The laboratory has the responsibility for verifying the correctness and completeness of the electronic deliverables by performing the ADaPT EDD Review. The laboratory QA section shall perform a QA check on 100% of data key-punched into EDDs and will perform a 5% spot-check of data electronically transferred into an EDD for consistency with hard copy deliverables.

All ADaPT EDDs shall be reviewed by the ADaPT EDD Error Checker to ensure completeness and that no critical errors exist prior to submission. QC checks using ADaPT will be performed on each laboratory data EDD. The QC checks must ensure that field and laboratory QC data are acceptable and that the format for each data type is consistent with the database attributes and elements. The EDD is imported into the ADaPT data checker and compared to the project-specific library consisting of a set of valid values. This project-specific library will be based on FDEP valid values, and the methods and criteria specified in this PQAP.

Any ADaPT-defined critical errors shall be corrected by the laboratory before submitting to SFWMD. The SFWMD will return any ADaPT EDDs that contain critical errors to the laboratory for resolution. The laboratory shall enter a comment or explanation for any other errors identified by ADaPT in the EDD error log.

Once the laboratory has completed the EDD check and generated the required reportable data, the laboratory shall submit the project required reportable files to the SFWMD PM. The SFWMD will coordinate with the laboratory on the specific reporting procedures.

3.6 LABORATORY DATA STORAGE

The SFWMD will store ASR well data in the DBHYDRO database. The SFWMD-designated data validator will use the ADaPT files to validate the data, qualify data as necessary, and then generate an EDD that the SFWMD can upload to DBHYDRO. The DBHYDRO browser allows users to search the DBHYDRO database using one or more criteria, and to generate a summary of the data from the available period of record. DBHYDRO users can select data sets of interest and have the time series data dynamically displayed in tables or graphs. ASR data stored in the DBHYDRO database will also be accessible through Morpho. Morpho packages together different data types, makes them searchable, and provides long-term data storage. See Chapter 4 for data management requirements for the project.

4 DATA ASSESSMENT

4.1 LITERATURE DATA ASSESSMENT

Historical and reference data for the area will be tapped into as needed to help assess results on a regional scale and fill in data gaps, as necessary. Data from non-direct measurement may come from various sources, including, but not limited to, the following:

- Physical information, such as descriptions of sampling activities and geologic logs
- State and local environmental agency files
- Reference computer databases and literature files
- Historical reports on a site or similar projects

Data from non-direct measurements will be reviewed by competent personnel for accuracy and applicability. Data must be evaluated for comparability and applicability to the DQOs of the project how the data is being used. The specifics for the review process will depend on the type of data to be reviewed. Data from all non-direct measurement sources will be stored as project data to ensure data can be accessed in project reviews.

4.2 FIELD DATA ASSESSMENT

Data collected by field crews, including, but not limited to, geophysical, geological, ecological, water quality, and land survey data, will be reviewed by each entity collecting the data. The reviewer will confirm the method of data collection and note any deviations in the field log. Data will be reviewed for completeness, comparableness, and representativeness. When applicable, accuracy and precision will be assessed. Any calibration exercises and QA/QC procedures will also be assessed to confirm the data is valid and appropriate. Work Plans implemented as part of the project shall reference the SOP for field test data validation (excluding water quality assessment) associated with the specific project.

Field data assessment of water quality parameters (i.e., pH, DO, etc.) measured in association with samples collected for laboratory analysis shall initially be performed by the sample collection team. This assessment shall include the review of calibration logs for appropriate standards (based on sample concentrations) if calibration verifications are within acceptance limits specified in Table 2-2, and if samples were preserved appropriately and within 15 minutes of sampling. The results of the assessment must be documented in the field log or the forms specified in the associated Work Plan. Water quality field data not meeting any of the requirements associated with these QC elements must be qualified as estimated ("J," see Table 3-1).

Table 4-1 below provides the qualifier codes and definitions related to other issues commonly encountered during field activities. With the exception of the "G" qualifier, which can only be applied once analytical results are obtained, the sample collection team shall note in the field log any qualifiers in Table 4-1 that may apply to samples collected during an event.

Table 4-1. Field Data Validation Qualifier Codes and Definitions

Qualifier	Definition
D	Measurement was made in the field (i.e., in-situ). This code applies to any value (except field measurements of pH, specific conductance, dissolved oxygen, temperature, total residual chlorine, transparency, turbidity, or salinity) that was obtained under field conditions using approved analytical methods. If the parameter code specifies a field measurement (e.g., "Field pH"), this code is not required.
E	Indicates that extra samples were taken at composite stations.
G	A "G"–qualified sample value indicates that the analyte was detected at or above the method detection limit in both the sample and the associated field blank, equipment blank, or trip blank, and the blank value was greater than 10% of the associated sample value. The value in the blank shall not be subtracted from associated samples.
R	Significant rain in the past 48 hours. (Significant rain typically involves rain in excess of 1/2 inch within the past 48 hours.) This code shall be used when the rainfall might contribute to a lower or higher than normal value.
S	Secchi disk visible to bottom of waterbody. The value reported is the depth of the waterbody at the location of the Secchi disk measurement.
!	Data deviate from historically established concentration ranges.

The assessment by the sample collection team, documented in the field logs or sampling forms, must be submitted to the SFWMD PM to be validated and included in the DUS. Additional field data review, validation, and documentation is detailed in Section 4.3.1 below.

4.3 LABORATORY DATA ASSESSMENT

The following laboratory data assessment procedures meet all the requirements for data validation and assessment in Rule 62-160.670, F.A.C., QAOT SOP-007 *SOP for Validation of Contract Laboratory Data by an Analytical Provider for USACE Water Quality Compliance Monitoring*, DEP-QA-002/02 *Requirements for Field and Analytical Work*, DEP-EA-001/07 *Process for Assessing Data Usability,* and USEPA *National Functional Guidelines*.

4.3.1 Data Validation

The SFWMD shall designate a data validator to perform the validation and assess the usability of laboratory data and associated field data. The PM shall provide the data validator all laboratory project deliverables, COCs, sampling forms, and field logs submitted for an event. The data validator will be responsible for:

- Assessing completeness of the documents received based on contractual requirements
- Performing validation of analytical and associated field data according to requirements in this PQAP or the project-specific requirements of the associated Work Plan
- Documenting the results of the review in a DUS and EDD compatible with DBHYDRO

The CERP QASR specifies the FDEP DEP-EAS 00/01 *Tiered Approach to Data Quality Assessment* for guidance on the degree of data validation required to meet project DQOs. The

QASR Section 5.7.2 provides a summary of the three tiers. For the purposes of the ASR Science Plan DQOs, the Tier 2 advanced data review, which includes all Tier 1 elements, will be performed by the SFWMD-designated data validator, and includes:

- Verifying completeness (all samples submitted are reported) and data reported in the correct format
- COC forms signed and dated (both by sampler and lab)
- Samples preserved properly
- Holding times met
- MDLs comply with PQAP requirements
- Appropriate data qualifiers applied when necessary
- Field QC blank and field duplicate evaluated
- Lab QC checks (method blanks, LCS, MS, surrogate recoveries, duplicates)
- Data reversal evaluation (e.g., total versus dissolved, OP<TP)
- Inter-parameter checks (e.g., conductivity versus TDS)
- Reasonable range checks (e.g., pH)

If a more detailed Tier 3 review is deemed necessary by the SFWMD, a Level 4 laboratory data package will be generated, and the following review elements will be added to the above Tier 2 list:

- Calibration curves meet method requirements
- MDL studies
- Mass spectra, chromatograms, and other instrument reports
- Lab bench notes
- Field notes

The data validator shall perform the Tier 2 advanced data review utilizing ADaPT. Detailed instructions for the validation process using ADaPT are provided in QAOT SOP-007 *SOP for Validation of Contract Laboratory Data by an Analytical Provider for USACE Water Quality Compliance Monitoring, Section 5.* The general process is as follows:

- Import laboratory generated project ADaPT library
- Import the project lab, field, and error log ADaPT files
- Run the ADaPT error check
- Assign field QC sample associations
- Run automated data review
- Review and assign all appropriate final qualifiers (see Section 4.3.1.1)
- Export final EDD in format capable of upload to DBHYDRO
- Generate a DUS to document any issues noted during the validation process

If the ADaPT library does not support a particular method or parameter required for a specific project (i.e., radiological, ecotoxicity data), the data validator must validate this data following requirements in this PQAP or in individual Work Plans, and then generate an EDD with the validation results for upload to DBHYDRO.

Table 4-2 below details the qualifier codes that are to be added by the data validator to the DBHYDRO EDD to correspond with ADaPT file reason codes. Other than the "V" qualifier, these are not the appropriate DBHYDRO EDD qualifiers. The Adapt reason codes must be matched to the appropriate FDEP qualifier and this qualifier shall be added to the EDD along with the corresponding reason (Adapt reason code definition).

Table 4-2. Qualifier Codes for DBHYDRO EDD

Qualifier	Definition
G	Reported Concentration is Below the Laboratory Method Detection Limit
L1	LCS Recovery Outside of Control Limits
L2	LCS Duplicate Outside of Control Limits
M1	Matrix Spike Recovery Outside of Control Limits
M2	Matrix Spike Duplicate Outside of Control Limits
Q1	Sampling to Analysis Holding Time Exceeded
Q2	Sampling to Extraction Holding Time Exceeded
Q3	Extraction to Analysis Holding Time Exceeded
P	Field Duplicate QC Criterion Not Met
S	Surrogate Recovery Outside of Control Limits
V	Method Blank Contaminated
W1	Field Blank Contaminated
W2	Equipment Blank Contaminated
W3	Trip Blank Contaminated.

Source: QAOT SOP-007

4.3.2 Data Usability Summary

The SFWMD-designated data validator will prepare a DUS that describes the results of the data validation effort and summarizes the usability of the data in meeting specific project objectives. Table 5.2 of the CERP QASR provides a checklist of QA/QC elements to verify during the validation process. The DUS will discuss what QC measures were reviewed and validated, how these measures were reviewed or validated, the evaluation criteria used in the review/validation, all items identified as falling outside the evaluation criteria, the specific data potentially affected, and the potential effect on the quality of the associated data.

The DUS provides a description of the data that were validated, and identifies the project for which the validation was performed and the contents of the DUS. The validation SOP used, project-specific QC objectives, and when the analytical reports were received from the laboratory must be discussed.

The data validation section will include a table cross-referencing the laboratory identification number to field identification numbers and will identify all field QC samples submitted to the laboratory. This section will also include the results of the data validation, as applicable to the project. The section will indicate all items identified as falling outside the evaluation criteria, the specific data potentially affected, and the potential effect on the quality of these associated data. While the validation SOP covers common issues encountered, the data validator may have information (i.e., from field logs) that would result in data needing qualification based on

professional judgement. All professional judgement used to qualify data associated with QC measures outside acceptance criteria will be discussed in detail. It is acceptable for this section to contain descriptions only of those QC measures failing to meet acceptance criteria, as long as the text specifically indicates that all other QC measures specified for review met acceptance criteria for data review.

The validation section of the DUS will also contain a description of the reason for qualification and the direction of potential bias or imprecision (if known). Data review procedures will involve assignment of bias codes to each result qualified or rejected during data review. These bias codes will reflect the reason for qualification as well as the potential direction of bias. Qualifiers and bias codes to be used are listed in Table 3-1, Table 4-1, and Table 4-2.

The validation section will include a discussion of the following QC elements:

- Sample receipt temperature and holding time issues
- Calibration issues
- MDL issues
- Blank contamination
- LCS issues
- Matrix spike issues
- ICS, SD, and PDS issues
- Lab duplicate precision
- Field duplicate precision
- Summary table of qualified data

The summary section of the DUS will describe the effect of the uncertainty associated with results qualified as estimated, which may affect the usability of the data in making a meaningful comparison to the project objectives. The text will include an evaluation of how representative the analytical results are of the medium being evaluated based on measures such as sampling design, replicate analyses, etc. It will include discussion on the sufficiency of the valid data set in meeting project objectives. The DUS will also contain a listing of all data that have been rejected during data review or that have been considered to be unusable in meeting specific project objectives. It will further provide a detailed discussion of whether any of the rejected or unusable data are considered critical to meeting project objectives and what the specific project consequences are of having these rejected or unusable data. In addition to the DUS, the qualifiers identified during the validation process may be added to the ADaPT file.

4.3.2.1 QC Element Validation Criteria

QAOT SOP-007 Appendix C contains a summary table of the QC elements detailed below and appropriate qualifiers to be used when failures are noted.

Sample Temperatures and Holding Times

The holding times and sample temperatures will be compared to the holding time and sample temperature requirements contained in Tables 2-4 thru 2-7 of this PQAP. Results for analyses not

performed within holding time limits will be qualified "Q." If the holding time is exceeded for any analyte, the data will be qualified with a "Q" and the reviewer should use professional judgment to evaluate the need to reject non-detectable results.

Instrument Calibration

The acceptance criteria specified in the respective method shall be used to evaluate the initial calibration. If the Case Narrative or data validation process indicates that the initial calibration for any analyte did not meet the acceptance criteria, then all results for that given analyte associated with the initial calibration will be qualified as estimated ("J").

Method or laboratory specific acceptance criteria shall be used to evaluate continuing calibration verification results. If the data validation process indicates that the initial or continuing calibration verification for any analyte did not meet the acceptance criteria, then all results for that given analyte associated with the initial or continuing calibration verification will be qualified as estimated ("J").

Surrogate and Internal Standards

Surrogate standards are used to evaluate sample preparation efficacy, while analysis of internal standards determines the existence and magnitude of instrument drift and physical interferences. The laboratory established acceptance criteria for surrogate or internal standard recoveries shall be used to evaluate associated sample data. If surrogate or internal standard recoveries fall outside the acceptance criteria, associated data will be qualified as estimated ("J").

Blanks

Criteria for evaluating blank results are provided in the DEP-EA-001/07. The results for equipment blanks, field blanks, preparation or method blanks, calibration blanks, and other blanks reported in the data package will be reviewed. If the associated sample matrix is a solid, positive rinsate, calibration, and other associated aqueous blank results will be converted to equivalent concentrations in the solid samples by assuming that all contamination found in the aqueous blank aliquot analyzed is potentially present at up to 10 times that amount in the solid sample aliquot analyzed. When applicable (at least one sample in the analytical batch is equal to or less than 10 times the detected concentration in the method blank), the lab will re-prepare and reanalyze the batch with the blank contamination. If the contamination persists, or if limited sample is available for re-preparation, the laboratory shall qualify all detected sample results less than or equal to 10 times the blank concentration with the "V" qualifier at the reported concentration ("V" qualifier is not used for non-detect results). Preparation blanks are associated with all samples prepared with that sample (preparation batch). Continuing calibration blank samples are considered to be associated with all samples back to the previously analyzed continuing calibration blank sample and up to the next continuing calibration blank sample in the analytical run. The "V" qualifier is specific to laboratory blank (i.e., method, preparation, calibration) contamination, while the "G" qualifier will apply to contamination in all other blank types (i.e., equipment, field, trip blanks).

LCS Data

Criteria for evaluating LCS (and LCSD if applicable) results are provided in the respective method or established by the laboratory. The CERP QASR Table 5.4 states analyte recoveries obtained for LCS analyses will be compared to an acceptance range of 85% to 115% or analytical method requirements and to laboratory acceptance ranges (Work Plans must specify). All analytes specified in the analytical method must be spiked into the LCS. Data associated with LCS recoveries outside the acceptance range will be qualified as follows:

- If the LCS recovery for an analyte is greater than the upper acceptance limit, suggesting a potential high bias in reported results, all positive results for that analyte in all associated samples in the batch will be qualified as estimated ("J"), whereas non-detect results will be considered to be acceptable for use without qualification because the high bias does not affect non-detected results.

- If the LCS recovery for an analyte is less than the lower acceptance limit but less than the ADaPT library rejection point, suggesting a potential low bias in reported results, positive and non-detect results for that analyte in all associated samples in the batch will be qualified as estimated ("J").

- If the LCS recovery for an analyte is less than the ADaPT library rejection point, positive sample results will be qualified as estimated ("J"), whereas non-detect results will be qualified as unusable ("?") for all associated sample results in the batch.

Matrix Spike Data

The CERP QASR Table 5.4 states analyte recoveries obtained for MS (and MSD if applicable) analyses will be compared to an acceptance range of 80% to 120% or analytical method requirements and to laboratory acceptance ranges (Work Plans must specify). Recovery calculations are not required if the concentration added is less than 30% of the sample background concentration. In such a case, the MS recovery may not be an appropriate measure of accuracy. All MS will be fortified with the analyte of interest at an appropriate level respective to expected sample concentration (0.5 to 5 times the target analyte concentration). Automatic laboratory reanalysis is required for all unacceptable matrix spikes (and spikes not in the specified spike to sample ratio) as specified in Standard Methods. Data associated with MS recoveries that are outside the acceptance range will be qualified as follows:

- If the MS recovery for an analyte is greater than the upper acceptance limit, suggesting a potential high bias in reported results, all positive results for that analyte in the sample used for the MS/MSD will be qualified as estimated ("J").

- If the MS recovery for an analyte is less than the lower acceptance limit but less than the ADaPT library rejection point, suggesting a potential low bias in reported results, positive and non-detect results for that analyte in the sample used for the MS/MSD will be qualified as estimated ("J").

- If the MS recovery for an analyte is less than the ADaPT library rejection point, positive sample results will be qualified as estimated ("J"), whereas non-detect results will be qualified as unusable ("?") for that analyte for the sample used for the MS/MSD.

All samples of a similar matrix in the analytical batch will be qualified with a "J" if both the MS and MSD do not meet acceptance criteria.

Laboratory Duplicate Data

Criteria for evaluating duplicate results are provided in the CERP QASR Table 5.4 and DEP-EA-001/07. Results for the duplicate sample (LCSD, MSD, laboratory duplicate) analyses will be compared to an acceptance criterion of ≤20% RPD (per QASR, for all matrices and parameters) or the laboratory acceptance criteria (Work Plans must specify). Sample results with RPDs exceeding this criterion are qualified as estimated, "J."

Samples with reported analyte concentrations above the MDL, but below the PQL, can produce greater variability, leading to greater RPDs. RPD values are not considered representative or appropriate for evaluation by the data validator when the following conditions exist:

- One or both results are less than the PQL
- One or both results are qualified as estimated or rejected or are suspected of blank contamination
- One or both results are not detected

Interference Check Standard Data (Metals)

The respective method specifies the QC acceptance criteria for ICS analysis for metals analysis methods covered under this PQAP.

- If the %R for analytes present in the ICS sample is above the upper acceptance criterion, then results reported as detected for that analyte in associated samples for which the potentially interfering elements were present at concentrations equivalent to or greater than those present in the ICS sample will be qualified as estimated ("J").
- If the %R for analytes present in the ICS sample is less than the lower acceptance criterion, then both detected and non-detected results for that analyte in associated samples for which the potentially interfering elements were present at concentrations equivalent to or greater than those present in the ICS sample will be qualified as estimated ("J").

Serial Dilution Data (Metals)

ICP serial dilutions are run to help evaluate whether or not significant physical or chemical interferences exist due to sample matrix. When analyte concentrations are sufficiently high (the concentration in the original sample is minimally a factor of 50 above the MDL), the results obtained for a five-fold dilution of the original sample are compared to the original results by

means of a percent difference (%D). The %D is compared to a precision acceptance limit of the respective method. If the absolute value of the percent difference between the diluted and original result is greater than the method limits, all results for that analyte in the analytical batch are qualified as estimated ("J").

Post Digestion Spike Data (Metals)

The analyte recoveries obtained for PDS analyses will be compared to the acceptance range for accuracy in the respective method. The test only needs to be performed for the specific elements that failed original MS limits. The recovery of the PDS must fall within a ±25 % acceptance range, relative to the known true value, or otherwise within the laboratory-derived acceptance limits. If the PDS recovery fails to meet the acceptance criteria, the sample results will be qualified based on the following guidance:

- If the recovery is above the upper acceptance limit, detected results will be qualified as estimated ("J"). No action will need to be taken for non-detects.
- If the recovery is below the lower acceptance limit, but greater than or equal to 30%, detected and non-detect results will be qualified as estimated ("J").
- If the recovery is less than 30%, detected results will be qualified as estimate ("J") and reject ("?") non-detect results.

Field Duplicate Data

Criteria for evaluating field duplicate results are not provided in the analytical methods. Therefore, the following criteria will be used for validation of homogenized or collocated field duplicate results for all analyses based on DEP-EA-001/07. Where both the sample and duplicate values are greater than the PQL, acceptable sampling and analytical precision is indicated by an RPD for the two field duplicate results of less than or equal to 20% (per QASR, for all matrices and parameters). If the above criteria are not met for an analyte, all associated sample data for that analyte will be qualified as estimated ("J"). Where one or both analytes of the field duplicate pair are less than the PQL, RPD is not calculated.

Technical Consistency Checks

For chemistry results, the sum of the individuals for most routine measurements should not be more than 120% of the total measurement based on FDEP-QA-002/02. If sample result uncertainty is provided by the laboratory, the data validator may use professional judgement in the evaluation of these checks. When relevant chemical analyses are performed, the following comparisons must be evaluated according to QASR Section 5.7.3.9 and FDEP-QA-002/02 Section 4:

- Charge balance – total anion charge must be within 80-110% of total cation charge
- Measured conductivity must be within 80-120% of the calculated conductivity from either cations or anions

- TDS must be with 40-120% of the measured conductivity
- Ammonia must be less than 120% of TKN [total Kjeldahl nitrogen]
- Ortho-phosphate must be less than 120% of total phosphorous
- In general, dissolved or filtered results must be less than 120% of total or unfiltered results

5 WELL CONSTRUCTION AND TESTING

Several ASR wells and associated monitoring wells will be constructed at wellfield sites around Lake Okeechobee as part of the ASR well program. In addition to the ASR wells, continuous cores will be collected from selected ASR wellfield sites. A QA program does not exist for the construction of wells and coring programs; however, standards, regulations, and rules do control and guide the construction and testing of ASR wells and associated monitoring wells. In addition, the design drawings and specifications define the construction requirements that the Drilling Contractor is required to follow.

This section outlines the ASR wells and associated monitoring well construction and testing requirements to conform with FDEP UIC permit requirements, industry standards, and SOPs. Water quality testing associated with the ASR well monitoring and permit compliance are discussed in Chapters 2 and 3.

5.1 AQUIFER STORAGE AND RECOVERY WELLS

Construction of the ASR wells and the associated monitoring wells will be in accordance with Chapter 62-528, F.A.C., and the latest editions and current revisions and amendments of the applicable local, state, and federal codes, standards, rules, and regulatory requirements, which are considered to be minimum requirements for material workmanship and safety. These include:

- Draft Technical Data Report Comprehensive Everglades Restoration Plan Aquifer Storage and Recovery Pilot Project Kissimmee River ASR System and Hillsboro ASR System (August 2013)
- Comprehensive Everglades Restoration Plan Regulation Act (Section 373.1502, F.S.)
- 2018 CERP Guidance Memorandum
- 2021 Aquifer Storage and Recovery Science Plan
- QASR Manual, USACE and SFWMD (August 2018)
- FDEP UIC permit requirements and SOPs
- National Pollution Discharge Elimination System (NPDES) of the Clean Water Act (CWA), Rule 62-302.530 F.A.C.
- State of Florida Surface Water Quality Standards for Phosphorus within the Everglades Protection Area Criteria Rule 62-3 302.540 F.A.C.
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- American Welding Association (AWS)
- American Water Works Association (AWWA) Standards for Water Wells
- Cast Iron Soil Pipe Institute (CISPI)
- FDEP rules and regulation for Water Wells in the F.A.C.
- North American Insulation Manufacturers' Association (NAIMA)

- National Sanitation Foundation (NSF)
- National Electrical Manufacture's Association (NEMA)
- National Fire Protection Association (NFPA)
- Plumbing Drainage Institute (PDI)
- SFWMD Chapter 40-3, Regulation of Wells
- USEPA Manual for Water Well Construction Practices EPA Document #EOA-570/9-75-001
- Underwriters' Laboratories Listed (U.L.)

Drilling Contractors, Consultants, and SFWMD shall also obtain all applicable permits for the construction and testing of the wells. These permits include:

- FDEP UIC construction, testing, and operating permits
- Local or SFWMD well construction permits
- NPDES permits
- Local construction permits
- USACE 408 and 404 permits

In addition to codes and standards, the construction of the ASR wells and associated monitoring wells will follow accepted QA construction practices appropriate for this type of work. These include:

- Contractor Project Superintendent with experience managing similar well construction activities shall be a direct employee of the drilling Contractor and should fluently speak, read, and write English. All construction activities shall comply with the design drawings and specifications.

- Construction Management conducted by the Consultant shall be overseen by a qualified Professional Geologist with experience in well construction, testing, data analysis, and reporting. Permit requirements must be adhered to, and well construction must generally conform to the design drawings and specifications.

- The Engineer of Record (responsible engineer) shall have a Professional Engineer license and experience in well construction.

- Field observation shall be conducted by a qualified field hydrogeologist with experience with well construction, testing, data analysis, and reporting.

5.2 WELL CONSTRUCTION AND TESTING ACTIVITIES

5.2.1 Well Construction

During well construction activities, the integrity of the borehole, casing setting, mechanical integrity of the well, general aquifer hydraulics, and general aquifer water quality will be determined through observations and testing. These observations and tests, frequently required

by FDEP UIC permit and construction specifications, shall be in accordance with both the permits and requirements specified in the design documents. The construction, operation, permitting, and closure (plugging and abandonment) activities for injection wells will be administered in accordance with Chapter 62-528, F.A.C.

The following must be conducted as applicable to: (1) ensure and document that the ASR wells are constructed in accordance with the plans and specifications, (2) determine if there are differing geologic conditions that require field changes, and (3) meet the permit requirements and function as designed:

- Review Contractor submittals, including Requests for Information (RFI) and pay applications
- Prepare daily field logs
- Maintain communications with FDEP UIC and SFWMD regarding major construction activities and milestones
- Sample temporary compliance monitoring wells as required in the FDEP UIC permit
- Prepare weekly construction and testing reports and submit to FDEP UIC and SFWMD as required in the permit
- Describe geologic material from cuttings collected during pilot hole drilling
- Collect specific capacity pumping and water quality data during drill stem testing as outlined in the design specifications
- Determine packer test and core collection intervals
- Describe geologic materials from collected cores
- Record specific capacity pumping and water quality data during packer testing
- Oversee activities and interpretation of data related to borehole geophysical logging
- Prepare casing seat requests and submit to FDEP UIC for approval
- Confirm approved casing lengths and observing casing installations
- Monitor cementing activities, including pumped cement volumes and weights
- Oversee well development and document development activities
- Oversee field services for post-construction pumping test activities as defined in the construction specifications and UIC permit

Drill cuttings and core samples collected from each ASR well, continuous core hole, and associated monitoring wells (cuttings only) will be described geologically in the field. Geologic descriptions include:

- Depth bls/sample interval
- Texture (sand, silt, clay)
- Fossil identification (if present)
- General porosity
- Rock type (limestone, dolostone, siltstone, claystone, etc.)
- Color
- Recovery amount (core only)
- Rock Quality Designation (core only)

The geologic description along with geophysical logs and results from packer and drill stem testing will be used to identify both geologic formations and hydrogeological units. A more detailed discussion associated with rock core handling is included in Chapter 7, Hydrogeological Evaluations.

5.2.2 Continuous Coring Activities

In addition to the ASR wells, a continuous coring program has been developed to collect site specific hydrogeologic information. The continuous cores are being advanced at some of the proposed ASR wellfield sites. These cores provide valuable information related to the suitability of the location and conditions applicable to wellfield design; this information helps ensure that the final wellfield when constructed will perform as expected. Reporting requirements for the continuous coring program are similar to the ASR well construction outlined above and provided in Chapter 9, Construction Observation. Core collection generally begins at approximately 500 feet bls so that the contact between the Hawthorn Group and the top of the UFA can be captured in the core. In addition, off bottom packer tests are conducted every 30 feet from the top of the UFA to the termination depth (approximately 2,000 feet). Water quality samples are collected at the end of each packer test. During the advancement of the continuous core holes, the following activities are necessary and must be documented:

- Provide geologic description of drill cuttings between land surface and 500 feet; observe and document installation of temporary casings
- Observe and document the collection of each 10-foot core
- Record recovery and rock quality designation for each 10-foot core
- Mark each core with red and blue markers to denote the top and bottom of the core
- Indicate the depth of each core segment on the core boxes
- Develop geologic description of each core, including fossil assemblages and contacts between formations
- Observe off-bottom packer testing and monitor field water quality to determine the interval has been developed
- Collect water quality samples at the end of the packer test and submit for laboratory analysis
- Evaluate packer test data to determine hydraulic properties for each interval including specific capacity
- Observe geophysical logging of the core hole
- Observe and analyze step drawdown tests

The rock cores collected from both the ASR well construction and the continuous coring activities will be stored on site at a location approved by the SFWMD. Selected cores will be sent to either a geotechnical laboratory for vertical and horizontal hydraulic conductivity and porosity determinations, or to the core lab for more detailed analyses. Selected cores to be sent to the core lab Mineralogy Inc. in Tulsa, Oklahoma shall be approximately 12-inch core segments and will need to be packaged and shipped to the lab. The selection of the intervals for additional analysis will be determined through consultation with SFWMD staff. Frequently, other studies, such as bacterial and pathogen study groups, and the need for data for geochemical modeling

will be included in the core selections. Each core segment sent to Mineralogy Inc. will be analyzed for the following:

- X-ray diffraction analysis
- X-ray fluorescence analysis
- Porosity and hydraulic conductivity determination
- Cation exchange capacity analysis
- Acid insoluble residue analysis
- Scanning electron microscope analysis
- Thin section preparation and description

Mineralogy Inc. will provide a detailed report outlining its results from these tests. Rock cores that are not submitted for laboratory analysis may be sent to Florida Gulf Coast University, the Florida Geological Survey, the U.S. Geological Survey, or other locations selected by the SFWMD. The integrity of each core must be maintained and each core stored appropriately to avoid damage.

5.2.3 Testing Activities During Construction

Testing activities are critical for determining well construction compliance with permits and design specifications. These also are critical for determining aquifer water quality and estimating aquifer hydraulic conditions required for selection of storage and monitoring intervals. Required testing activities are defined in the design specifications. Permitting documents specific to each well construction event are not specified in this PQAP. Water quality sampling activities are further defined in project-specific sampling plans. QA requirements for water quality sampling and analysis are provided in the water quality sampling and assessment sections (Chapters 2 and 3) of this PQAP.

Testing activities include collection of geologic materials during advancement of the borehole, water quality sampling, geophysical logging, and pumping tests. Water quality sampling includes both the collection of field parameters and laboratory samples as required in the FDEP UIC permit and indicated in the design specifications. Water quality samples obtained during well construction and testing events are collected from poorly developed intervals during drill stem and packer testing and will not comply with standard SOPs for water quality sampling. Water quality results will be uploaded to the DBHYDRO database. Reports associated with well construction and testing activities will go through the Dr. Checks process and comments will be resolved prior to finalizing reports.

It is important to note that water quality samples collected from drill stem and packer testing tests will be from undeveloped sections of the aquifer or collected from wells that have not been decontaminated. Contractor-related sampling equipment has not been decontaminated; therefore, collection of VOCs or other organics is not recommended from drill stem or packer testing equipment. However, samples collected during the drilling process help determine general water quality changes within the aquifer and identify the base of the USDW. Field sampling equipment will be decontaminated and calibrated prior to the sampling event. Details related to decontamination, calibration, and QA samples are provided in Chapter 2.

5.2.4 Post-Construction Pumping Tests

Once the construction of the test ASR well(s) is complete, a series of pumping tests will be conducted on each well. These tests will involve pumping each ASR well at a variable rate or at a constant rate for a set duration and include:

- Specific capacity pumping tests
- Variable rate pumping tests
- Constant rate pumping tests
- Artesian flow non-pumping tests

To facilitate the collection of usable test data of sufficient quality, the following efforts and general approach should be used. Well construction information and hydraulic conductivity, transmissivity, and storativity values will be stored in DBHYDRO.

An Aquifer Performance Test plan shall be prepared prior to the start of the constant rate pumping tests and submitted to the SFWMD for approval. This plan shall discuss all aspects of the planned testing, including pre-test phase, testing phase, and post-test recovery phase. The plan also shall define the assumed pumping rates, duration of each test, identification of monitoring wells, data collection frequency, and water quality sampling requirements.

Because water levels are under flowing artesian conditions in most wells, data logging transducers will be required to measure water levels during pumping tests. Whenever possible, these data loggers should not be memory gauges and should have the ability to periodically download data at the surface during the test. The exception could be packer testing events when a memory gauge is set deep in the aquifer and pressures are high. The pressure rating of the data logging transducer should be appropriate for the anticipated drawdown conditions within the well to be monitored or pressures that could be at depth. When possible, pressure gauges should be installed in both the pumping and monitoring wells. Also, when possible, water levels should be measured and recorded manually from pumping and monitoring wells.

During the specific capacity and variable rate pumping tests, at a minimum, water level measurements will be collected from the well being tested. Prior to the start of testing, background monitoring of water levels shall be conducted. The duration of the background monitoring shall depend on the type of pumping test. For constant rate pumping tests, a background water level monitoring period of 48 hours shall be conducted. This is typically done over a weekend ahead of the constant rate pumping test. During all pumping tests, discharge pumping rates shall be recorded periodically throughout the test. Once the test is complete, water levels shall be monitored during the non-pumping recovery period for a minimum of 12 hours or until levels recover to within 10 percent of the pre-test, non-pumping water levels.

Water quality data shall be collected during the constant rate pumping tests. This includes field data for TDS (calculated using conductance), temperature, salinity, pH, specific conductance, and turbidity. At the end of each test, water quality samples will be collected and submitted for laboratory analysis of Primary and Secondary Drinking Water Standards (Table 1-1). Water quality sampling QA procedures are included in Chapter 2.

Initial analysis of drawdown and recovery data from the pumping tests will use typical hydraulic analytical methods (i.e., time drawdown, distance drawdown, curve matching). Hydraulic conductivity, transmissivity, and storativity values will be determined. The analysis will evaluate the variability in aquifer hydraulic conditions within the aquifer by examining the results from each monitoring well. These data will be plotted to identify anisotropy within the aquifer. The pumping data will also be analyzed using the multi-layer well test analysis software MLU. MLU utilizes the principle of superposition in both space and time to compute drawdown and analyze well flow and aquifer test data in layered aquifer systems. This analysis will further refine the hydraulic parameters and assess leakage between the UFA and the APPZ.

Groundwater modeling will be used to refine the aquifer test data analysis and to simulate the impacts on the aquifers from the ASR wells completed in the UFA and APPZ aquifers around Lake Okeechobee.

All completion reports shall go through the DrChecks process. Comments will be resolved and included in the final submittal. Water quality sampling QA procedures are covered in Chapter 2. Water quality results will be uploaded to the DBHydro database via ADaPT.

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6 ENGINEERING DESIGN SERVICES AND LOCAL SCALE GROUNDWATER MODELING

Engineering design activities are required prior to the start of construction for the ASR and associated monitoring wells, the treatment systems, and associated supporting infrastructure. Groundwater modeling is an important tool for refining the spacing between the individual ASR wells and the interaction of the treated water with the natural groundwater system. Information from the modeling efforts is used to aid in the evaluation of an ASR well and facilitate final design. For the ASR program, engineering design efforts include:

- Well design
- Intake/outfall structures
- Piping
- Treatment systems
- Administrative buildings
- Access roadways

General guidelines are provided herein to ensuring a quality design that is informed with valid model outputs and other information.

6.1 ENGINEERING DESIGN

- General guidelines are outlined in ER 1110-1-12 USACE Engineering and Design Quality Management. These guidelines revolve around the Deming cycle, which include the following steps: Plan – design to achieve project requirements and provide for high quality product and services
- Do – implement quality control and quality assurance procedures
- Check – evaluate project results
- Act – identify and implement process changes for continual improvement

Key components in the planning phases are the QA Plan and Quality Control Plans, which are part of a Quality Management Plan. For Engineering design CERP projects, the SFWMD and USACE have a robust, proactive QA process that will be followed and includes the preparation of Basis of Design Reports (depending upon the project stage); reviews at different stages of the project, including independent technical review (ITR); use of DrChecks; and regular communication with the project team. The SFWMD, USACE, and Consultant will have a QA manager identified for each project to ensure these processes are followed and QA reviews are conducted and documented. The QA manager will be responsible for overseeing or responding to QA audits.

The implementation of the QA process and review of designs and associated deliverables are conducted by technical and management staff as part of QC that will be conducted by a Consultant team and an interagency PDT established on a project-by-project basis. The focus of QC is on the product for an ASR well project whether it is a report, technical memorandum, or design submittal. QC is maintained throughout data evaluation, development and simulations of any model, report preparation, front end documents (bidding information and requirements, contract and bond forms, contract conditions, and general requirements), technical specifications (qualitative requirements for systems, products, materials, and workmanship upon which the construction contract is based), and drawings (graphic documents which illustrate the work to be performed and dimensional relationships among the various components of the project). QC evaluations will include, but are not limited to, a comprehensive evaluation of correct application of methods, validity of assumptions, adequacy of basic data, correctness of calculations, reviewing computational codes (when necessary), evaluating the quality of secondary data, double-checking work as it is completed and providing written documentation of these reviews to verify that the standards set forth in the CQCP and in other planning documents are met. In addition, the assigned QA/QC staff will provide peer review oversight of the content of the work products and confirm that the work products comply with USACE's specifications.

The Project/Task Order Manager will be responsible for preparation of end products to which they are assigned. Contents of reports or other end products will be in accordance with task order statements of work. Technical memorandums, draft and final reports, and other technical deliverables will be prepared and will be subject to review. After internal review, the draft reports, technical memorandums, and design submittals will be submitted to the USACE and SFWMD for comments. Comments received from the USACE and SFWMD will be incorporated into final reports, memorandums, and design submittals as prescribed in task order requirements. DrChecks software will be used to track and document resolution of technical review comments. The comments will be structured to give a clear statement of the concern, the basis of the concern and, when appropriate, the actions necessary to resolve the concern. Comments will cite appropriate references. The PDT will evaluate and respond to each comment in DrChecks. Responses will clearly state concurrence or non-concurrence with the comment. Concurrences shall include what the corrective action is and where and when it will be done. Non-concurrences shall include an explanation or proposed alternative action. All comments are to be resolved and back checked in the DrChecks project record prior to final QA/QC certification.

An ITR will be conducted by the Consultant, SFWMD, USACE and/or other stakeholders that will be established on a project-by-project basis. The ITR is a review by a qualified person or team not involved with the project on a daily basis, for the purpose of confirming the proper application of clearly established criteria, regulations, laws, codes, principles, and professional practices. Each ITR team member should review each product for consistency across the various disciplines of the project. ITR team members must also review their discipline's elements and how they impact and align with the project's functions. Comments will be limited to those that are required to confirm adequacy of the product. ITR will be conducted in accordance with ER 1110-1-12. Each ITR will address and verify that:

- Concepts, assumptions, features, methods, analyses, and details are appropriate, fully coordinated, and correct

- An appropriate range of feasible alternatives was evaluated
- Problems, opportunities, and issues are properly defined and scoped
- Project costs are valid
- Analytical methods used are appropriate and yield reliable results
- Results and recommendations are reasonable, within policy guidelines, and supported by the presentation
- Any deviations from policy, guidance, and standards are appropriately identified and have been properly approved
- Products are biddable, constructible, operable, environmentally sound, and cost effective
- Products meet the customers' needs

All applicable codes, regulations, standards, and specifications will be applied, including but not limited to:

- FDEP UIC construction, testing, and operating permits including cycle testing permit (Chapter 62-528 F.A.C.)
- NPDES of the CWA, Rule 62-302.530 F.A.C
- State of Florida Surface Water Quality Criteria Rule 62-3 302.540 F.A.C.
- Comprehensive Everglades Restoration Plan Regulation Act (Section 373.1502, F.S.)
- 2018 CERP Guidance Memorandum
- QASR Manual, USACE and SFWMD (August 2018)
- FDEP SOPs
- Local or SFWMD well construction permits
- NPDES permits
- USACE 408 permits
- Local construction permits
- ASTM Standards for materials and material testing
- Standard Penetration Test (SPT) ASTM D1586
- Unified Soil Classification System (ASTM-D2487)
- North American Vertical Datum, 1988 (NAVD88)
- American Welding Society (AWS)
- American Concrete Institute (ACI)
- Concrete Reinforcing Steel Institute (CRSI)
- Portland Cement Association (PCA)
- American Plywood Association (APA)
- American National Standards Institute (ANSI)
- Federal Specifications for electrical systems
- National electrical Contractors Association, Inc. (NECA) Standard of Installation
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories, Inc. (UL)
- State and Federal Laws
- Uniform Fire Code
- Occupational Safety and Health Administration (OSHA)

- Florida Building Code
- Local Laws and Ordinances

During the construction process, the "For Construction" documents will be updated via red line changes and RFIs throughout the construction process. These changes to the original design documents will be captured at the end of the project via the As-Constructed or As-Built documents. This includes updates to both the design plans and specifications. These documents will be provided to SFWMD for their files and will remain with each well field or treatment system, so they are readily available to the System Operators.

Once the well or treatment system is constructed, the preparation of operations and maintenance (O&M) manuals and procedures will be developed for the ASR wellfields and for the treatment systems. The preparation of the O&M manual will utilize existing standards, rules, and guidelines and will include equipment operational information, cut sheets, and operational procedures. The O&M manual will be the basis for the System Operators to manage the ASR system(s) and will be part of the ASR System Operation Plan (see Chapter 11, ASR System Operation Process).

6.2 LOCAL SCALE GROUNDWATER MODELING

The same QA/QC process and procedures used for engineering design will be used for modeling; however, the timing of reviews and need for an ITR will be established on a project-by-project basis. To ensure that the model will meet the intended needs and yield reliable results, further discussion is provided below regarding the efforts and tools needed.

Prior to development of the groundwater flow model, a desktop data and literature review will be conducted from available information for the project area that supports the modeling effort. The local scale model will be based primarily on the USACE regional and Kissimmee River ASR pilot site (KRASR) local scale models.

A local scale numerical groundwater flow model will be constructed to simulate hydrogeologic conditions in the vicinity of the ASR well sites and the surrounding area. The USACE operates the KRASR near C38S. The USACE has developed a local scale model of the KRASR site. The development of the local scale model will follow an approach similar to the development of the USACE KRASR local scale model. The model domain will encompass the KRASR model domain and the ASR well site being modeled, and calibration of the model will utilize the ASR wells and associated monitoring wells constructed at each wellfield and located near the test site. As additional ASR well sites are developed, the local scale model will be updated to include the site-specific aquifer hydraulic data collected from each ASR well.

A density-dependent modeling code is required to model ASR operations of recharged freshwater in potential brackish zones. The MODFLOW/MT3DMS based software, SEAWAT, will be used to construct a density-dependent groundwater flow and transport model to simulate saturated flow and mass transport conditions. MODPATH software may be used in conjunction with SEAWAT to delineate potential flow pathways from the ASR wells to potential groundwater source areas. The groundwater model shall be developed in general accordance

with ASTM Standard Guide for Application of Groundwater Model to a Site-Specific Problem (ASTM 2013).

Model layering will be the same as the KRASR model, with 28 layers from land surface to the Boulder Zone below the Lower Floridan hydrogeologic unit (Table 6-1). Modification of the model layers may be needed as additional hydraulic information is obtained from multiple wellfield locations.

Table 6-1. Anticipated Model Layers (from USACE KRASR Local Scale Model Report)

Hydrogeologic Unit	Number of Model Layers
Surficial Aquifer System (SAS)	1
Intermediate Confining Unit (ICU)	3
Flow Zone	3
Upper Floridan (UFA)	9
Upper Middle Confining Unit (MC1)	2
Avon Park Permeable Zone (APPZ)	3
Lower Middle Confining Unit (MC2)	2
Lower Floridan (LF)	2
Lower Confining Unit (LC)	2
Boulder Zone (BZ)	1

Initially, horizontal grid spacing will follow the KRASR model with 100-foot grid spacing in the area of the ASR wellfield and then expand to 534-foot spacing toward the model boundaries. Grid spacing may be refined further around an ASR wellfield as additional hydraulic information is collected depending on the configuration of the well pairs installed at each location. Time discretization will be appropriate to simulate the pumping tests that are conducted at each wellfield.

Model boundary conditions will be set in similar fashion to the KRASR local scale model with head dependent boundaries interpolated from the USACE regional model at the sides of the aquifer layers, and no-flow boundaries at the base of the model and the sides of the confining layers. Well boundary conditions will be used to simulate pumping at each ASR wellfield.

Initial conditions for TDS and temperature will be imported from the USACE regional model and modified based on site-specific water quality conditions identified at each wellfield. TDS and temperature will be set at the head dependent boundary conditions on the sides of the model.

The numerical groundwater flow model will simulate current pseudo steady-state and transient groundwater flow conditions. The proximity of the KRASR facility and other pumping in the area precludes a steady-state model calibration. However, calibration to pre-pumping, or pseudo steady-state conditions, will be conducted. Several five-day pumping tests will be conducted at each ASR wellfield. Primary model calibration will be to the transient water level responses to the pumping tests and TDS concentrations measured during well testing. Calibration to groundwater levels and drawdown targets will be accomplished by varying boundary conditions and hydraulic parameters to provide a better fit between simulated and observed heads in the

pumping wells and nearby observation wells. Calibration to TDS will be accomplished by varying transport parameters including dispersivity and porosity.

A sensitivity analysis will be performed on the numerical groundwater flow model to assess how changes in model parameters and boundary conditions affect the final calibrated heads and the predictive simulation results. The sensitivity analysis provides a measure of confidence relative to the hydrologic parameters used in the model and which parameters have the greatest influence on modeled results.

The calibrated transient model will provide a baseline tool for simulations of future ASR recharged/storage/recovery scenarios and will be used to determine additional ASR well spacings as the wellfields are built out. Predictive simulations shall also be conducted during model runs to assess potential recovery efficiency of the ASR wells and initial storage/recovery scenarios, and to determine well spacing for the next phase of well construction.

A Groundwater Modeling Report will be prepared after each model iteration that includes information regarding the construction, calibration approach, and sensitivity of the groundwater model. The report will include maps and figures displaying model parameters and the locations of model boundary conditions. Groundwater elevations and flow directions will also be identified. The results and sensitivity of the predictive simulations will also be delivered as part of the Groundwater Modeling Report. The final model report will go through the DrChecks review process and comments will be resolved as part of the final report. All associated GIS data and digital model files will be provided as part of the final groundwater flow modeling report.

7 HYDROGEOLOGICAL EVALUATIONS

Several desktop hydrogeological evaluations will be conducted as part of the ASR program, including hydrogeological evaluations associated with the ASR wellfields. These hydrogeological evaluations will be expanded as additional ASR wellfields are identified and included in the ASR program. Data from DBHydro, SFWMD, Florida Geological Survey, USACE, and other published information were used to prepare the evaluations. Additional sources that should be utilized when preparing hydrogeologic evaluations include:

- Draft Technical Data Report Comprehensive Everglades Restoration Plan Aquifer Storage and Recovery Pilot Project Kissimmee River ASR System and Hillsboro ASR System (August 2013)
- CERP Regulation Act (Section 373.1502, F.S.)
- 2018 CERP Guidance Memorandum
- 2021 Aquifer Storage and Recovery Science Plan
- QASR Manual, USACE and SFWMD (August 2018)

In addition to the desktop hydrogeological evaluations, several data collection events are envisioned for ASR wellfields beyond those outlined in Chapter 6 as part of data collection efforts during construction and testing of ASR wells. These additional evaluations will provide a better understanding of the regional hydrogeological conditions, which will aid in the system design and assessment of risks. It is anticipated that additional hydrogeological evaluations will include:

- Surface geophysical surveys
- Tracer testing
- Pathogen inactivation studies
- Nutrient reduction studies

It does not appear that there are specific ASTM standards for these studies. ASTM standards that have been identified include:

- ASTM D6429-99 (2011) Surface Geophysical Methods
- ASTM D5613-94 (2014) Open-Channel Measurement of Time of Travel Using Dye Tracers

Surface geophysical surveys and tracer testing requirements have not been developed at the time this of this PQAP was prepared. Applicable EPA QA/G4 DQOs based on industrial standards

shall be utilized when preparing work plans for each of these studies. Water quality collection SOPs and QA objectives are included in the water quality discussion (Chapter 2). Pathogen inactivation and nutrient reduction studies will be conducted during cycle testing (Section 10.1). Similar to geophysical surveys and tracer testing, work plans will need to be developed for each study. These work plans will need to follow FDEP SOPs, the USEPA DQOs, and the QASR Manual. All work plans will be submitted as drafts to SFWMD and will go through the DrChecks process, and comments will be resolved prior to finalizing plans.

8 ECOLOGICAL EVALUATIONS

Work plan development for the ecotoxicological and environmental portions of the ASR program are in their very early stages. Consequently, it is only possible at this time, with few exceptions, to address QA/QC requirements for these aspects of the overall program at a very high level. Specifically, much of the focus of this section is on identifying resources to assist with developing experimental and monitoring designs that will meet the overall QA/QC requirements of the ASR program. However, the PQAP is a living document, and it is anticipated that as specific ecotoxicological and environmental workplans are developed, relevant QA/QC methods will be developed to address their specific needs.

Based on the initial set of ecotoxicological and environmental studies used during the initial Kissimmee River Aquifer Storage and Recovery (KRASR) test project and comments provided by the NRC in 2015, future ASR ecotoxicological and environmental studies will most probably focus on: (1) required regulatory ecotoxicological studies of recovered water as defined in 40 CFR Chapter 1D 136.3, (2) bench scale, laboratory-based bioaccumulation studies for a range of matrices in recharge and recovered waters, including, but possibly not limited to, mercury, methyl mercury, arsenic, molybdenum, antimony, aluminum, cadmium, chromium, zinc, and radium 226 and 228, (3) ecological monitoring of local receiving waters under baseline conditions and during discharge of recovered water, (4) Possible acquisition of water quality and other data for further expansion, and or calibration of validation of the Lake Okeechobee Environmental Model (LOEM), and (5) mesocosm experiments to test community level responses to recharge and recovered waters.

When developing work plans for any of the above referenced study types, all related chemical sampling and analysis must conform to the QA/QC guidance laid out in Chapters 2 and 3 of this PQAP. Similarly, any instrumentation used to collect physical parameters, such as temperature, pH, DO, specific conductance, and photosynthetically active radiation, must be maintained, calibrated, and used according to manufacturers' specifications and QA/QC guidance laid out in this PQAP.

Further, all data collected during the ecotoxicological and environmental study phases of the ASR program must conform to the requirements of the CERP QASR minimum field data element requirements; QASR 8.9.2.2 Table 8.4 and data verification, validation, and assessment requirements; QASR 8.9.3.1, 8.9.3.2 and 8.9.3.3; and any other relevant QASR rules as described in Chapter 4 of this document.

8.1 MOBILE LABORATORY FACILITY CONSTRUCTION

Since the ecotoxicological and bioaccumulation studies are to be conducted in a specially built mobile laboratory facility that will be transported to each ASR site as required; therefore it is necessary to define the compliance parameters for the mobile facility. Test laboratory design should adhere to guidance provided in USEPA publication 821-R-02-013. Key elements of this

guidance are provided below. However, there may be other specific items not included herein, and it is recommended that the entities charged with the design and construction of the laboratory consult the referenced USEPA publication directly.

- All components in the laboratory that contact water need to be made of non-toxic potable water grade materials. Tempered glass and perfluorocarbon plastics (TEFLON®) should be used whenever possible to minimize sorption and leaching of toxic substances. These materials may be reused following decontamination. Containers made of plastics, such as polyethylene, polypropylene, polyvinyl chloride, TYGON®, etc. may be used as test chambers or to ship, store, and transfer effluents and receiving waters, but they should not be reused because they could carry over adsorbed toxicants from one test to another, if reused.

- Temperature control can be achieved using circulating water baths, heat exchangers, or environmental chambers.

- Air used for aeration must be free of oil and toxic vapors. Oil-free air pumps should be used where possible. Particulates can be removed from the air using BALSTON® Grade BX or equivalent filters, and oil and other organic vapors can be removed using activated carbon filters (BALSTON®, C-1 filter, or equivalent).

- Sample preparation, culturing, and toxicity test areas should be separated to avoid cross contamination. Air pressure differentials between such rooms should not result in a net flow of potentially contaminated air to sensitive areas through open or loosely fitting doors. Organisms should be shielded from external disturbances.

- New plastic products of a type not previously used should be tested for toxicity before initial use by exposing the test organisms in the test system where the material is used. Equipment (pumps, valves, etc.) which cannot be discarded after each use because of cost must be decontaminated between uses.

- Fiberglass and stainless steel, in addition to the previously mentioned materials, can be used for holding, acclimating, and dilution water storage tanks, and in the water delivery system, but once contaminated with pollutants the fiberglass should not be reused. All material should be flushed or rinsed thoroughly with the test media before using in the test.

- Copper, galvanized material, rubber, brass, and lead must not come in contact with culturing, holding, acclimation, or dilution water, or with effluent samples and test solutions. Some materials, such as several types of neoprene rubber (commonly used for stoppers), may be toxic and should be tested before use. Silicone adhesive used to construct glass test chambers absorbs some organochlorine and organophosphorus pesticides, which are difficult to remove. Therefore, as little of the adhesive as possible should be in contact with water. Extra beads of adhesive inside the containers should be removed.

- A good quality, laboratory-grade deionized water, providing a resistance of 18 megaohm-cm, must be available in the laboratory and in sufficient quantity for laboratory needs and for use in making up culture controls and test water dilution.

- Laboratory test temperature control equipment must be adequate to maintain recommended test water temperatures. Recommended materials (as noted above) must be used in the fabrication of the test equipment which comes in contact with the effluent.

- Test organisms should not be subjected to changes of more than 3°C in water temperature in any 12-hour period or 2 units of pH in any 24-hour period.

- Loss of electrical power during test runs immediately confounds results due to potential exceedances of temperature, aeration, flow, or other test criteria. A system for automatically logging power outages should be included in the mobile laboratory design; especially if the facility will be unattended during non-working hours. Outage data should be recorded in a permanent logbook.

8.2 OPERATIONAL CONSIDERATIONS

8.2.1 Test Organisms

The following specifications for test organisms reflect the USEPA whole effluent toxicity (WET) test criteria.

- The health of test organisms is primarily assessed by the performance (survival, growth, and/or reproduction) of organisms in control treatments of individual tests. The health and sensitivity of test organisms is also assessed by reference toxicant testing.

- The supplier of test organisms must certify the species identification of the test organisms and provide the taxonomic reference (citation and page), or name(s) of the taxonomic expert(s) consulted.

- USEPA allows the use of indigenous species only where state regulations require their use or prohibit importation of the recommended species. Where state regulations prohibit importation of non-native fishes or the use of recommended test species, permission must be requested from the appropriate state agency prior to their use.

- Regardless of their source, test organisms should be carefully observed to ensure that they are free of signs of stress and disease, and in good physical condition. Some species of test organisms can be obtained from commercial stock certified as "disease-free."

- Young organisms are often more sensitive to toxicants than are adults. For this reason, the use of early life stages, such as larval fish, is required for all tests. In a given test, all organisms should be approximately the same age and should be taken from the same source.

- When the testing is concluded, all test organisms (including controls) should be humanely destroyed and disposed of in an appropriate manner (NEVER RELEASED TO THE ENVIRONMENT).

8.2.2 Food Quality

The nutritional quality of the food used in culturing and testing fish and invertebrates is an important factor in the quality of the toxicity test data. Problems with the nutritional suitability of the food will be reflected in the survival, growth, and reproduction of the test organisms in cultures and toxicity tests. If the food is used for culturing, its suitability should be determined using a short-term chronic test which will determine the effect of food quality on growth or reproduction of each of the relevant test species in culture, using four replicates with each food source.

8.3 ECOTOXICOLOGICAL TESTING

Based on regulatory criteria as defined by 40 CFR Part 136, and the permit requirements for the original KRASR tests, it is anticipated that the following ecotoxicological survivability tests are likely to be required: Water flea (*Ceriodaphnia dubia*) seven-day static renewal test and 96-hour acute static renewal; Fathead minnow embryo (*Pimephales promelus*) seven-day static renewal test; Bannerfin shiner (*Cyprinella leedsi)* 96-hour acute static renewal and green algae (*Selenastrum capricornutum*) 96-hour chronic non-renewal growth; *Daphnia magna* 21-day growth and reproduction test; and *Xenopus sp. teratogenic* assay. These WET methods consist of exposing living aquatic organisms (plants, vertebrates, and invertebrates) to various concentrations of a sample of water, usually from a facility's effluent stream. WET tests are used by the NPDES permitting authority to determine whether a facility's permit and discharge complies with the WET requirements or limits. Table 8-1 below lists the relevant USEPA method for each of these tests. TNI certification for WET testing is required for analysis under NPDES permitting.

Table 8-1. Reference Numbers for Ecotoxicological "WET" Tests

TEST	REFERENCE NUMBER
Ceriodaphnia 7 day	EPA 1002.0
Fathead minnow 7 day	EPA 1000.0, EPA 2000.0
Bannerfin Shiner 96 hr	EPA 2000.0
Daphnia magna 21 day	EPA OCSPP 850.1300
Xenopus teratogenic assay	ASTM: E 1439 - 91
Selenastrum capricornutum 96 hr	EPA 1003.0

8.4 BIOCONCENTRATION STUDIES

Based on the earlier KRASR protocols, bench scale bioconcentration tests were conducted for mercury, methyl mercury, arsenic, molybdenum, antimony, aluminum, cadmium, chromium, zinc, and radium 226 and 228. Test organisms used were the blue gill (*Lepomis macrochirus*),

and the freshwater mussel (*Elliptio buckleyi*). The initial test durations were 28 days and test conditions included control water made up with laboratory reverse osmosis water, recharge water (local surface water), full strength recovered water, and a 50:50 mixture of surface water and recovered ASR water. Tests were run in triplicate. Whole homogenized fish and mussel tissue were used for all metal testing. Shucked mussel tissue was used for radium testing. The ASR final technical data report (2013) from which the above summary was paraphrased did not provide a great deal of specific methodological detail.

It is probable that with some changes the new proposed bench scale bioconcentration studies will mirror in many ways the original studies. Consequently, this section will focus on (1) proposed changes suggested by the 2015 NRC review of the Technical Data Report (TDR) and (2) a listing of sources relevant to confirming or improving the QA/QC compliance of the bioconcentration studies.

Suggestions for methodological improvements:

- NRC (2015) recommended increasing the exposure duration of testing to better match the recharge and recovery periods of the various ASR wells to be tested. A duration of greater than 69 days was suggested for in-situ studies. This was based on the assumption that the length of any recovery period would be 69 days or longer. In the event that a recovery period is less than 69 days, the length of exposure testing should correspond to the length of the recovery period.

Since Lake Okeechobee is habitat regularly used by the federally endangered snail kite *Rostrhamus sociabilis*, whose sole food source is apple snails (genus Pomacea), it is recommended that apple snails be included in bioconcentration testing. Although *P. paludosa,* the native species, is the preferred food source, over the past years, a large population of the exotic apple snail *P. maculata* has also become established in Lake Okeechobee. *P maculata* is also used as a food source by kites, and it is suggested that both species be included in any bioconcentration testing. Resources for confirming/improving QA/QC compliance of bioconcentration studies include:

- Bioconcentration experiments should be conducted only in a facility that meets the criteria described in Section 8.1 above.

- All relevant QA/QC procedures as identified in the CERP QASR and Chapters 2 and 3 of this PQAP should be used in designing, running, recording, and analyzing the bioconcentration studies.

- Bioconcentration test design, particularly as it relates to choosing concentration ranges, numbers of test organisms, and numbers of replicate or duplicate runs, should include the use of power analysis, as outlined in Steidl and Thomas 2001 (NRC recommended), Morrison (2007), and others.

- Preparation of test subject samples for transport to analytical laboratories should adhere to the methodologies provided in EPA 823-B-06-0007 Sample handling, packaging, and preservation of fish and shellfish from collection to delivery to sampling laboratory.

- All chemical analyses for tissue samples for metals and radium 226 and 228 must follow procedures outlined in Chapters 2 and 3 of this report.

- Although analysis-of-variance, as used in the original bioconcentration studies, may be an adequate statistical tool for analyzing results, there are other more powerful parametric and nonparametric analytical tools available. For example, see Cox and Oakes (1984).

- Other useful information for designing bioconcentration studies may be found in:

    — EPA-822-R-03-032 Technical Summary of Information Available on the Bioaccumulation of Arsenic in Aquatic Organisms (December 2000)

    — EPA-822-B-00-005 Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000)

    — Also see Section 2.6.4 of this report

8.5 LAKE OKEECHOBEE ENVIRONMENTAL MODEL

LOEM currently includes ASR operations and calcium, chloride, sulfate, and their respective heavy metal compounds (Jin et al. 2014). Any need to expand the parameters modeled by LOEM, or to generate new input data for additional calibration or validation exercises, will require that such data be collected in accordance with the Chapter 62-160, F.A.C., and with all the specific water quality collection and sample analysis criteria described in previous sections of this report.

8.6 BASELINE ECOLOGICAL STUDIES

Although a great deal of baseline community data was collected at the KRASR site between 2006 and 2013 (Formation Environmental, LLC 2021), Lake Okeechobee and the lower C-38 canal (Kissimmee River) are very dynamic systems. Given potential short-term changes in climate, the ongoing restoration of the Kissimmee River affecting downstream flows, and changes in operations strategies for Lake Okeechobee and the Kissimmee River, much of this information may no longer be representative of current conditions and may need to be re-collected. Whenever possible, and if the original study methods were successful, the same techniques should be used to improve the potential comparability of the data.

Areas of concern, based on the original ASR environmental studies (TDR 2015), include the ecological impact and extent of the differential in temperature and DO content between the discharge plume and the C38 receiving waters (particularly on fish survival and spawning behavior, the risk of entrainment or impingement of spawning products and larval fish during recharge operations, and more general receiving water risks from chemical components in the recovered water).

- By virtue of the limited time frame during which the original KRASR tests were conducted and the informal way in which the spatial distribution of the returned recovered water plume was determined, additional and more temporally extensive plume

modeling, and upstream, downstream, and cross-stream water quality sampling, might be required. See EPA/600/R-94/086 Dilution Models for Effluent Discharge for possible approaches to modeling the discharge plume of recovered water. Any water quality sampling for physical or chemical parameters will need to follow all relevant QA/QC procedures as outlined in the CERP QASR, Chapters 2 and 3 of this PQAP, and the approved Monitoring Plan. Results from plume modeling and in-situ chemical and physical parameter sampling should be used to guide the necessity, nature, and extent of additional in-situ ecological monitoring.

- The TDR (2013) raised concerns about fish spawning products and fish larvae entrainment and/or impingement on the ASR recharge water intake structure and pointed out the need for an improved method for obtaining samples from the intake structure wet well. The solution to this problem is probably structural in nature. However, design of the sampling protocol should be developed in a way that ensures adequate data collection power to address the issue. In addition, CERP QASR 8.8.5, which requires that any field studies must include collection and preservation of voucher specimens for species identification confirmation purposes, should be followed. Per NRC (2015), results of larval fish impingement and entrainment studies should be interpreted by a population-level approach to modeling the impacts on fish populations and communities as described in Suter et al. (2005).

- NRC (2015) recommended additional in-situ sampling and bioconcentration studies utilizing periphyton, macroinvertebrates, and mussels. Any studies or monitoring programs should be designed using power analysis, as noted in earlier sections of this document, to ensure that the resulting data is adequate to answer the matters being investigated. Similarly, for any associated physical or chemical sampling or analysis, all relevant requirements of the CERP QASR, Chapters 2 and 3 of this PQAP, and the approved Monitoring Plan need to be followed. For work involving fish and shellfish tissue, particular attention should be paid to section 2.6.4 of this report.

    — For periphyton sampling, see the Federal Water Pollution Control Administration publication titled Use of a Floating Periphyton Sampler for Water Pollution Surveillance (Weber and Paschke 1970). FDEP method FS-7200 may be consulted for additional guidance. If periphyton are identified taxonomically, voucher samples should be collected per QASR 8.85.

    — For macroinvertebrate sampling, see EPA/600/4-90/0300 Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters. An alternative approach to macroinvertebrate sampling in Lake Okeechobee might be the use of Hester Dendy samplers as outlined in Rodusky et al. (2008) or in FDEP method FS-7400. Per QASR 8.85, collection and preservation of macroinvertebrate voucher samples is required.

    — In-situ mussel bioconcentration studies should follow procedures similar to those described in the TDR (2013). Care should be taken that mussel enclosure materials meet the same standards promulgated for laboratory materials used for bioconcentration test systems. Sufficient voucher samples should be collected to

ensure that mussel species identification can be confirmed in future if required. If mussels are to be transported to a laboratory for tissue analysis, EPA 823-B-06-0007 or FDEP FS-6100, Sample handling, packaging, and preservation of fish and shellfish from collection to delivery to sampling laboratory must be followed.

Table 8-2 below details the anticipated target analytes and MDLs for the ecological evaluations for waters, sediments, and tissues.

Table 8-2. Potential Ecological Evaluation Analyte List and Minimum MDL Requirements

Media	Analytes	Minimum MDLs	Units
In-situ mussels	Radium-228	1.13	pCi/g
	Radium-226	0.35	pCi/g
	Aluminum	2.3	mg/kg
	Antimony	0.23	mg/kg
	Arsenic	0.04	mg/kg
	Cadmium	0.47	mg/kg
	Chromium	0.29	mg/kg
	Mercury	0.59	mg/kg
	Methyl Mercury	0.06	mg/kg
	Molybdenum	0.012	mg/kg
	Nickel	0.023	mg/kg
	Selenium	0.09	ng/g
	Zinc	0.8	ng/g
Fish tissue in lab	Radium-228	1.13	pCi/g
	Radium-226	0.35	pCi/g
	aluminum	2.5	ug/Kg
	Chromium	0.25	ug/Kg
	Nickel	0.04	ug/Kg
	Zinc	0.51	ug/Kg
	Arsenic	0.32	ug/Kg
	Selenium	0.63	ug/Kg
	Molybdenum	0.06	ug/Kg
	Cadmium	0.013	ug/Kg
	Antimony	0.025	ug/Kg
	Mercury	0.09	ng/Kg
	Methyl Mercury	1.5	ng/Kg
Mussel tissue in lab	Radium-228	0.93	pCi/Kg
	Radium-226	0.3	pCi/Kg
	aluminum	2.4	ug/Kg
	Chromium	0.24	ug/Kg
	Nickel	0.04	ug/Kg
	Zinc	0.49	ug/Kg
	Arsenic	0.3	ug/Kg
	Selenium	0.61	ug/Kg
	Molybdenum	0.06	ug/Kg
	Cadmium	0.012	ug/Kg
	Antimony	0.024	ug/Kg
	Mercury	0.09	ng/Kg
	Methyl Mercury	0.8	ng/Kg
Water in lab	Radium-228	1.15	pCi/L
	Radium-226	0.44	pCi/L
	aluminum	4	ug/L
	Chromium	0.1	ug/L

Media	Analytes	Minimum MDLs	Units
	Nickel	0.1	ug/L
	Zinc	0.2	ug/L
	Arsenic	0.15	ug/L
	Selenium	0.6	ug/L
	Molybdenum	0.06	ug/L
	Cadmium	0.02	ug/L
	Antimony	0.02	ug/L
	Mercury	0.08	ng/L
	Methyl Mercury	0.019	ng/L

Note: Table provided by Environmental Consulting and Technology (ECT)
Key:
MDL = method detection limit
mg/kg = milligram per kilogram
ng/g = nanogram per gram
ng/L = nanogram per liter
ng/Kg = nanogram per kilogram dry weight
pCi/g = picocuries per gram
pCi/L = picocuries per liter
ug/L = microgram per liter
ug/Kg = microgram per Kilogram dry weight

8.7 MESOCOSM STUDIES

Mesocosm studies have been proposed as an additional approach to evaluating the impacts of recovered ASR water on ecological community structure. As no specific location or design details exist for such studies at this time, no specific QA/QC requirements can be defined. However, in general terms, mesocosm studies should follow the majority of the QA/QC requirements laid out in this document. Thus:

- Power analysis should be used to establish appropriate levels of replication to ensure data reliability.

- Materials used in mesocosm construction and operations must meet the same non-toxic, non-absorptive criteria as those used in laboratory ecotoxicological and bioconcentration studies.

- Appropriate systems should be provided for maintaining and monitoring temperature, pH, DO, and any other field parameters that may influence or confound study outcomes.

- Mesocosms that depend on electrical power to run aerators, pumps, etc. should have a back-up power system and/or a power monitor in place to identify power failures, particularly if the system is unattended for significant periods of time.

- All sampling of chemical and physical parameters must adhere to the guidance developed in the CERP QASR, Chapters 2 and 3 of this PQAP, and the approved Monitoring Plan.

- Any collections of floral or faunal samples for tissue analysis should follow appropriate agency guidelines, as for example, EPA 823-B-06-0007 Sample handling, packaging, and preservation of fish and shellfish from collection to delivery to sampling laboratory.

- Any taxonomic identifications of mesocosm species should follow QASR 8.85 and include the preservation of voucher specimens for potential future identification confirmation needs.

9 CONSTRUCTION OBSERVATIONS

Obtaining quality construction is a combined responsibility of the Construction Contractor, SFWMD and USACE, and the Consultant supporting construction oversight efforts. USACE ER 1180-1-6 provides guidance on construction quality management. This guidance outlines requirements for the development and review of a Contractors Quality Control Plan and activities to implement and enforce quality control. The goal is to have a quality product that conforms to the plans and specifications or any approved modifications, meets permit requirements, and ensures work is conducted in a safe manner.

This chapter of the ASR PQAP is not intended to be cover all aspects of construction quality management as it only highlights some of the key activities associated with construction observations, testing and reporting particularly as they related to ASR wells.

9.1 OVERSIGHT ACTIVITIES AND ASSOCIATED REPORTING

Construction observation is a critical phase following the design activities. There is overlap between this Construction Observations section and the Well Construction and Testing section with respect to permitting and the rules associated with ASR wells. The construction, operation, permitting, and closure activities for injection wells, including Class V ASR wells, are administered in accordance with Chapter 62-528, F.A.C., which contains stringent requirements to prevent the degradation of the existing water quality of the aquifers above to the injection zone. The standards and general reporting requirements during construction are outlined in this section. The construction observation process generally includes the following:

- Observe project progress and activities
- Confirm materials and components being supplied meet the requirements per the plans and specifications
- Conduct inspections to confirm the project is being constructed in accordance with the plans and specifications
- Verify that permit conditions are being met for the UIC well and project site, including but not limited to, those associated with groundwater quality, stormwater runoff, erosion control, wetland impacts, and threatened and endangered species as applicable
- Conduct or oversee materials testing
- Observe mechanical integrity testing (submit results to the SFWMD and FDEP UIC)
- Identify safety hazards and promote safe work practices

- Monitor close out activities including demobilization and site restoration

In addition, during construction of the ASR wells, associated monitoring wells, and water treatment facilities, there are multiple reporting requirements that may include but are not limited to:

- Prepare daily field logs documenting construction activities, conformance to the plans and specifications, field test results, deficiencies and corrective actions
- Review Contractor construction submittals utilizing e-Builder
- Prepare weekly progress reports (submit to the SFWMD and FDEP UIC) as per UIC permit requirements
- Submit specific drilling containment pad dimensions and locations to FDEP UIC
- Submit weekly sampling of containment pad monitoring wells (submit results to the SFWMD and FDEP UIC)
- Demonstrate confinement including but not limited to lithologic properties, geophysical evidence, packer testing (submit justification to the SFWMD and FDEP UIC)
- Submit results of well mechanical integrity testing to the SFWMD and FDEP UIC)
- Submit, if applicable, results of materials testing conducted onsite
- Maintain red-line drawings and prepare as-built/as-constructed documents
- Prepare Construction and Testing Report (submit to the SFWMD and FDEP UIC)

The construction and testing report is required under the FDEP UIC permit and by the SFWMD. The report will include all documentation prepared during the construction of the wells, including:

- Daily construction report
- Geologic logs
- Geophysical logs
- Casing tally sheets
- Cementing logs
- Water quality results
- Drill stem testing results
- Packer testing results
- Acidization logs
- As Contracted/As Built drawings and specifications
- Step drawdown testing data and results
- Constant rate pumping test data and results

The aquifer testing section of the report shall outline all aspects of the tests, including the pre-test, test, and post-test water level monitoring. This report also shall include the results for the groundwater sampling (field and laboratory results) conducted during construction of the wells, and during constant rate testing. The draft testing report shall go through the DrChecks review process, and the Consultant shall resolve all comments before finalizing the report.

The SFWMD shall be copied on all correspondence and reporting to FDEP UIC. All completion reports shall go through the DrChecks process and comments will be resolved and included in the final submittal. Water quality sampling QA procedures will be covered in Chapters 2 and 3. Water quality results will be uploaded to the DBHydro data base via ADaPT.

The above efforts provide quality control checks on the construction activities and compliance with permit conditions, which are documented and then reviewed by others to confirm the project is being constructed as designed and permitted. Deviations to the plans and specifications will be reviewed for impacts to the project performance, budget, and schedule, and vetted for approval in accordance with procedures established by the SFWMD and USACE.

Additional details specific to the ASR and monitoring well construction activities and documentation are provided in Chapter 5.

9.2 TESTING PROCEDURES

Water quality sample collection shall follow the guidance in CERP QASR, Chapters 2 and 3 of this PQAP, and the approved Monitoring Plan. Pumping and well integrity tests conducted on ASR wells shall follow industry accepted practices and/or standard procedures. In addition to the ASR wells, continuous cores will be advanced at some of the proposed ASR wellfield sites and specialized testing as outlined in Chapter 5 may be required. For any testing that does not follow a recognized procedure, the method should be reviewed to the extent necessary to confirm the testing will provide reliable results at the accuracy needed.

Materials testing shall conform to ASTM standards or other criteria as outlined in the project specifications.

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10 CYCLE TESTING

Cycle testing will be conducted on ASR wells completed in the UFA and APPZ aquifers at each ASR wellfield. This testing helps determine the recovery rates of treated water injected into the groundwater and subsequent changes in groundwater quality characteristics with each injection and withdrawal cycle. There are no existing SOPs for ASR cycle testing, but industry practices will be followed and aided by lessons learned from the Kissimmee and Hillsboro Canal ASR system testing and inclusion of recommendations in the 2021 ASR Science Plan. Cycle Testing Plans will need to be developed for each ASR system for submittal to the SFWMD and the FDEP UIC for approval prior to cycle testing to affirm the proposed approach will yield representative and high-quality data. The testing will also be dictated by regulatory requirements. The existing Hillsboro and Kissimmee ASR systems required NPDES, UIC, and Comprehensive Everglades Restoration Plan Regulation Act permits and prior FDEP UIC approval to conduct cycle testing. It is assumed that similar permits and approvals will be required for future ASR well systems constructed as part of the LOWRP ASR wellfields. Cycle testing shall be conducted in accordance with Chapter 62-528, F.A.C., and as outlined in the FDEP UIC permit.

Initial ASR systems will be constructed along the Kissimmee River to the north of Lake Okeechobee. The Kissimmee River is classified as a State of Florida Class III surface water, with designated uses that include fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Floridan aquifer is classified as a USDW, characterized by TDS less than 10,000 mg/L. Therefore, any ASR cycle testing program must be in compliance with state and federal regulations that protect both surface and groundwater (Draft CERP ASR Pilot Project Technical Data Report 2013).

Surface water quality criteria and regulations for discharge of recovered water into the Kissimmee River are defined within the NPDES of the CWA, Rule 62-302.530, F.A.C., (State of Florida Surface Water Quality Criteria) and Rule 62-302.540, F.A.C. (State of Florida Water Quality Standards for Phosphorus in the Everglades Protection Area). Groundwater quality criteria are defined within the FDEP UIC program of the Safe Drinking Water Act and Chapter 62-550, F.A.C. (Drinking Water Standards, Monitoring, and Reporting). Surface water (recharge water) and native groundwater are characterized prior to the onset of cycle testing so that water quality changes in groundwater or recovered water can be identified (Draft CERP ASR Pilot Project Technical Data Report 2013).

The full-scale treatment system will need to be constructed prior to the start of cycle testing. This system will treat surface water to Primary and Secondary Drinking Water Standards before the water is recharged into each aquifer. An ASR system Operation Plan will need to be prepared for both the treatment system and ASR wells. This plan is outlined in Chapter 11, ASR System Operation Process.

10.1 CYCLE TESTING PROGRAM

As part of the cycle testing program, a Cycle Testing Plan shall be developed for each ASR wellfield. This plan will identify all permits obtained as part of the cycle testing program, outline the number of cycles to be conducted, recharge and recovery periods, volumes to be recharged and recovered, and data acquisitions requirements. In general, cycle testing activities will be tied to river and lake levels. The overall cycle testing goal is to demonstrate the feasibility of multi-year water storage and recovery program and will utilize a storage and recovery capacity of 5 MGD for each ASR well. At this time, it is assumed that surface water will be treated to Primary and Secondary Drinking Water Standards prior to recharging the aquifers. The development of a buffer zone to improve recovery efficiency will be included in the cycle testing program and will be designed to allow recharge of an initial volume of water to form a buffer zone. Also, the APPZ is anticipated to contain higher salinity water than the UFA. Therefore, future ASR wells completed within the APPZ will need to be cycle tested with a long-term strategy to develop a buffer zone to minimize recovery of saline water.

Monitoring and identifying inter-aquifer mixing and convergence of recharge water plumes will be addressed in the Cycle Testing Plan. The local scale groundwater model developed during the design evaluations will be used to estimate the size of recharge water plumes within the storage zone (see Chapter 6, Engineering Design Services, and Local Scale Groundwater Modeling). The model will be calibrated to responses from the monitoring wells during the ASR well testing program and will be used to determine the volumes of water that should be recharged into the ASR wells during cycle testing to maximize recovery and minimize entrapment of poor-quality water between wells.

The ASR program is intended to have progressively longer recharge periods leading to a large storage volume within the aquifer. The sources for this water are the local river and canals located around Lake Okeechobee. Recharge periods are generally planned for high stage periods within the river/canal adjacent to the ASR wellfield. The stored water can then be recovered during periods of low stage in the river. The recharge, storage and recovery periods will be defined in the Cycle Testing Plan and approved by FDEP UIC, SFWMD, and USACE.

Cycle testing efforts may need to be coordinated with other studies, such as ecological and bacterial studies. Ecological studies and risk assessment associated with the discharge water to the surface water system may be conducted concurrently with cycle testing. In addition, sample collection associated with ongoing bacterial studies also may be occurring concurrently with cycle testing efforts. As a result, the Cycle Testing Plan should include coordination efforts with the ecological team, bacterial studies group, or any other studies that may be ongoing at the time of the testing.

10.2 WATER QUALITY MONITORING

The Cycle Testing Plan shall have a water quality monitoring component that lists the water quality parameters to be monitored in the source water, from the treatment system, and from the recovered water prior to entering the surface water system. The list of water quality parameters shall be approved by FDEP UIC, SFWMD, and USACE. In addition, water quality monitoring

shall occur at the associated monitoring wells constructed near the ASR wells. Water quality monitoring shall include an evaluation of the mobilization of arsenic in the aquifer and how arsenic mobilization occurs within the storage zone. In addition, water quality monitoring shall evaluate the reduction of nutrients, such as phosphorus and nitrogen, within the aquifer during the storage period. QA procedures for water quality sampling are contained in Chapters 2 and 3.

As outlined in the 2021 ASR Science Plan, cycle testing monitoring program will be developed once the multi-well surface facilities are constructed and cycle testing begins. During cycle testing, nutrient concentrations will be monitored in water recharged into the ASR well and at monitoring wells various distances away from the ASR well completed within and just outside the storage zone. The following variables will be tracked at each monitoring well, either by down-well sondes or in the field at the wellheads:

- Temperature
- Salinity
- TDS
- pH
- DO
- Specific conductance
- Oxidation-Reduction Potential (Redox)

Additionally, grab samples may be collected for laboratory analyses of the following variables at the wellheads to generate a time series data set:

- Cations
- Anions
- Metals (including molybdenum)
- Nutrients
- Sulfate
- Sulfide
- Total carbon
- Dissolved organic carbon

The Redox condition of surface water and groundwater is defined by systematic quantification of terminal electron accepting processes (i.e., the dissolved constituents that accept electrons as the water quality evolves from oxic [surface water] to reduced [native groundwater]). There are routine geochemical analyses (DO, nitrate, iron, manganese, sulfate/sulfide, and methane) that are used to quantify the Redox condition. However, all constituents must be analyzed in each water sample obtained during cycle testing to completely characterize the Redox environment. For example, transition metal analyses, at parts per billion detection levels, must be included with redox-sensitive species. These metals (e.g., molybdenum, vanadium, arsenic) occur in sulfide minerals in Florian Aquifer System lithologies and are released during pyrite oxidation. The Redox conditions of surface water and groundwater also shall be part of the water quality section of the Cycle Testing Plan (2021 ASR Aquifer Storage Recovery Science Plan).

10.3 REPORTING

Cycle testing activities shall be documented and reported to FDEP UIC as required in the permit. This reporting also shall be submitted to SFWMD, FDEP UIC, and USACE. The report shall document all cycle testing monitoring data including water levels, water quality, recharge quantities, storage periods, and recovery data. The report will include all documentation prepared during the cycle testing, including:

- Daily field reports
- Field water quality results
- Laboratory water quality results
- Recharge and recovery rates for each cycle
- Storage times for each cycle
- Recovery efficiency for each cycle
- Water quality trends during recharge, storage, and recovery

The draft testing report shall go through the DrChecks review process, and the Consultant shall resolve all comments before finalizing the cycle testing report.

11 ASR SYSTEM OPERATION PROCESS

The operation of the ASR wellfield and treatment system will require operators that understand the equipment, treatment process, regulatory requirements, and the purpose of the program. Consequently, an ASR System Operation Plan shall be prepared that defines the processes and procedures required to operate the full-scale ASR system including the treatment system. An operation plan will need to be prepared for each ASR well system and updated as changes are made to the system. This plan also shall describe the treatment processes and include an O&M manual developed for each treatment system and for the operation of each ASR well. Operation of the ASR system shall be conducted in accordance with Chapter 62-528, F.A.C., and as outlined in the FDEP UIC permit.

Many of the operational processes will be similar to those defined in Chapter 10, Cycle Testing. These processes will need to be updated as each ASR well system is brought online, and the specific operational processes are defined for the system. Applicable industrial standards and reporting requirements will be included in the operation process document. The ASR system operational reporting processes generally include:

- FDEP UIC permit compliance monitoring during recharge, storage, and recovery
- Monthly operating reports submitted to FDEP UIC (including submittal forms)
- NPDES permit adherence
- Annual testing and reporting submittals

As the ASR wells and treatment systems are constructed, this PQAP will need to be updated to provide specific processes to be included in the ASR System Operation Plan. The ASR System Operation Plan will be a substantial document when completed and will need to be updated as equipment and system changes are made. In general, the ASR system Operation Plan shall include:

- Operator training documents and procedures
- Startup and shutdown procedures for both intake and well pumps
- Startup and shutdown procedures for treatment systems
- Maintaining and updating of O&M manuals
- Dosage of flocculants (if used)
- Outlining maintenance frequency and procedures for both the ASR wellfield and the treatment system
- Off-site disposal of treatment generated waste
- Water quality monitor requirements and procedures for the source water, treated water (recharge water), and recovered water
- Procedures for adjusting treatment processes to accommodate variable source water quality conditions

- Procedures for monitoring discharge water oxygen levels
- Reporting requirements outlined in future UIC operation and NPDES permits

Operators will need to be trained to run the ASR wellfield and treatment plants. This training is ongoing with periodic refresher training. Operator training is outlined under rule under Chapter 62-602, F.A.C. Given that each ASR treatment plant will be capable of treating 50 MGD at full build out, a Class A Lead/Chief Operator will be required. Staffing can be Class C or higher operators. These facilities will need to be staffed 24 hours, 7 days a week when the treatment system is operating. Training of operators shall be included in the Operation Plan.

12 DATA MANAGEMENT AND AUDITS

12.1 DATA MANAGEMENT

The following sections, based on the CERP QASR, detail requirements and procedures for storage, custody, security, access, and archiving of data generated during the course of the ASR project.

12.1.1 Storage

Data management of physical data (i.e., field logbooks, calibration logs, data sheets) and electronic data (i.e., electronic files, laboratory data, engineering documents, and project reports) will be maintained and managed following QASR Section 10.6, ASR Science Plan Section 8.5, and DEP-SOP 001/01 FD 1000 *Documentation Procedures*.

Water quality and hydrological data will be stored in the DBHYDRO database. Additional data, such as ecological, engineering documents, and research studies, will be stored in the Morpho database. Morpho is a metadata generation program, conforming to the Ecological Metadata Language specification. Information about people, sites, research methods, and data attributes are among the metadata created. Data are packaged with metadata in the same container. Morpho allows the user to create a local catalog of data and metadata that can be queried, edited, and viewed.

The database will be maintained and archived by SFWMD. All electronic data, including laboratory data results, will be maintained in their original form in the database. Data changes such as unit adjustments, changes in reporting limits based on data validation, and rejection of data, will be maintained in separate fields or records with specific metadata acknowledging how and why data were modified and specific party authorizing the data change.

12.1.2 Custody

Custody procedures must be established to protect data and information integrity. Custody of data shall be documented from creation to its final storage place. Once data is finalized, validated, and transferred to the database, further changes may only be made upon approval from the SFWMD PM (or their designee). Once the data are stored in the database, data custody will be the responsibility of SFWMD. Contractors will not release data to third parties without written permission from SFWMD. On a yearly basis, the PM will oversee audits to document compliance with custody requirements.

12.1.3 Security

All data and all records will be protected against fire, theft, loss, and environmental deterioration. Electronic data and electronic records will also be protected from electronic or magnetic sources. Storage media will be protected from deteriorating conditions such as temperature, humidity,

magnetic fields, or other environmental hazards. An electronic data backup procedure to recover from disaster or hardware failures must be identified. Backup systems should be tested annually (at a minimum) by restoring information from back-up to online resources.

Data migrations and changes in information technology infrastructure must be documented. It is critical that new operating systems, electronic data filing systems, databases, and data handling systems are capable of supporting existing data for the required retention period or provide an adequate path of migration for it.

12.1.4 Access

To ensure data validity and integrity, a mechanism must be in place to give access solely to authorized individuals. ASR project data will be managed within an internet accessible environment requiring a username and password for login. Upon receiving a username and password, individuals and groups from academia, non-governmental organizations, commercial institutions, governmental agencies, and members of the public will be able to access the data.

DBHYDRO Database

The DBHYDRO browser allows users to search DBHYDRO, using one or more criteria, and to generate a summary of the data from the available period of record. DBHYDRO users can select data sets of interest and have the time series data dynamically displayed in tables or graphs. DBHYDRO can be accessed at: https://www.sfwmd.gov/science-data/dbhydro

Morpho Database

ASR data stored in the DBHYDRO database will also be accessible through Morpho. Morpho packages together different data types, makes them searchable, and provides long-term data storage. Data contained in Morpho are accessed by logging on to CERPZone.org. CERPZone can be accessed at: https://www.accessify.com/c/cerpzone.org

12.1.5 Archiving

The database server will be backed up periodically to minimize the risk of data loss; data that is backed up will be stored off-site in order to provide further physical protection.

All records in the ASR project database, file system, or Document Management System, as well as CDs and tape back-ups, must be retained indefinitely unless otherwise directed by the SFWMD. Per the FDEP QA Rule, 62-160.220 and .340, F.A.C., and FDEP SOP FD1000 Documentation, all raw data records, including laboratory and sample collection documentation, will be kept for a minimum of five years beyond the end of the project. Contractors and laboratories must obtain written consent from the SFWMD before disposing of records at the end of the five-year period. All information necessary for the historical reconstruction of data, including original observations, calculations, calibrations, and reports, must be maintained by the data collection organization for at least five years beyond the end of the project. Five years after the end of the project, records can be destroyed unless records are to be used for evidentiary or legal purposes. Records that are stored only on electronic media must be supported by the hardware for their retrieval.

In the case of laboratory stored data, the record keeping system must ensure that all records are maintained or transferred per SFWMD instructions in the event that a laboratory transfers ownership or goes out of business. The laboratory will obtain written consent from the SFWMD before disposing of records.

12.2 AUDITS

Audits will be conducted as a principal means to determine compliance with this PQAP. This approach will be used to review the actual performance of the project during its course and throughout all operations and levels of management. Specifically, audits will be conducted for both field and laboratory operations to assess the accuracy of the measurement systems and to determine the effectiveness of QC procedures. Several factors will be taken into consideration for determining the scope and frequency for audits as follows:

- Complexity of the activity
- Duration and scope of activity
- Degree of QC specified
- Criteria to achieve QA objectives
- Requirements for deliverables
- Participation of subcontractors
- Criticality of data collection
- Potential for or frequency of nonconformances

The SFWMD will have responsibility for conducting audits and has the authority to delegate ASR project audit functions, as necessary. For complex or highly specialized tasks, senior technical specialists may be assigned portions of an audit. Both the SFWMD PM (or their designee) and technical specialists will be familiar with the technical and procedural requirements of both field and laboratory operations, the associated Monitoring Plan, and this PQAP. In addition, auditors will not be directly involved with the actual tasks, so as not to introduce bias in the auditing process.

The audit process includes selecting an audit team, notifying the auditee, pre-audit planning, conducting the audit, identifying nonconformances (if applicable), reporting the audit results, and tracking closure of corrective actions. A process that does not meet the specifications in this PQAP is considered to be a non-conformance and must be resolved through the corrective action procedures described in the following section. The term “nonconformance” is the same as a deficiency as referred to in F.A.C. 62-160.650. In circumstances where corrective actions have not been completed as planned or scheduled, the audit process provides for management intervention to resolve problems and for issuance of stop work orders, if necessary.

The various types of audits to be conducted during the project are described in the following sections. These audits will be used for the following purposes:

- To verify that measurement systems are operating properly
- To assess whether data quality is adequately documented
- To confirm the adequacy of data collection systems

- To evaluate management effectiveness to meet QA guidelines

All audits should be scheduled in advance. Audits should be conducted at or near the beginning of the project or task start to ensure sufficient time to implement corrective actions. The lead auditor will complete an audit plan and send the plan to the auditee approximately one week before the audit is scheduled. The audit plan should communicate all the requirements to auditee regarding the documents that will be reviewed and any materials or tasks that must be reviewed during the audit. The lead auditor should gather all relevant project documents, including any documents referenced that are applicable to the task being audited. The SFWMD shall review and approve the audit plan prior to submittal to the auditee.

The auditor will be responsible for preparing a findings report after completion of the audit and submitting this report to the SFWMD PM. The findings report will include a short summary of what was audited, copy of completed checklists, statements as to the conformity of the process with this PQAP, notable process improvements, and any deviations from this PQAP or other guidance that has not been fully documented or approved. The findings report should also include a data usability statement for audits involving environmental sampling and/or laboratory analyses. The SFWMD will be responsible for initiating corrective actions as described in Chapter 13.3. The SFWMD will perform follow-up audits as necessary to confirm the implementation of corrective actions.

Subcontractors will be used to collect and/or generate certain data for the project. These may fall under field or laboratory operations. Subcontractor audits may be performed on new sources or existing sources of services that have had significant changes in personnel, ownership, or quality systems. Audits may be performed to assess a subcontractor's QA program or verify the supplier's capability to supply an item or service in a manner that satisfies the project quality requirements. In addition to the subcontractor's QA program, the audit may include, as appropriate, the subcontractor's facilities, production capabilities, personnel capabilities, process and inspection capabilities, and organization.

13.2.1 Technical Systems Audits

A technical systems audit is used to confirm the adequacy of the data collection (field activities), data generation (laboratory activities), and engineering (construction and operation) systems. These are typically performed as an on-site audit to determine whether the PQAP, project-specific Work Plan, SOPs, and well construction and operation are properly implemented.

Laboratory Evaluation and Audits

Prior to use of any analytical laboratory, its NELAP accreditation to the specific method and matrix shall be confirmed. Certification documentation must be provided by the laboratory for consideration prior to selection of the laboratory. If the SFWMD deems necessary, the evaluation will involve the review of performance evaluation samples analyzed for specific methods for accreditation by NELAP. Laboratories are required under NELAP to routinely analyze performance evaluation samples for parameters for which they are accredited. These samples have known concentrations of constituents that are analyzed as unknowns in the laboratory. Results of the laboratory analysis will be calculated for accuracy against the known

concentrations and acceptance limits provided by the supplier or manufacturer. The SFWMD (or their designee) will audit the last three rounds of performance evaluation from the laboratory to verify compliance with the acceptance limits. For laboratories and/or laboratory parameters that are not accredited by NELAP, other method specific samples will be audited. Depending on the type of test, these samples could include initial demonstration of proficiency samples, secondary source calibration standards, and analysis of other standards with traceability to a certified standard, such as NIST Standard Reference Materials. These results will be evaluated in relation to this PQAP and the project DQOs.

During the project, technical systems audits will be conducted for the laboratory operation as deemed necessary by the project team. Laboratory audits may be omitted or abbreviated if the laboratory is a current participant in a federal validation program or equivalent state certification program which requires assessments (such as NELAP). However, certification does not always replace an audit relative to project-specific requirements.

A systems audit of laboratory procedures will evaluate and document, at a minimum, methods for: data qualification, analytical data generation, COC documentation and protocol, instrument calibration, data reporting, and QC methods. Systems audits also will evaluate laboratory procedures for procurement of supplies and standards as well as disposal of samples.

Audits of laboratories supplying data for the project using non-standard methods (not certified by NELAP) shall be performed at the discretion of SFWMD. During the data assessment process, if the PM or QAOT identify items requiring an audit, then the audit team will develop the appropriate checklists to employ depending on the specifics of the laboratory.

Field Audits

Technical systems audits of field activities (ecological and water quality audits) may be conducted once per calendar year or as needed. A systems audit of field procedures will evaluate and document, at a minimum, sampling methods (including collection, containers, and preservation), equipment decontamination, chain of custody, sample tracking and shipment documentation, sample labeling, methodology, pre-field activities, equipment maintenance and calibration, post-field activities, sampling documentation and other field activity logs, field team debriefing, and equipment check-in and re-calibration. Table 12-1 details the checklist elements from FDEP SOP FA 1000 to be used as the basis for conducting audits of field activities and/or documents, whether an on-site inspection is required or if a review of the documentation is sufficient. These audits may be performed together or scheduled separately, but all are recommended to be performed on an annual basis.

Table 12-1. Field Technical Audit Checklists

Checklist	Description	FA 1000 Reference
Universal Documentation	Documentation audit	FD 1000 Checklist
COC	Documentation audit	FD 1000 Checklist
Decontamination	Documentation audit	FD 1000 and FS 1000 Checklist
Field Calibration	Documentation audit	FT 1000 and FD 1000 Checklist
Field QC	Documentation audit	FQ 1000 Checklist
Maintenance	Documentation audit	FD 1000 Checklist
Groundwater	On-site audit	FS 1000 Checklist FS 2000 Checklist FS 2200 Checklist
Surface Water	On-site audit	FS 1000 Checklist FS 2000 Checklist FS 2200 Checklist
Ecological	On-site audit	FS 1000 Checklist

Engineering Audits

During the course of the project, a technical systems audit may be performed to evaluate the construction, operation, and maintenance of the well system has been implemented properly. Qualified personnel will use construction work plans, construction logs, "as-built" documents, and any other associated documentation to assess wells were constructed according to the specifications stated in these documents. Once constructed and operating, audits will include review and assessment of compliance with the project-specific O&M manuals. As with other audits, the final reports will detail all elements and documents reviewed, identify and explain any nonconformances or deficiencies noted, and if necessary, detail potential corrective actions.

Data Quality Audits

Over the course of a long-term project, the SFWMD should periodically perform a data quality audit. The data quality audit is an examination of data after they have been collected and verified by project personnel. It is conducted to determine how well the measurement system performed with respect to the performance goals specified in this PQAP and whether the data were accumulated, transferred, reduced, calculated, summarized, and reported correctly. The data quality audit report shall detail the results of custody tracing, a study of data transfer and intermediate calculations, and a study of project incidents that resulted in lost data. Particular attention is paid to the QC data to assess if systemic issues are present (i.e., consistent blank contamination, field duplicates failing criteria, elevated MDLs, etc.) that may not be sufficiently

highlighted in single event data reviews. The audit report ends with conclusions about the quality of the data from the project with respect to the DQOs and their fitness for intended use.

13.2.2 Data Management Audits

An audit of data management will evaluate and document, at a minimum, methods for data storage, access, custody, security, and archiving of project data. Systems audits will also evaluate data management procedures for tracking changes and access to the data and ensuring only current or the latest versions of data are available for access. Audits conducted by the SFWMD or QAOT shall follow the guidance and requirements stated in the QASR, ASR Science Plan, and this PQAP when conducting systems audits.

13.3 Corrective Actions

Provisions for establishing and maintaining QA reporting to the appropriate management authority will be instituted to assure that early and effective corrective action will be taken when data quality falls outside of established acceptance criteria described or referenced in this PQAP. In this context, corrective action involves the following steps:

- Discovery of a nonconformance
- Identification of the responsible party
- Plan and schedule of corrective/preventive action
- Review of the corrective action taken
- Confirmation that the desired results were produced
- Reporting/documentation of nonconformance, required corrective actions and verification of corrective actions taken

The discovery of a nonconformance, either from observations, data review, or from an audit conducted by the SFWMD, shall be documented in writing and promptly sent to the SFWMD PM and responsible parties. A corrective action plan (CAP) will be prepared by the group or contractor responsible for the activity within 45 days of receipt of the documented nonconformance.

CAPs must include the following:

- Identification of the nonconformance and the associated corrective action taken
- Organizational level responsible for the action taken
- Steps to be taken to implement the corrective action
- Verification of the corrective action taken, including confirmation that the desired results were achieved
- Corrections to all prior findings/data impacted by the nonconformance
- Transmittal of documentation of these steps to the SFWMD

Corrective action measures will be selected to prevent or reduce the likelihood of future nonconformances and address the causes to the extent identifiable. Selected measures will be appropriate to the seriousness of the nonconformance and realistic in terms of the resources required for implementation.

Once the CAP has been received, the SFWMD shall have 30 days to provide written comments to the submitting party pertaining to technical applicability, appropriateness, and completeness of the CAP.

Upon implementation of the CAP, the SFWMD will evaluate the adequacy and completeness of the action taken. If the action is found inadequate, the SFWMD will resolve the problem and determine any further actions. Implementation of any further action will be scheduled by the SFWMD.

13 PQAP VERSIONS

Revisions to this PQAP may be needed periodically to address programmatic updates, additions, changes, equipment replacement. These changes may include, but are not limited to, approved modifications to analytical or field procedures, revised/new sampling locations, data collection protocols, and sampling frequencies. All revisions to this PQAP will adhere to the specifications and requirements of the QASR and ASR Science Plan.

13.1 VERSION TRACKING

Requests for changes to the PQAP shall be conducted annually or within a timeframe (e.g., annually) as mutually agreed upon by all Agency staff. Proposed changes to the PQAP will be submitted in writing at least 60 days prior to the intended modification for review and approval. Exceptions to the 60-day advance notice requirement shall be granted by the SFWMD based on demonstrated good cause (such as a sudden loss of equipment where rapid resolution is needed to prevent/minimize a break in continuity of time series data collection). Requests for changes to the PQAP shall, at a minimum, include the following information:

- Specific locations and type of monitoring impacted by proposed modification or addition.
- Justification/basis for request, including supporting data if needed or requested
- Specific text to be inserted, deleted, and/or modified
- Identification of any text or provisions contained in the individual project plans that may conflict with the proposed PQAP changes, along with proposed revision language which would prevent a conflict between the two documents

13.2 CHANGES TO DOCUMENT

Changes to the PQAP will consist of an overview of the revision number, date, section, page, as well as the changes and basis for those revisions (example shown in Table 13-1). All agreed-upon amendments to the document will be recorded in Table 13-2 for the relevant sections.

Table 13-1. Chronological ASR PQAP Revision Dates

Revision Description and #	Revision Date	Section	Page	Changes, Additions, Deletions	Basis

Table 13-2. Summary of Versions to Approved PQAP

Section	Approved PQAP Version	Agencies Recommendations or Revisions	Revision Approval Date

Once a revision has been approved in writing, the revision date will be stated at the bottom of each affected page in this PQAP. In addition, a description of each approved revision will be appended to Table 13-2. The last date entered in Table 13-2 will correspond to the current and active copy of this PQAP.

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APPENDIX D:
MINERALOGY INC REPORTS FOR L63N COREHOLE

MINERALOGY INC
WHERE SCIENCE GETS DOWN TO EARTH

L-63N Continuous Corehole

Well: M01L63N

Core Evaluation

Requested by:
Rick Cowles
Stantec

Mineralogy, Inc. Number 21048

Date:
May 14, 2021

Submitted by:

Timothy B. Murphy

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CONDITIONS AND QUALIFICATIONS

Mineralogy, Inc. will endeavor to provide accurate and reliable laboratory measurements of the samples provided by the client. The results of any x-ray diffraction, petrographic or core analysis test are necessarily influenced by the condition and selection of the samples to be analyzed. It should be recognized that geological samples are commonly heterogeneous and lack uniform properties. Mineralogical, geochemical and/or petrographic data obtained for a specific sample provides compositional data pertinent to that specific sampling location. Such "site-specific data" may fail to provide adequate characterization of the range of compositional variability possible within a given project area, thus the "projection" of these laboratory findings and values to adjoining, "untested" areas of the formation or project area is inherently risky, and exceeds the scope of the laboratory work request. Hence, Mineralogy, Inc. shall not assume any liability risk or responsibility for any loss or potential failure associated with the application of "site or sample-specific laboratory data" to "untested" areas of the formation or project area. Unless otherwise directed, the samples selected for analysis will be chosen to reflect a visually representative portion of the bulk sample submitted for analysis. Where provided, the interpretation of x-ray diffraction, petrographic or core analysis results constitutes the best geological judgment of Mineralogy, Inc., and is subject to the sampling limitations described above, and the detection limits inherent to semi-quantitative and/or qualitative mineralogical and microscopic analysis. Mineralogy, Inc. assumes no responsibility nor offers any guarantee of the productivity, suitability or performance of any oil or gas well, hydrocarbon recovery process, dimension stone, and/or ore material based upon the data or conclusions presented in this report.

This report is to only be replicated in its entirety.

Sample Retention: Samples will be stored for a period of 30 days and thereafter discarded. If additional sample storage time and/or return shipping is required, appropriate charges will be billed to the client.

Introduction

Three core intervals have been submitted for evaluation from the L-63N Continuous Corehole project located in South Florida. The three cores are representative of selected (~1' thick) intervals from the Lake Okeechobee aquifer system and span an overall depth range from ~ 697 ft to 951 ft below ground surface. Sediments from each of these intervals have been assessed for mineralogy and chemical composition, fabric properties, and pore system characteristics. Rock properties testing has included x-ray diffraction mineralogical analysis (XRD), x-ray fluorescence chemical analysis (XRF), porosity and permeability analysis, cation exchange capacity analysis, and acid insoluble residue analysis. Summaries for these test methods are presented in Appendix I. Petrographic and SEM analysis has been performed to evaluate the mineralogy, fabric & pore system properties for each of the core intervals. Representative images & summaries of the petrographic and SEM evaluations are provided in Appendix II.

Sample ID	Mineralogy, Inc. ID	Testing Protocol
697.4 - 697.5 ft.	21048-01	XRD, XRF, CEC, SEM, TSP, Acid Insoluble, Porosity, Hydraulic Conductivity
755.5 - 755.7 ft.	21048-02	
950.4 - 950.5 ft.	21048-03	

XRD = X-ray diffraction • XRF = X-ray fluorescence • CEC = Cation Exchange Capacity • SEM = Scanning Electron Microscopy • TSP = Thin Section Petrography

Summary

The results of the core analysis investigation performed for selected intervals from the L-63N project are noted as follows:

- The results of the x-ray diffraction mineralogical analysis are summarized in Table I. Core 1 (from a depth of ~ 697.4 ft) contains significant amounts of calcite (~50.5%) and dolomite (~21%) together with sub-equal amounts of quartz (~15%) and fluorapatite (~13%). Traces of clay matrix minerals are also locally present within this sample. Cores 2 & 3 from core depths 755.5 & 950.4 ft respectively each exhibit an overwhelming predominance of calcite (99 - 100%), with localized traces of ferroan dolomite (0-1%), and scattered traces (<0.5%) of clay matrix minerals (including illite mica and mix-layered illite smectite).

- Results of the x-ray fluorescence (XRF) chemical analysis are summarized in Table II. The chemical analysis results (typically reported as oxides) indicate a composition for core 1 that includes significant amounts of calcium, silicon, phosphorus, and magnesium. The chemical analysis results for core #1 are consistent with sediment materials that include apatite & quartz-rich sand grains + dolomite-replaced skeletal fragments. Similarly, chemical data obtained for cores 2 & 3 indicate elemental chemistries dominated by calcium (CaO ~ 96.9 - 97.3%). Minor amounts of magnesium (MgO; ~1.04%) and silicon (SiO2; ~0.7-0.8%) are also present. Locally significant amounts of sulfur (S) were detected within cores 1 (~0.34%) & 3 (~0.21%) respectively.

- Results of the porosity and permeability analysis are summarized in Table III. Horizontal and vertical core plugs have been evaluated for variations in gas permeability, porosity, and grain density. Klinkenberg permeability estimates are also calculated to approximate hydraulic conductivity. Gas permeability values for core 1 range between ~ 0.17 - 0.30 mD (millidarcies), with porosity values of ~ 9.9 - 13.8%. The grain density of 2.78 g/cc measured for core 1 reflects the influence of dolomite and fluorapatite as significant mineralogical constituents. Horizontal gas permeability data for cores 2 and 3 are impressive & range between ~238-484 mD. Vertical gas permeability values for companion core plug specimens range from ~89 - 575 mD . Helium porosity values for core 2 (~42.7-44.2%) and core 3 (~40.0-40.1%) attest to a weakly consolidated and porous limestone framework within these intervals of the aquifer system. Grain density values ranges between ~ 2.66 - 2.73 g/cc. The relatively suppressed grain density values observed for core #3 may reflect the influence of organic matter dispersed within the limestone framework.

- Results of the cation exchange & leachate analysis are summarized in Table IV. The analysis of CEC leachate solutions for these intervals indicates an overwhelming predominance of exchangeable calcium ions (Ca; ~108-138 meq/100g), relative to

leachate concentrations for magnesium (Mg; ~ 3.6 - 4.59 meq/100g), sodium (Na; < 0.5 meq/100g), and potassium (K; < 0.11 meq/100g).

- Results of the acid insoluble residue analysis are summarized in Table V. The acid residue data for cores 2 & 3 range from ~ 0.4 - 1.0% of the sample mass. These findings are consistent with the calcite-rich mineralogy for these intervals (see Table I). Core #1 exhibits an acid insoluble residue of 24.7%, consistent with the presence of relatively large amounts of quartz sand and fluorapatite.

- The results of the thin section petrography and SEM analysis performed for these aquifer intervals are presented in Appendix II. The petrographic analysis includes a data summary that specifies the carbonate classification [as per Dunham (1962)], coupled with brief descriptions of the carbonate grain composition, texture, matrix and cement constituents, and pore system properties for each aquifer interval. Figure plates provide representative images of the fabric and pore system. Results fo the SEM analysis are collated with the thin section petrographic data for each of the aquifer intervals.

- Core #1 (@ ~697.4 ft) is a quartz sand and apatite-rich, dolomitic, skeletal lime packstone. Coarsely textured skeletal grains include gastropod and mollusk shell fragments that are largely replaced with very finely crystalline dolomite. A portion of the skeletal grain debris has been leached, contributing to significant amounts of skel-moldic dissolution voids. The poorly sorted lime packstone framework contains localized concentrations of detrital apatite & quartz-rich sand grains that are mildly to moderately packed and cemented with micrite (i.e., microcrystalline calcite or lime mud). The micro-crystalline calcite is micro-porous and fills most of the available inter-particle space within core 1. The helium porosity measured for this interval (~ 9.9-13.8%), is largely limited to micro-pores + secondary skel-moldic voids that are poorly inter-connected.

- Core #2 (@ ~ 755.5 ft) consists of porous, foram and algae-rich lime packstone. The limestone is weakly cemented, grain-supported, and friable. Poorly sorted skeletal fragments are weakly bound together with clusters of lime mud matrix material. Skeletal grains include foraminifera (including varieties that are similar to Numulites (sp), Discocyclina (sp), and/or Miliolid (sp) skeletal types). Calcareous algae include silt to sand-sized plates and encrusting algae varieties. The algae particles are comprised of microcrystalline calcite. Undifferentiated skeletal fragments are present & include foram, mollusk, +/- echinoderm skeletal grain fragments. The disaggregation of algae particles accounts for most (if not all) of the dissociated (microcrystalline) calcite within the aquifer pore system. The matrix clusters are susceptible to migration & ‘brush-piling’ within the inter-particle pore throats. Inter-particle porosity accounts for ~ 42.7 - 44.2% of the bulk volume. Locally significant amounts of inter-crystalline micro-porosity are associated with the micro-crystalline calcite matrix material and skeletal grains.

- Core #3 (@ ~ 950.4 ft), is comprised of weakly consolidated, porous, algae and foram-rich lime packstone. The skeletal framework is dominated by calcareous

algae particles, together with minor amounts of undifferentiated fossil grains & Miliolid-like foram tests. The packstone interval is mildly compacted and has retained significant amounts of inter-particle void space. The localized disaggregation of algae particles has contributed to locally significant concentrations of pore-filling matrix material. As within core 2, the matrix clusters present in this limestone are susceptible to migration and 'brush-piling'. Localized concentrations of very-finely crystalline calcite spar cement are locally admixed with the lime mud. The authigenic calcite spar is present as a direct replacement for the micrite (attributed to aggrading neomorphism). The algae and lime matrix clusters locally incorporate traces of organic matter +/- microcrystalline pyrite cement. Void space within this packstone interval accounts for ~ 40% of the bulk volume. Inter-particle macro-porosity accounts for most of the effective void space within this aquifer interval.

Conclusions

The selected intervals of the Okeechobee aquifer system from the L-63N well include skeletal-rich, porous & permeable, calcite-rich lime packstone intervals with storage capacities that locally exceed 40%. The porous lime packstones within this aquifer system that are comparable to cores 2 & 3 are likely to exhibit modest fluctuations of transmissivity related to fines migration and 'brush-piling' of microcrystalline calcite within the inter particle pore throats. Core 1 (@ 697.4 ft) is representative of a well-cemented, dolomitic lime packstone with a grain composition dominated by quartz and apatite-rich sand + dolomite-replaced mollusk shell fragments. The carbonate grains in core 1 are well-cemented with pore-filling lime mud matrix. Large, poorly inter-connected skel-moldic voids account for a storage capacity of ~ 9.9 - 13.8%, with gas permeability values of < 0.3 mD. Intervals comparable to core 1 are likely to serve as effective vertical permeability barriers within the aquifer system.

Appendix I

X-ray Diffraction, X-ray Fluorescence, Cation Exchange Capacity, & Acid Insoluble Residue

X-ray Diffraction

Table I

Client:	Stantec	MI#:	21048
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	X-ray Diffraction

	Depth	697.4 - 697.5 ft.	755.5 - 755.7 ft.	950.4 - 950.5 ft.
	MI#	21048-01	21048-02	21048-03
Mineral Constituent	Chemical Formula	Relative Abundance (%)		
Quartz	SiO_2	15		<0.2
Calcite	$CaCO_3$	50.5	99	100
Dolomite	$(Ca,Mg)(CO_3)_2$	21		
Ferroan Dolomite	$Ca(Mg_{0.67}Fe_{0.33})(CO_3)_2$		1	
Fluorapatite	$Ca_5F(PO_4)_3$	13		
Illite / Mica	$KAl_2(Si_3AlO_{10})(OH)_2$	0.5	<0.5	
Mixed-Layered Illite/ Smectite	$K_{0.5}Al_2(Si,Al)_4O_{10}(OH)_2 \cdot 2H_2O$	<0.5	<0.5	
Total		**100**	**100**	**100**
% Illite Layers in ML I/S		*80%*	*BDL*	

BDL = Below Detection Limit

X-ray Fluorescence

Table II

Client:	Stantec	MI#:	21048
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	X-ray Fluorescence

Depth	697.4 - 697.5 ft.	755.5 - 755.7 ft.	950.4 - 950.5 ft.
MI#	21048-01	21048-02	21048-03
Elemental Phase	Results (Mass %)		
Na2O	0.2503	ND	0.1095
MgO	4.3828	1.039	1.0375
Al2O3	0.4877	0.1362	0.1303
SiO2	25.1419	0.7644	0.6925
P2O5	7.013	0.1101	0.092
S	0.3378	0.0788	0.2108
Cl	0.0134	0.0199	0.0478
K2O	0.1444	0.0487	0.0622
CaO	60.9682	97.3373	96.9382
TiO2	0.0338	ND	ND
MnO	0.0066	ND	ND
Fe2O3	0.3676	0.1	0.0757
Sr	0.2319	0.1351	0.1674
BaO	0.0727	0.0879	0.0897

ND = Not Detected

Porosity & Permeability

Table III

Client:	Stantec	MI#:	21048
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	Core Analysis

Sample Number	Depth (ft.)	Air Permeability (mD)	Klinkenberg Permeability (mD)	Porosity (%)	Grain Density (g/cc)
1H	697.90	0.2973	0.1400	9.88	2.78
1V	697.70	0.1678	0.0636	13.84	2.78
2H	755.20	484	454	44.15	2.73
2V	755.05	575	554	42.69	2.73
3H	950.60	238	226	40.02	2.67
3V	950.90	88.7	81.2	40.09	2.66

Note: Data provided by SCAL, Inc.

Cation Exchange Capacity

Table IV

Client:	Stantec	MI#:	21048
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	CEC

697.4 - 697.5 ft.; 21048-01

Test	Result	Notes	PQL#
Exchangeable Calcium	108	meq/100g	0.010
Exchangeable Magnesium	4.59	meq/100g	0.010
Exchangeable Potassium	0.103	meq/100g	0.010
Exchangeable Sodium	0.457	meq/100g	0.010

755.5 - 755.7 ft.; 21048-02

Test	Result	Notes	PQL#
Exchangeable Calcium	124	meq/100g	0.010
Exchangeable Magnesium	3.60	meq/100g	0.010
Exchangeable Potassium	0.044	meq/100g	0.010
Exchangeable Sodium	0.314	meq/100g	0.010

950.4 - 950.5 ft.; 21048-03

Test	Result	Notes	PQL#
Exchangeable Calcium	138	meq/100g	0.010
Exchangeable Magnesium	3.90	meq/100g	0.010
Exchangeable Potassium	0.045	meq/100g	0.010
Exchangeable Sodium	0.229	meq/100g	0.010

Method Reference: 40 CFR 136, 261, Method for Chemical Analysis of Water and Waste EPA-600/4-79-020 March 1983

CEC Method Reference: Method of Soil Analysis, Chemical and Microbiological Properties, 2nd Ed.; American Society of Agronomy, Inc.

Soil Science Society of America, Inc. page 160.

**CEC analysis provided by Accurate Laboratories & Training Center; Stillwater, OK*

***PQL= Practical Quantitation Limit*

Acid Insoluble Residue

Table V

Client:	Stantec	MI#:	21048
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	Acid Insoluble Res.

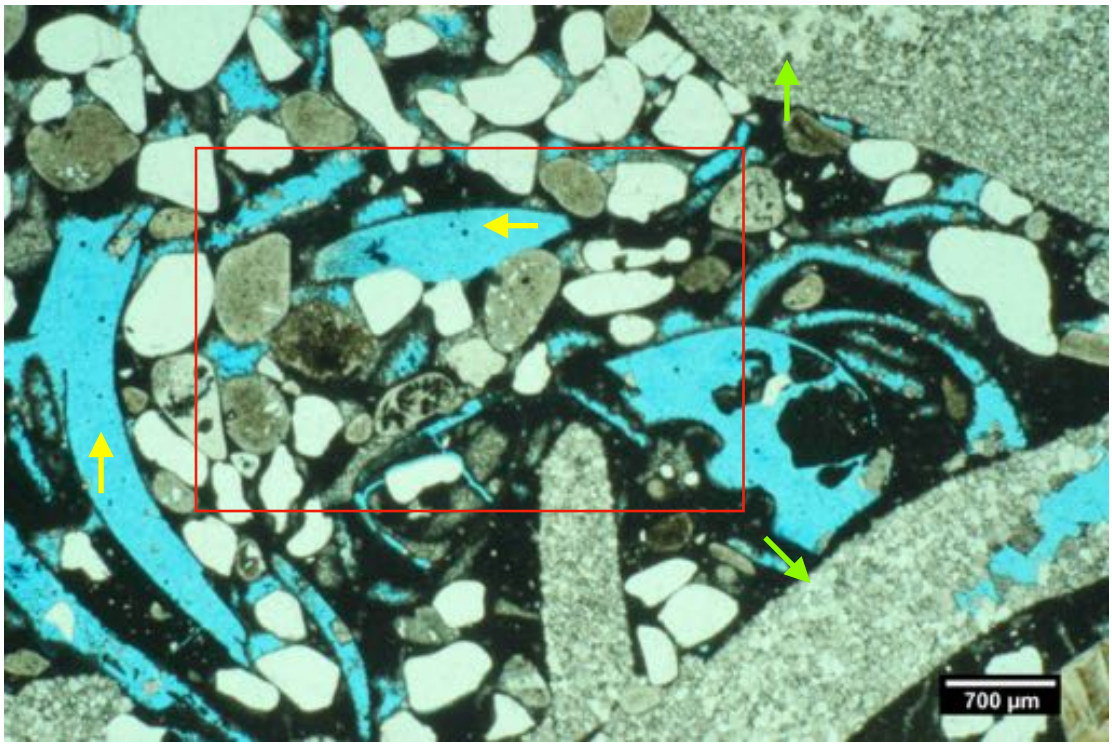
Depth	Lab ID	Acid Insoluble Residue (%)
697.4 - 697.5 ft.	21048-01	24.7
755.5 - 755.7 ft.	21048-02	0.4
950.4 - 950.5 ft.	21048-03	1.0

Appendix II
SEM & Petrographic Findings

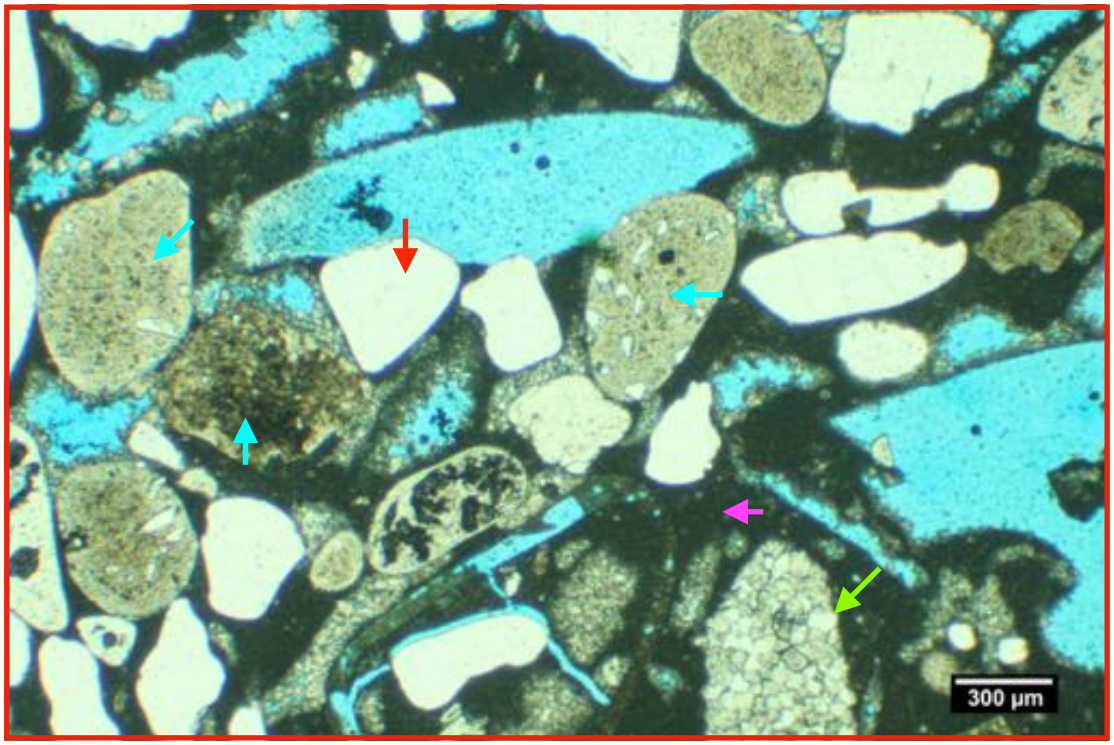
Petrographic Data Summary - L-63N; Core Depth: 697.4 - 697.5 ft.; MI#21048-01

Lithologic Classification	Quartz and apatite-rich, dolomitic, Skeletal Lime Packstone
Texture	Medium-to coarse-grained quartz-rich sand (mean diameter ~0.50 mm) admixed with elongated, dolomite-replaced mollusk shell fragments. The sand grains & skeletal fragments are grain-supported, poorly sorted, and cemented with lime mud matrix material (microcrystalline calcite).
Detrital Grains / Allochems	1) Dolomite-replaced mollusk shell fragments (including gastropod shell debris) are common. Dissolution of mollusk fragments has also occurred and contributed to significant amounts of secondary grain-mildic porosity. 2) Quartz sand 3) Fluorapatite grains - rounded pellet-shaped grains with a groundmass of fluorapatite +/- traces of embedded silt, organic matter, calcite &/or clay minerals. 4) Calcareous algae plates 5) Foraminifera tests (mosly miliolid-like forms) 6) Echinoderm plates
Matrix	Lime mud matrix material (microcrystalline calcite) is common as a pore-filling cement. The groundmass includes minor amounts of organic matter + very finely crystalline calcite spar (attributed to aggrading neomorphism).
Cements	Pore-lining & pore-filling authigenic cements include dolomite + very finely crystalline calcite spar. Authigenic dolomite is abundant as an intra-particle replacement cement associated with the mollusk shell fragments.
Pore Stystem	Common skel-moldic pores attributed to the dissolution of elongated skeletal grains (likely mollusk shell fragments). Minor amounts of residual inter-granular porosity are also present. The secondary moldic macro pores are relatively isolated & poorly inter-connected owing to the well-preserved groundmass of densely crystallized microcrystalline calcite matrix. Klinkenberg permeability values are <0.15 md, in spite of pore volumes that range from ~9.9-13.8%.

697.4 - 697.5 ft.; MI#21048-01

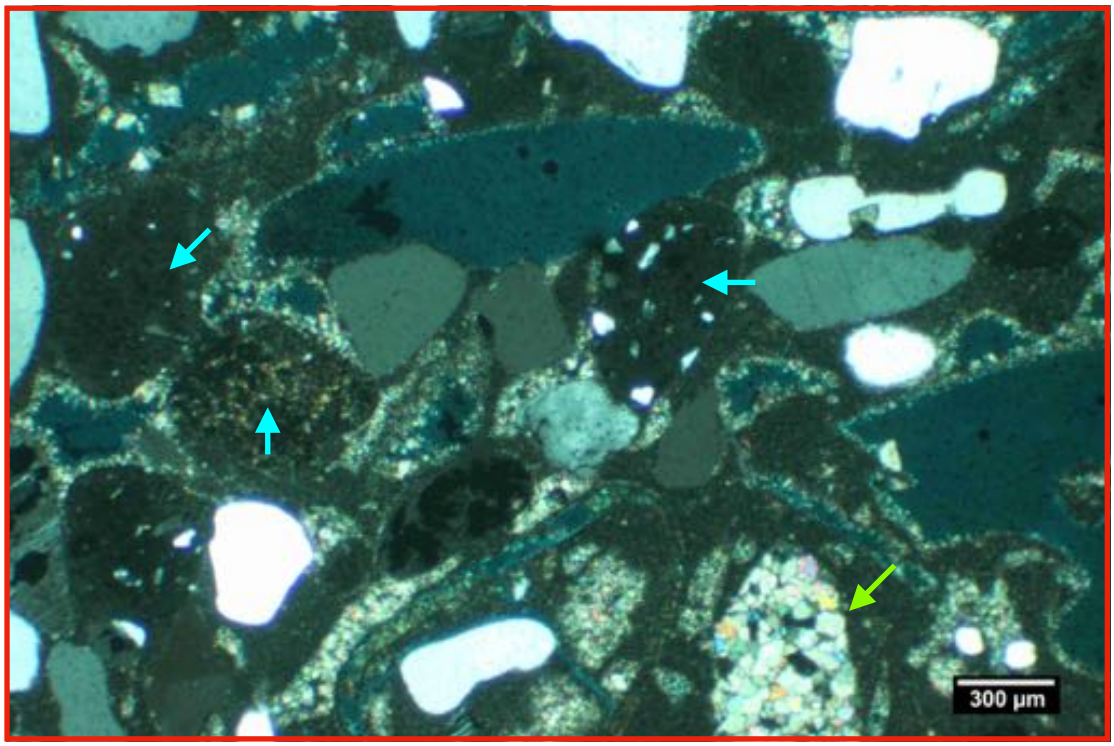


1A. Quartz sand & apatite-rich, dolomitic lime packstone. Secondary mold voids (blue; yellow <) are common. Note the mollusk fragments replaced with dolomite (green <).

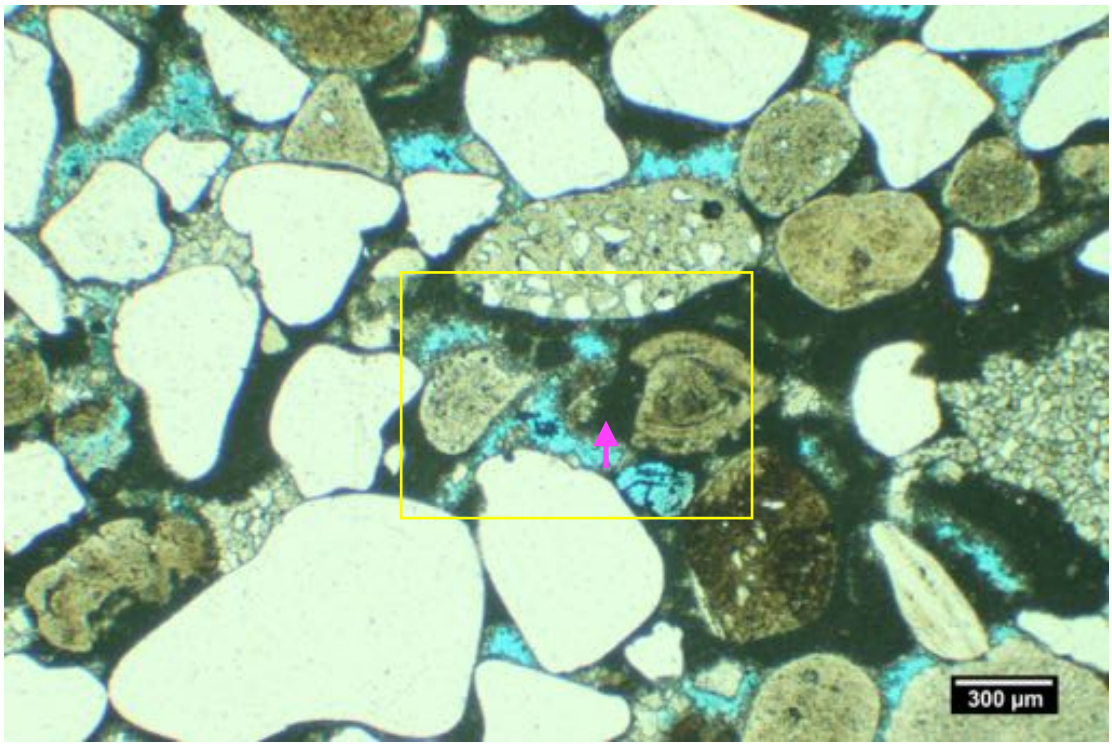


1B. Detailed view of the highlighted area from Figure 1A. Quartz sand (red <) and apatite (blue <) detrital grains are cemented with calcareous matrix material (magenta <).

697.4 - 697.5 ft.; MI#21048-01

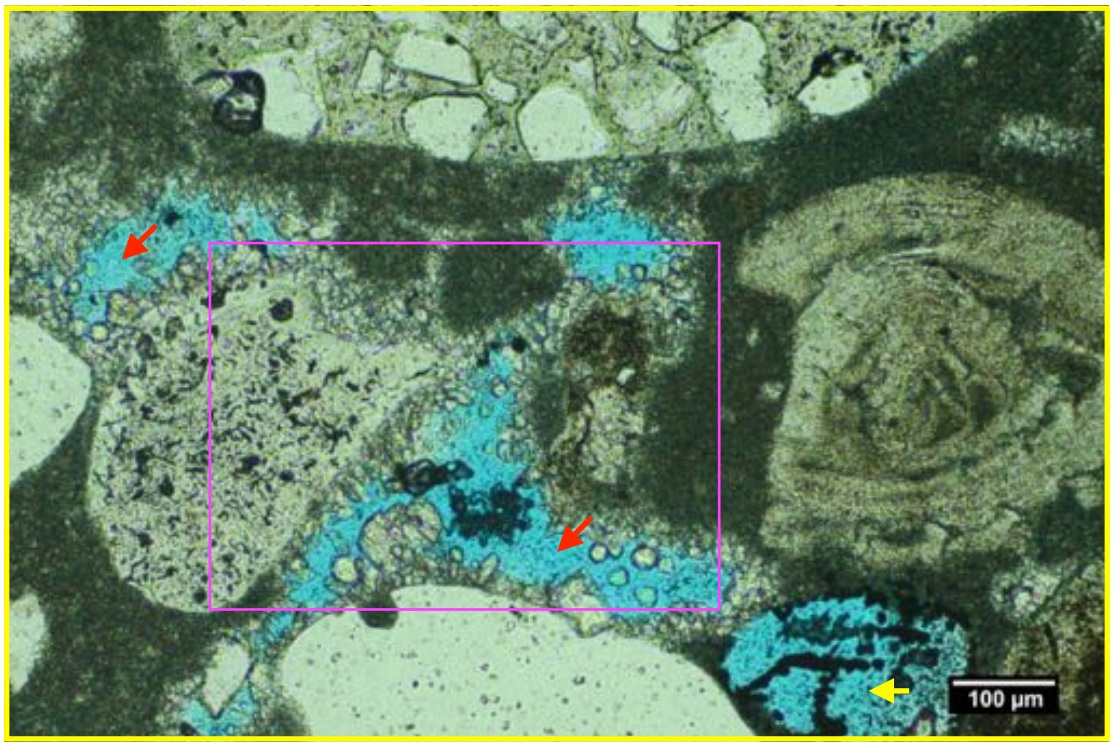


1C. As in Figure 1B, with cross polarized light. The apatite grains (blue <) are extinct (i.e., dark) in cross polarized transmitted light. Note the dolomite cement (green <).

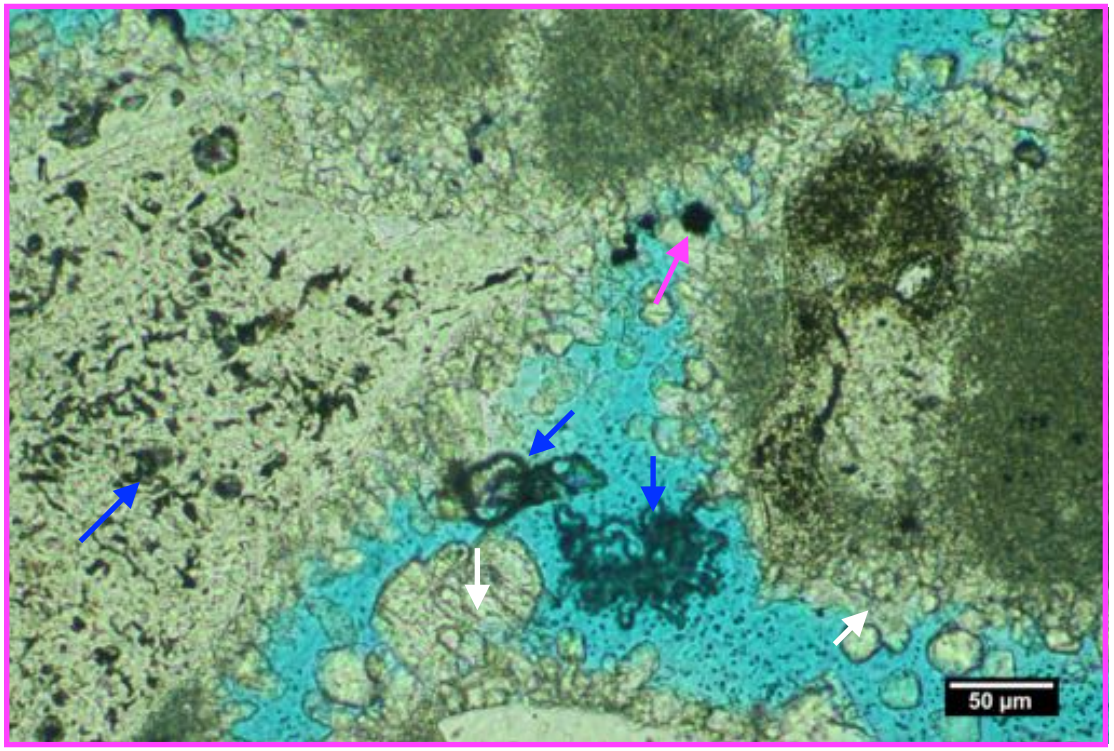


1D. Sand-rich portions of the framework are grain-supported and cemented with microcrystalline calcite (magenta <). The highlighted area is detailed in Figure 1E.

697.4 - 697.5 ft.; MI#21048-01



1E. Detailed view of the highlighted area from Figure 1D. The macro pore system (blue) includes inter-granular (red <) and grain-moldic pore (yellow <) types.



1F. Detailed view of the highlighted area from Figure 1E. The pores are rimmed with very finely crystalline calcite spar cement (white <). Note the traces of organic matter (blue <) & pyrite cement (magenta <).

L-63 Continuous Corehole

Boring: M01L63N

697.4 - 697.5 ft

MI#21048-01 - SEM

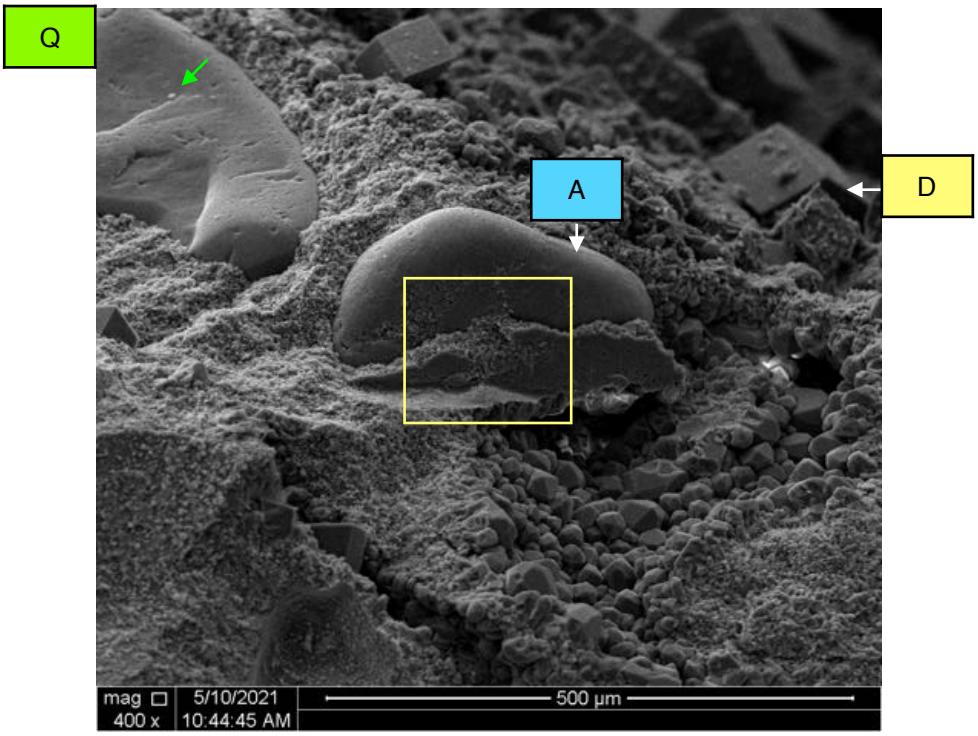
Summary: This core interval is comprised of quartz and apatite-rich, dolomitic, skeletal lime packstone. The sand grains & skeletal fragments are grain-supported, poorly sorted, and cemented with lime mud matrix material (microcrystalline calcite). The limestone contains large, dolomite-replaced mollusk shell fragments (including gastropod shell debris). A portion of the mollusk grain material has been subjected to dissolution, resulting in common, skel-moldic pores. The moldic pores are locally rimmed &/or filled with euhedral crystals of authigenic dolomite (D) cement (e.g., see SEM Figures 1D & 1E). The detrital sand fraction of the limestone includes well rounded grains of quartz (Q) and apatite grains (A) (see SEM Figure 1A). Traces of authigenic illite clay (I) + pyrite framboids (P) are also locally present as accessory constituents (see SEM Figure 1F).

21048-01 Photo Index: (bookmarks)

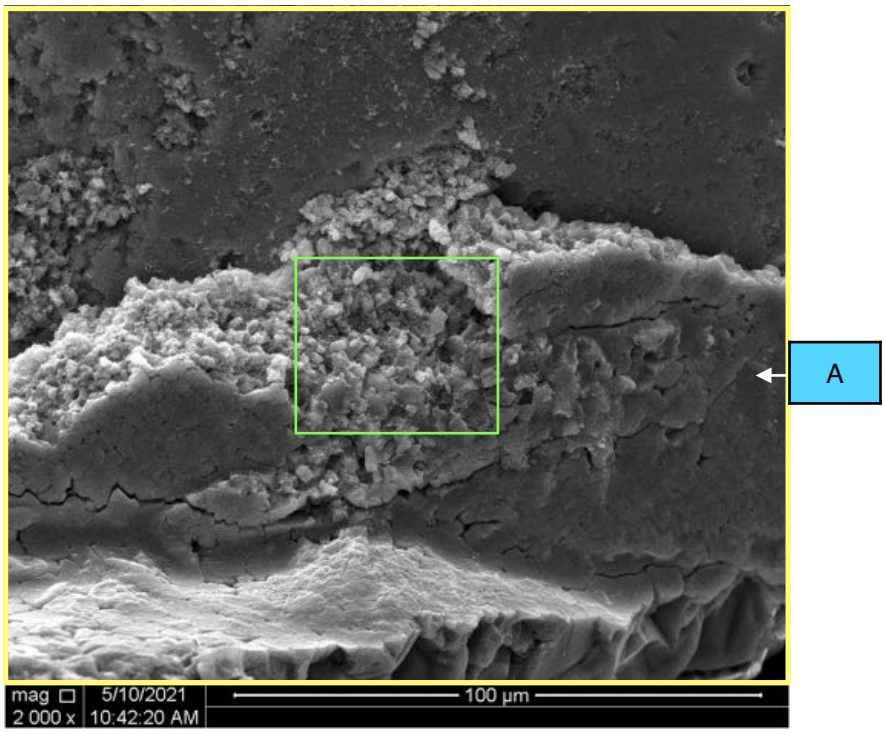
Sample ID	Magnification
21048-01A	400X
21048-01B	2000X
21048-01C	8000X
21048-01D	500X
21048-01E	2000X
21048-01F	12000X

Quartz	Q
Apatite	A
Calcite Spar	C
Dolomite	D
Pyrite	P
Illite	I

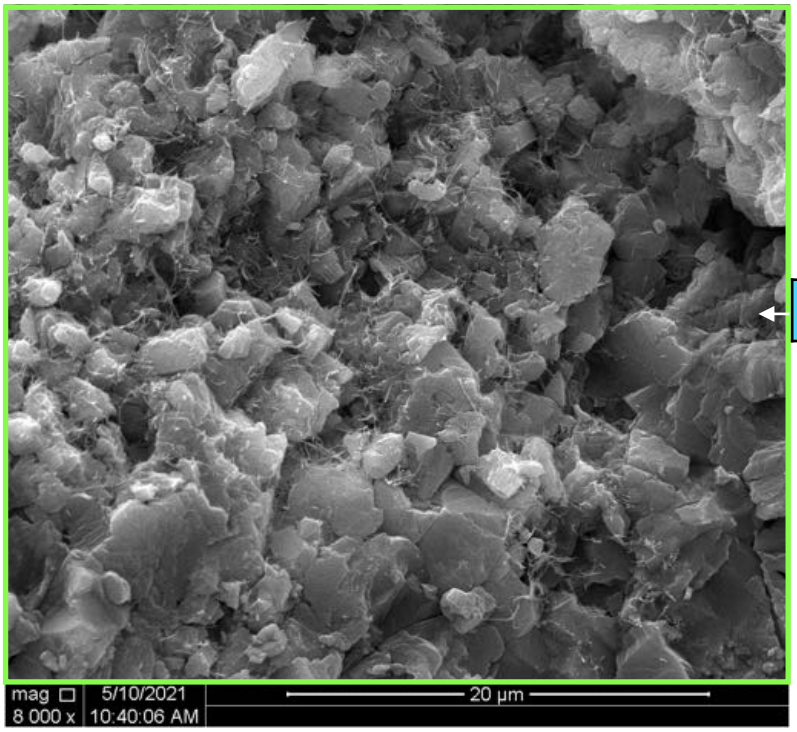
21048-01A 400X



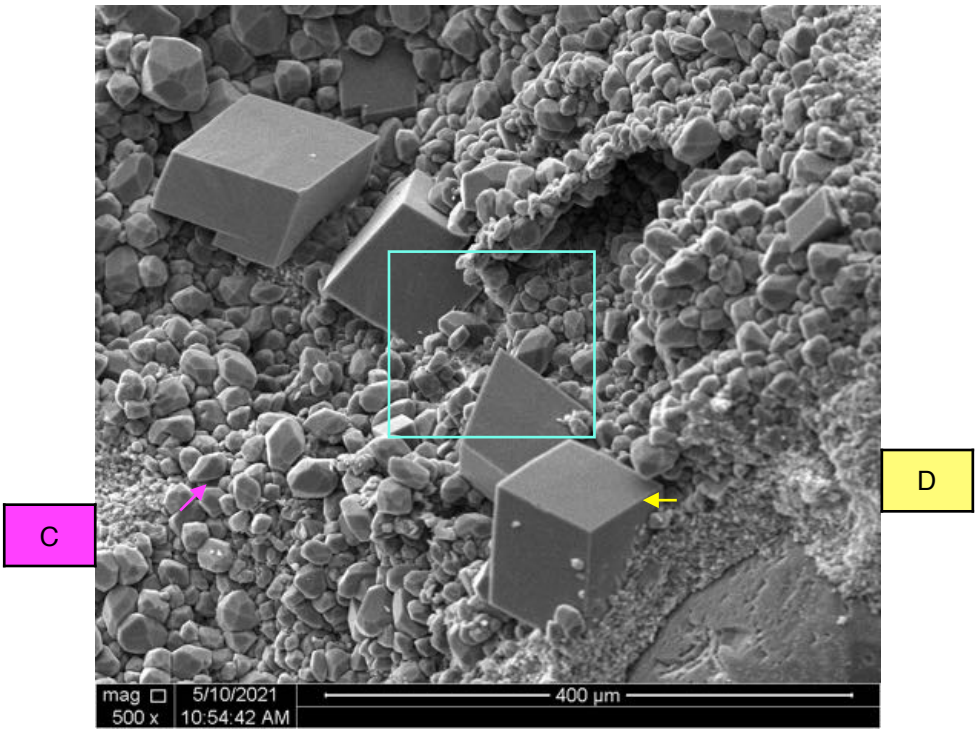
21048-01B 2000X



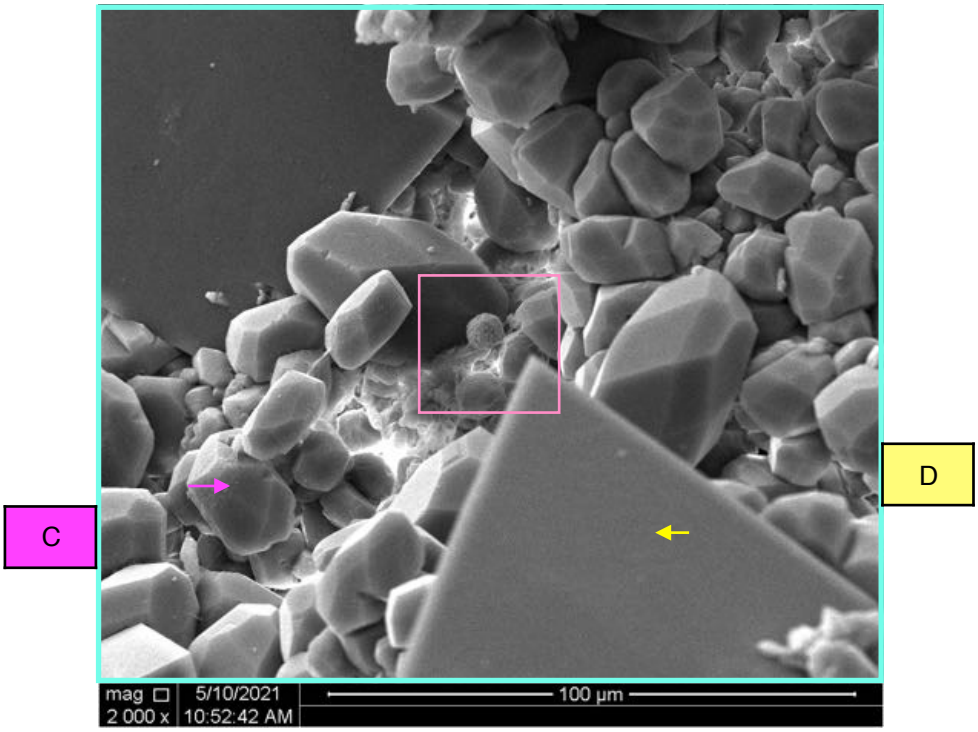
21048-01C 8000X



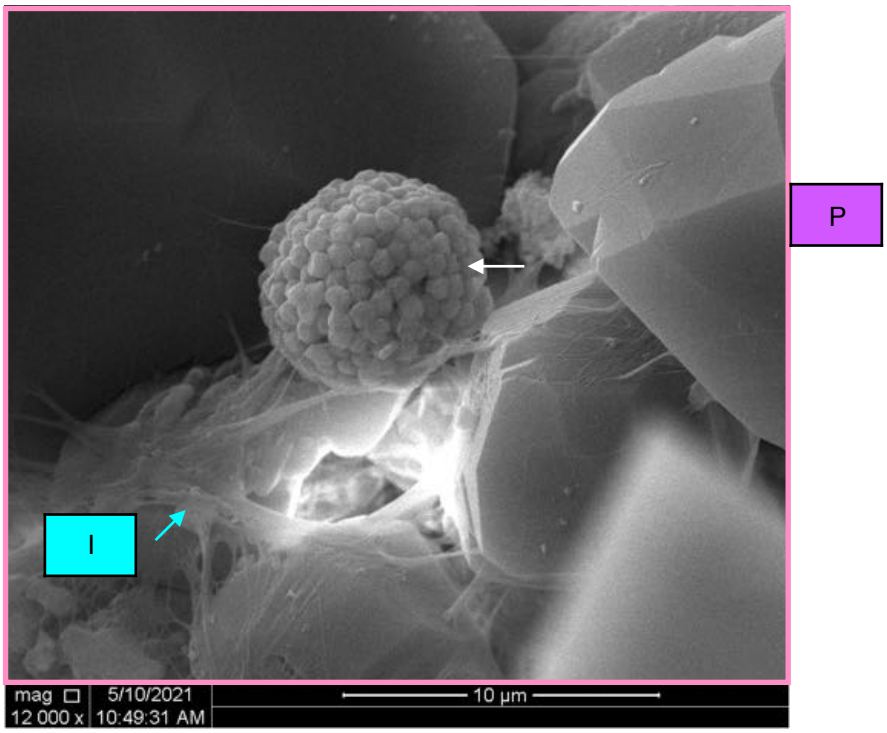
21048-01D 500X



21048-01E 2000X



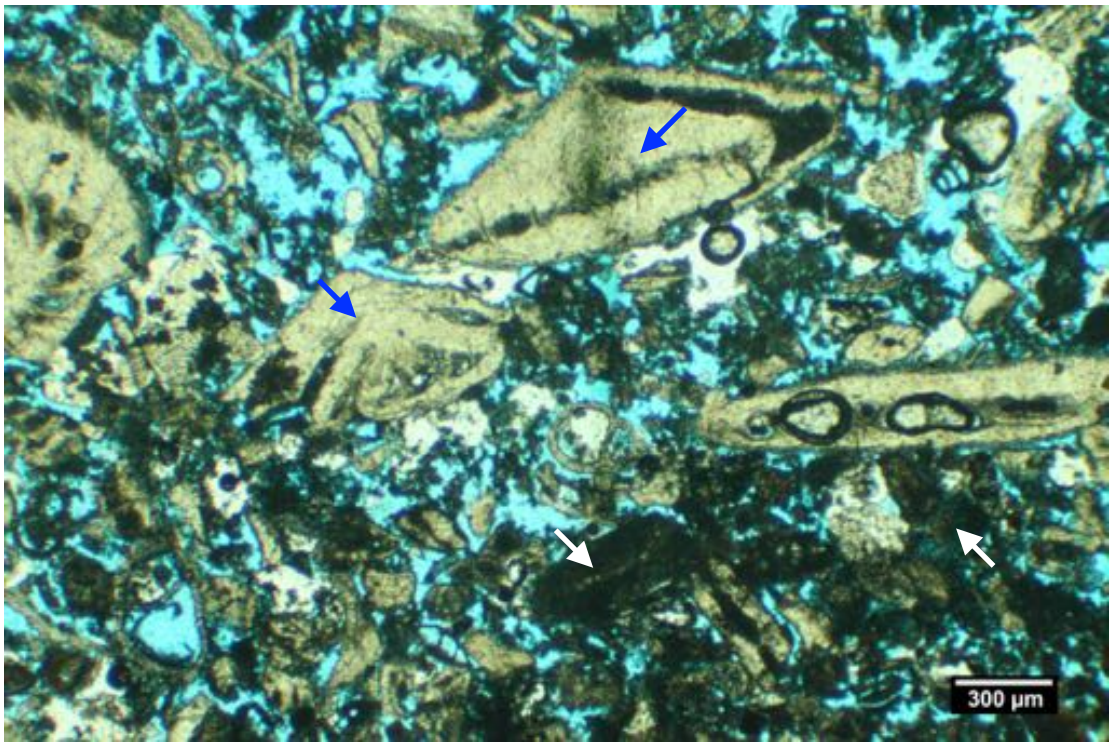
21048-01F 12000X



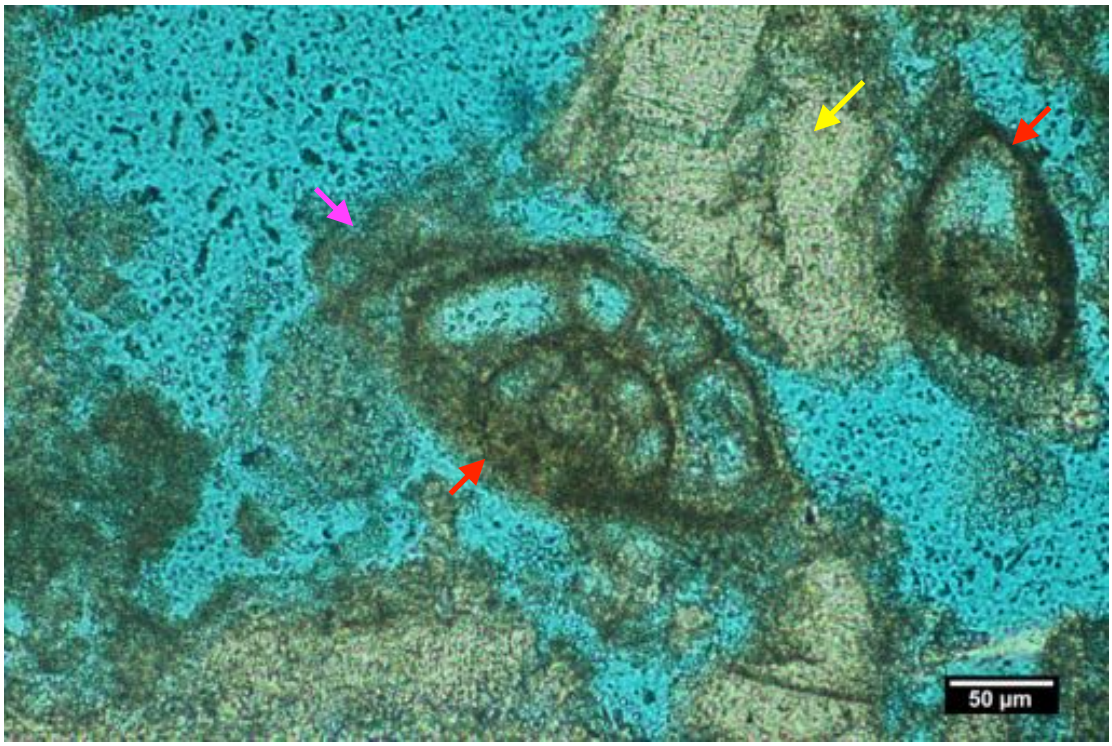
Petrographic Data Summary - L-63N; Core Depth: 755.5 - 755.7 ft.; MI#21048-02

Lithologic Classification	Porous, Foram - Algal Lime Packstone
Texture	Grain-supported, poorly sorted, fossiliferous, weakly consolidated, matrix cemented. Calcareous skeletal grains account for all of the rock framework material in this interval. Interparticle spaces are locally filled with clusters of microcrystalline lime mud +/- very finely crystalline calcite. Elongated foraminifera grains are weakly aligned parallel to bedding.
Detrital Grains / Allochems	1) Forams - Large forams (similar to Numulites &/or Discocyclina) + miliolid forams are predominant form types. 2) Calcareous algae plates are abundant and have directly contributed to the pore-filling matrix materials 3) Undifferentiated skeletal fragments
Matrix	Microcrystalline lime mud. Much of the lime mud has been derived from the disaggregation of calcareous algae plates & occurs as irregular clusters of microporous, microcrystalline calcite locally concentrated within the pore throats of the packstone. Concentrations of organic matter are distributed within the pore system as minor to accessory pore-filling constituents.
Cements	Traces of very finely crystalline calcite are locally present within selected matrix clusters (attributed to the beginning stages of aggrading neomorphism).
Pore Stystem	The helium porosity measured for this interval ranges between ~42.7-44.2%. The pore system is includes well inter-connected inter-particle macro-porosity. Modest amounts of intra-particle porosity are present in association with the miliolid foram tests. Significant inter crystalline microporosity occurs throughout the packstone fabric (within matrix clusters & skeletal constituents comprised of micro-crystalline calcite).

755.5 - 755.7 ft.; MI#21048-02

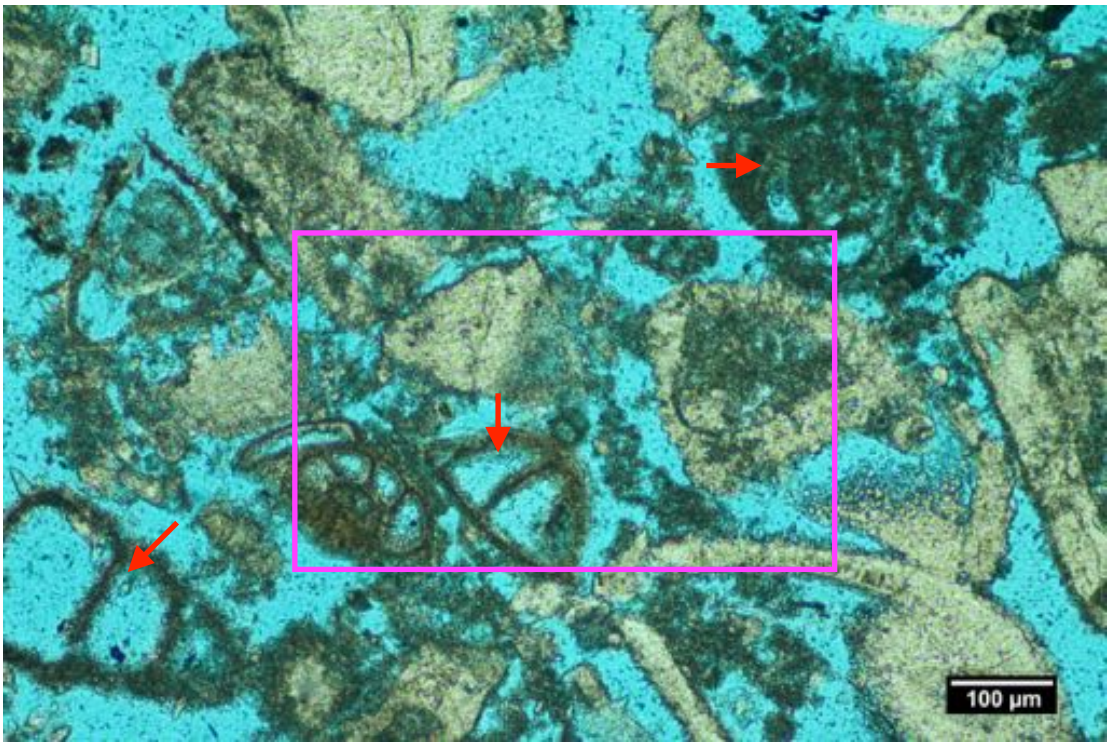


2A. Alignment of Numulites-like form tests (blue <) help to define the bedding orientation for this cross section. Note the abundance of porosity (blue) & algae plates (white <).

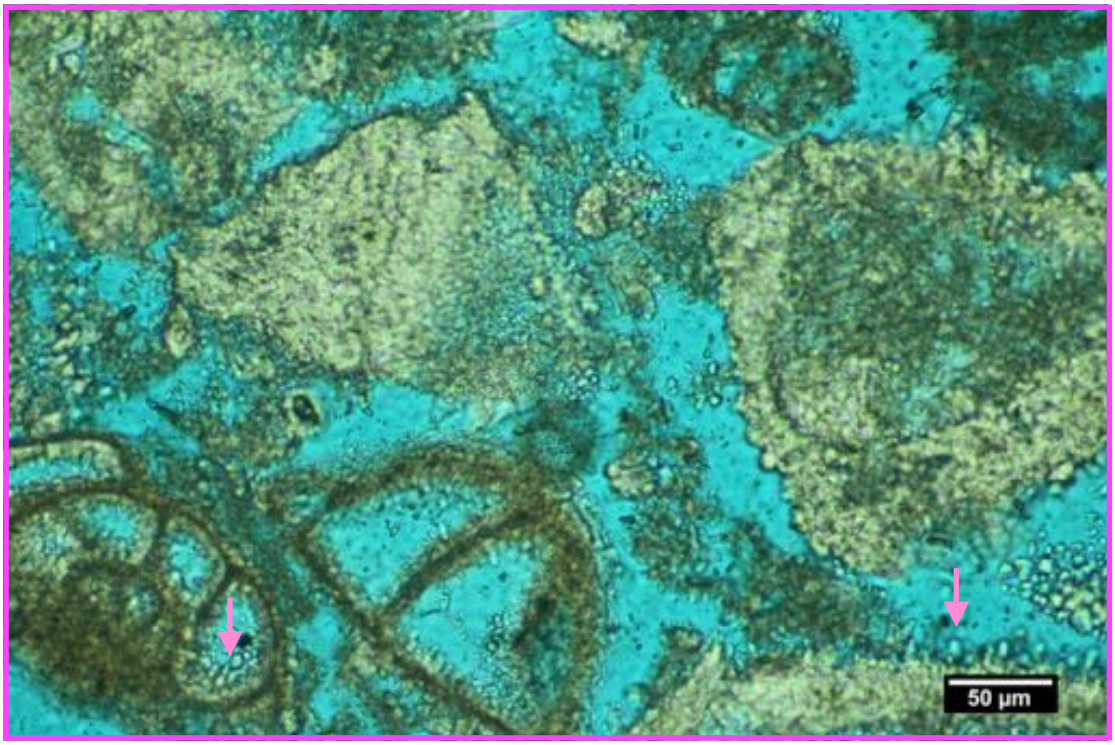


2B. Small miliolid foram tests (red <) + undifferentiated skeletal fragments (yellow <) are surrounded by macro pores + minor amounts of pore-filling micro-crystalline calcite (magenta <).

755.5 - 755.7 ft.; MI#21048-02



2C. Miliolid-like foram tests with common intra-particle porosity (red <). Note the well-interconnected macro pores throughout this view.



2D. Detailed view of the highlighted area from Figure 2C. Note the pore-lining crystals of very finely crystalline calcite spar (pink <) locally rimming the skeletal grains.

L-63 Continuous Corehole

Boring: M01L63N

755.5 - 755.7 ft

MI#21048-02 - SEM

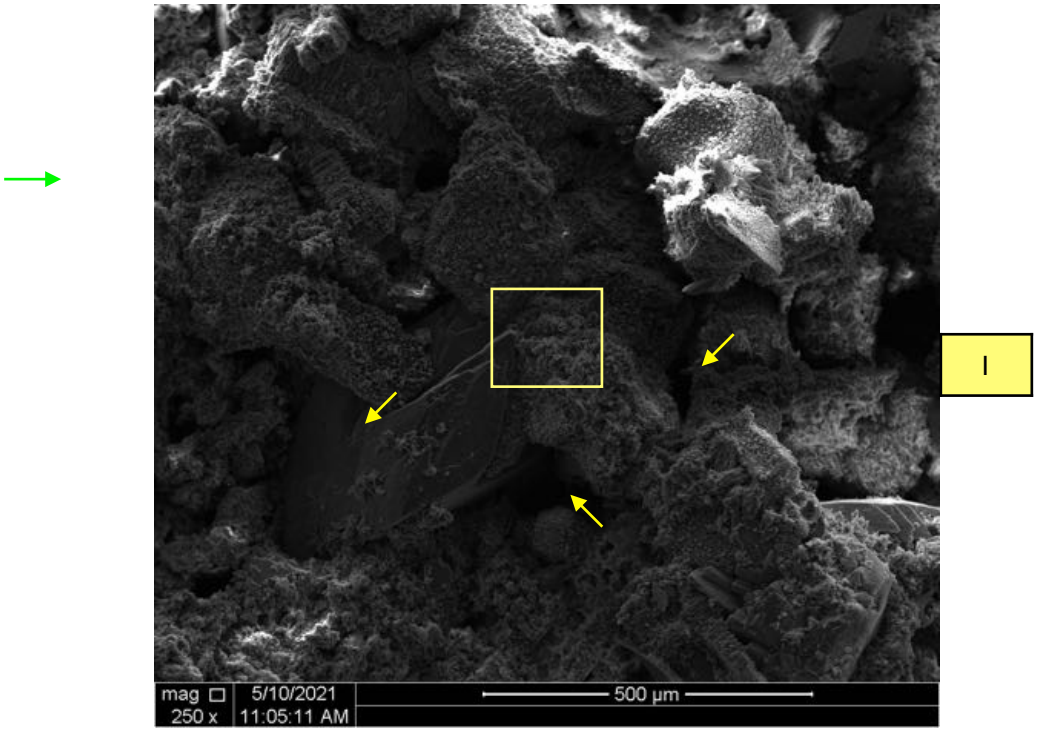
Summary: This core interval is comprised of porous, skeletal lime packstone. The limestone fabric is porous, grain-supported, poorly sorted, fossiliferous, weakly consolidated, and matrix cemented. Calcareous skeletal grains include foram tests + calcareous algae + undifferentiated skeletal fragments. Calcite accounts for >99% of the mineral mass based on the XRD analysis. Interparticle spaces are locally filled with clusters of microcrystalline lime mud +/- very finely crystalline calcite. Elongated foraminifera grains are weakly aligned parallel to bedding. SEM Figures 2A - 2C, and 2D - 2F provide progressively more detailed views of calcareous skeletal fragments encrusted with subhedral crystals of very finely crystalline calcite spar (C) cement admixed with micrite (M; ie. microcrystalline calcite or lime mud).

21048-02 Photo Index: (bookmarks)

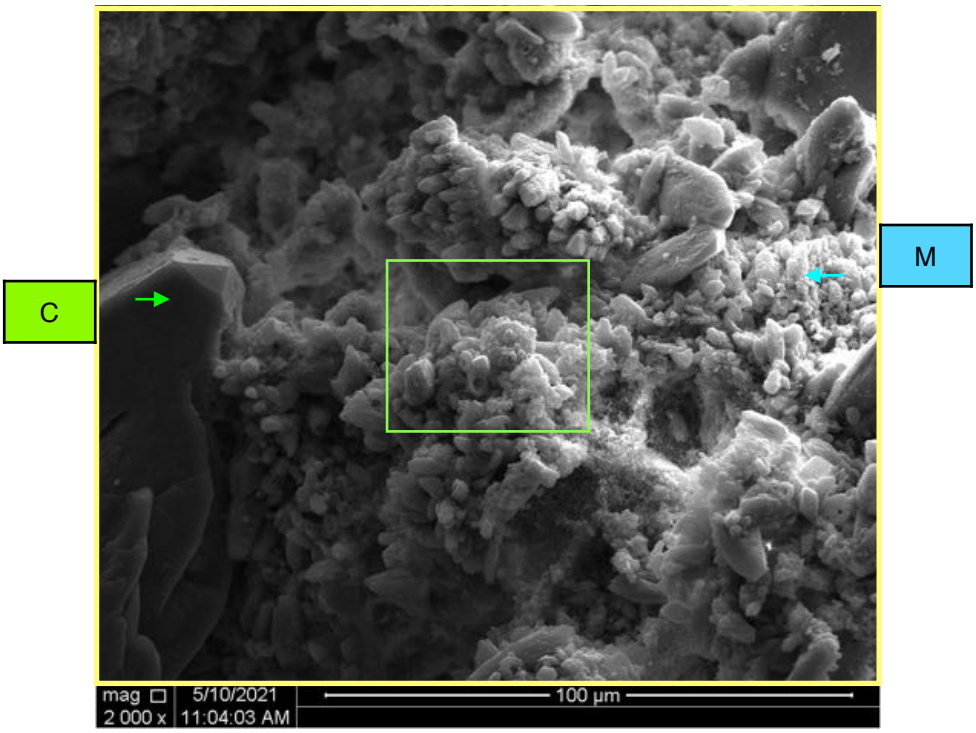
Sample ID	Magnification
21048-02A	250X
21048-02B	2000X
21048-02C	8000X
21048-02D	400X
21048-02E	1300X
21048-02F	5000X

Calcite spar cement	C
Microcrystalline calcite	M
Inter-particle porosity	I
Secondary moldic porosity	S

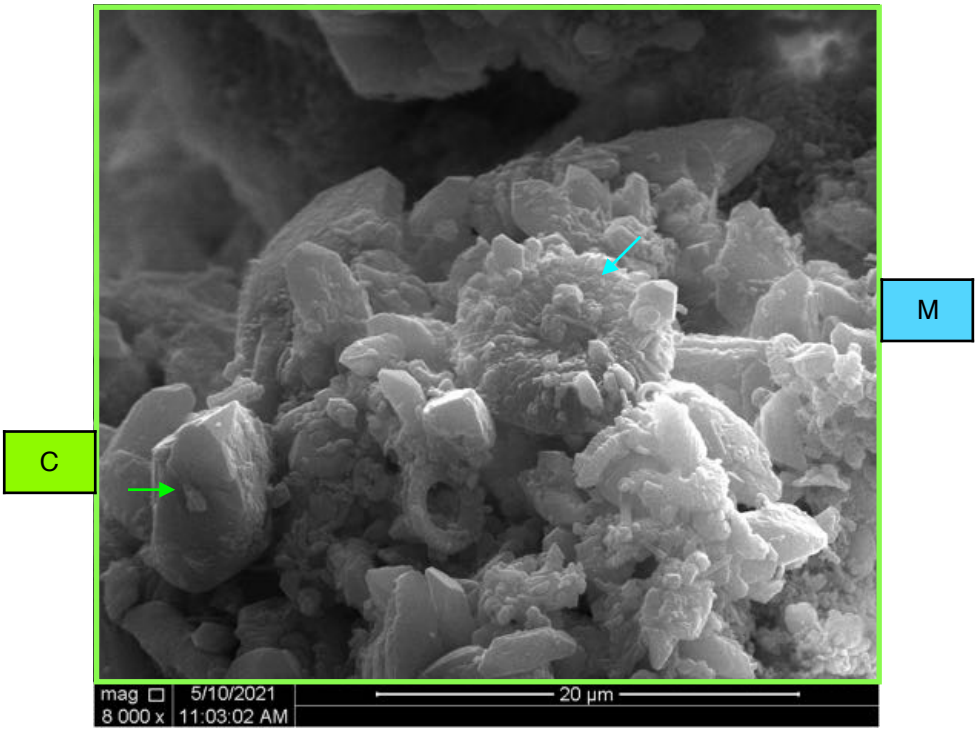
21048-02A 250X



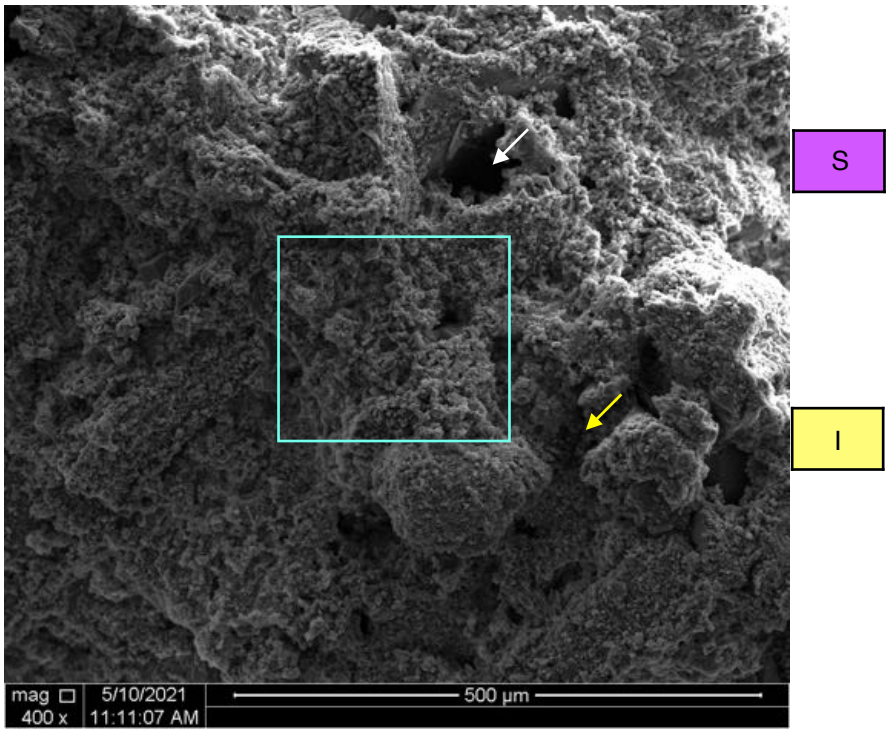
21048-02B 2000X



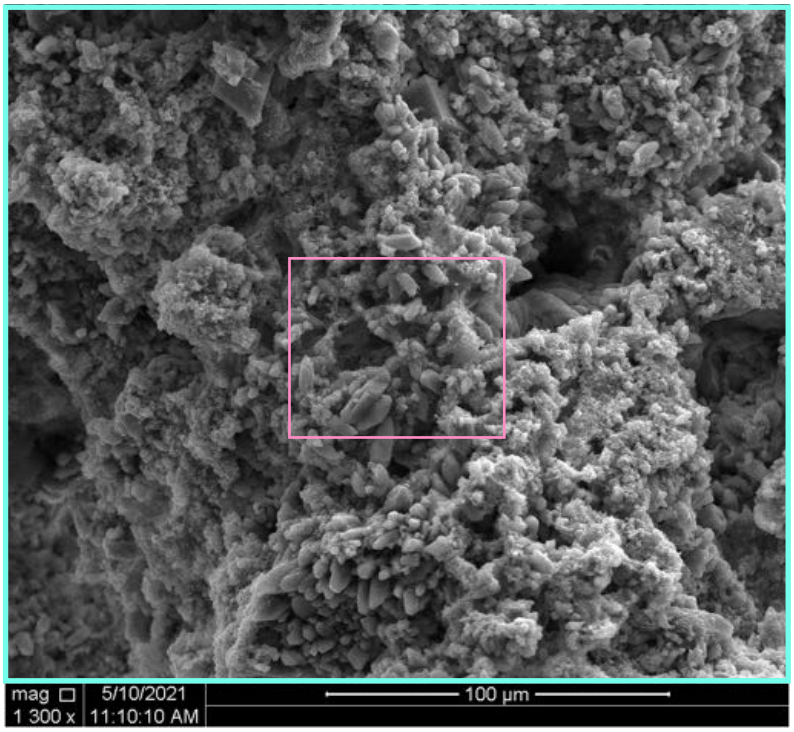
21048-02C 8000X



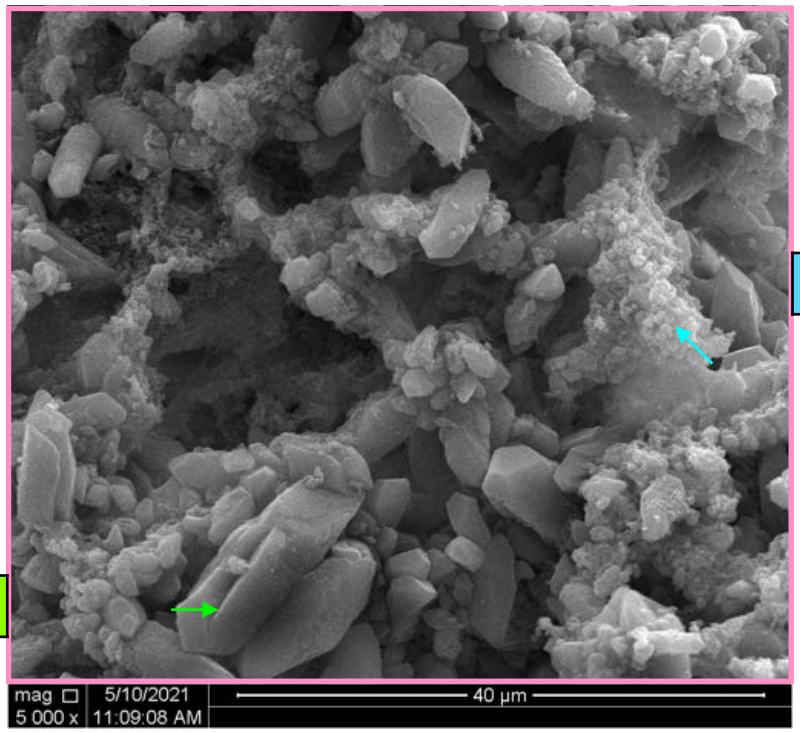
21048-02D 400X



21048-02E 1300X



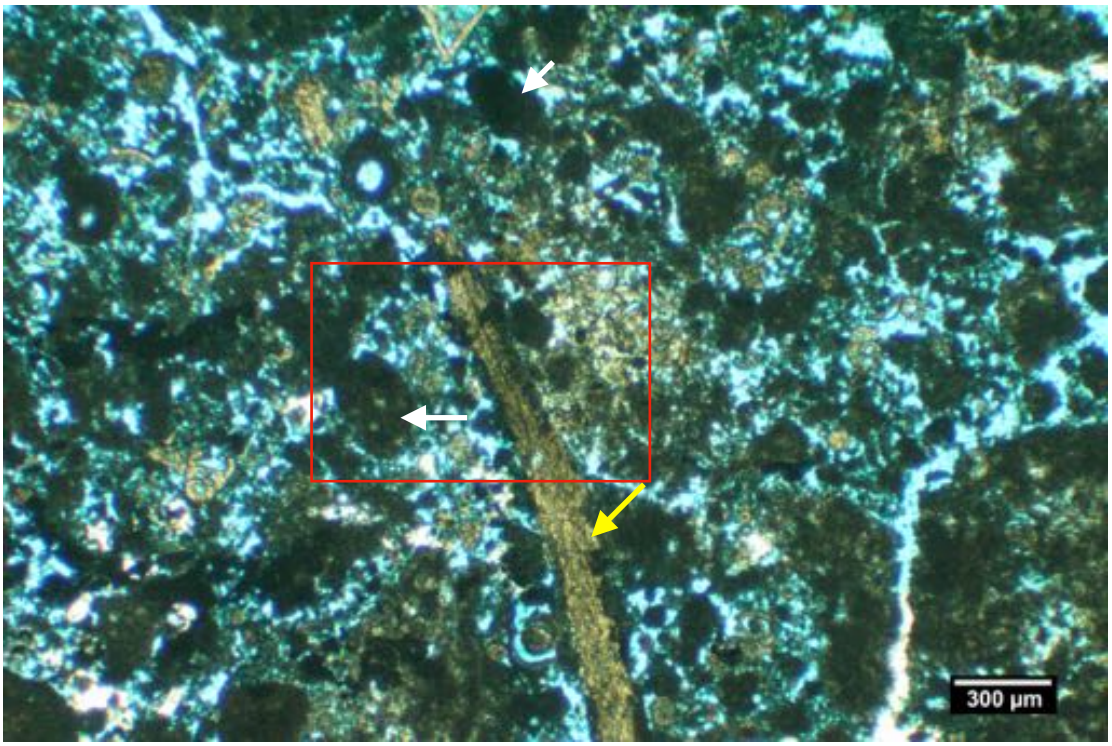
21048-02F 5000X



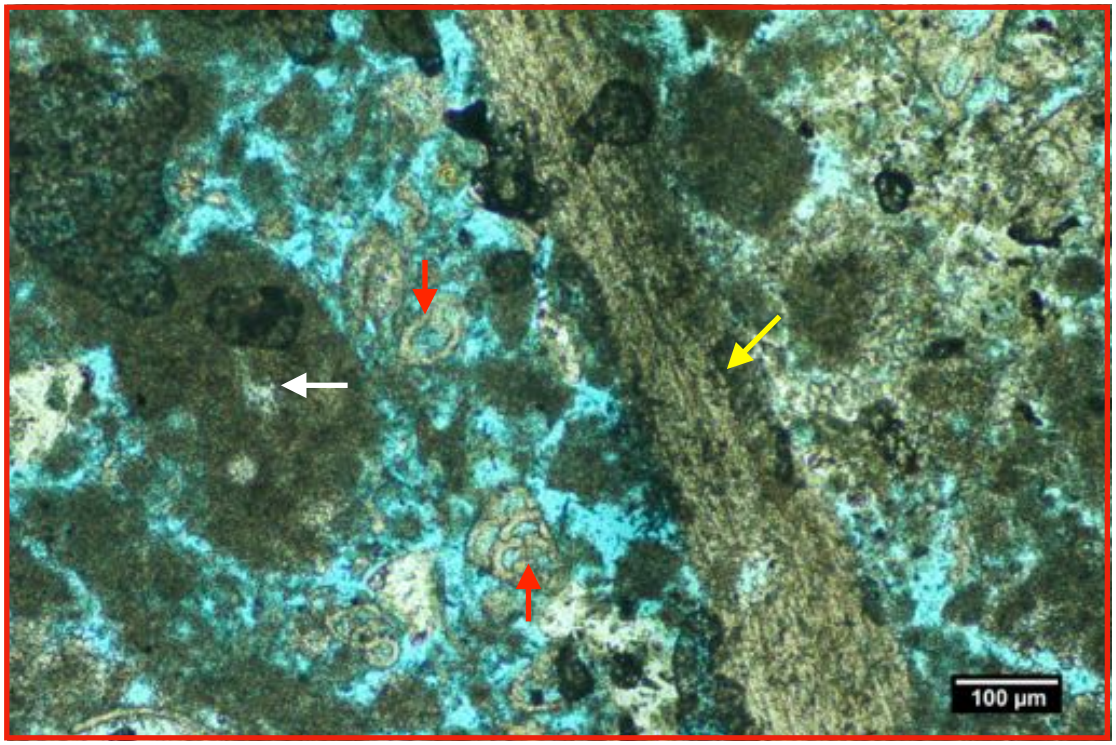
Petrographic Data Summary - L-63N; Core Depth: 950.4 - 950.5 ft.; MI#21048-03

Lithologic Classification	Porous, Algae - Foram Lime Packstone
Texture	Grain-supported, poorly sorted, fossiliferous, weakly consolidated, matrix cemented. Calcareous skeletal grains are poorly sorted and mildly packed, with well preserved and inter-connected macro-pores distributed throughout the fabric. The packstone exhibits weakly expressed sub-horizontal bedding with scattered shrinkage cracks expressed in the cross section. Interparticle spaces are locally filled with clusters of microcrystalline lime mud +/- very finely crystalline calcite.
Detrital Grains / Allochems	1) Calcareous algae plates are ubiquitous and have directly contributed to the pore-filling matrix materials 2) Undifferentiated skeletal fragments 3) Miliolid forams are predominant foram types.
Matrix	Microcrystalline lime mud. Much of the lime mud has been derived from the disaggregation of calcareous algae plates & occurs as irregular clusters of microporous, microcrystalline calcite locally concentrated within the pore throats of the packstone. Concentrations of organic matter are distributed within the pore system as minor to accessory pore-filling constituents.
Cements	Traces of very finely crystalline calcite are locally present within selected matrix clusters (attributed to the beginning stages of aggrading neomorphism).
Pore Stystem	The helium porosity measured for this interval is ~40.0%. Well inter-connected inter-particle macro-pores, intra-particle voids (associated with the miliolid foram tests) + inter crystalline microporosity accounts for the storage capacity for this aquifer interval. Micro-porosity is distributed throughout the limestone (within matrix clusters & skeletal constituents comprised of micro-crystalline calcite).

950.4 - 950.5 ft.; MI#21048-03

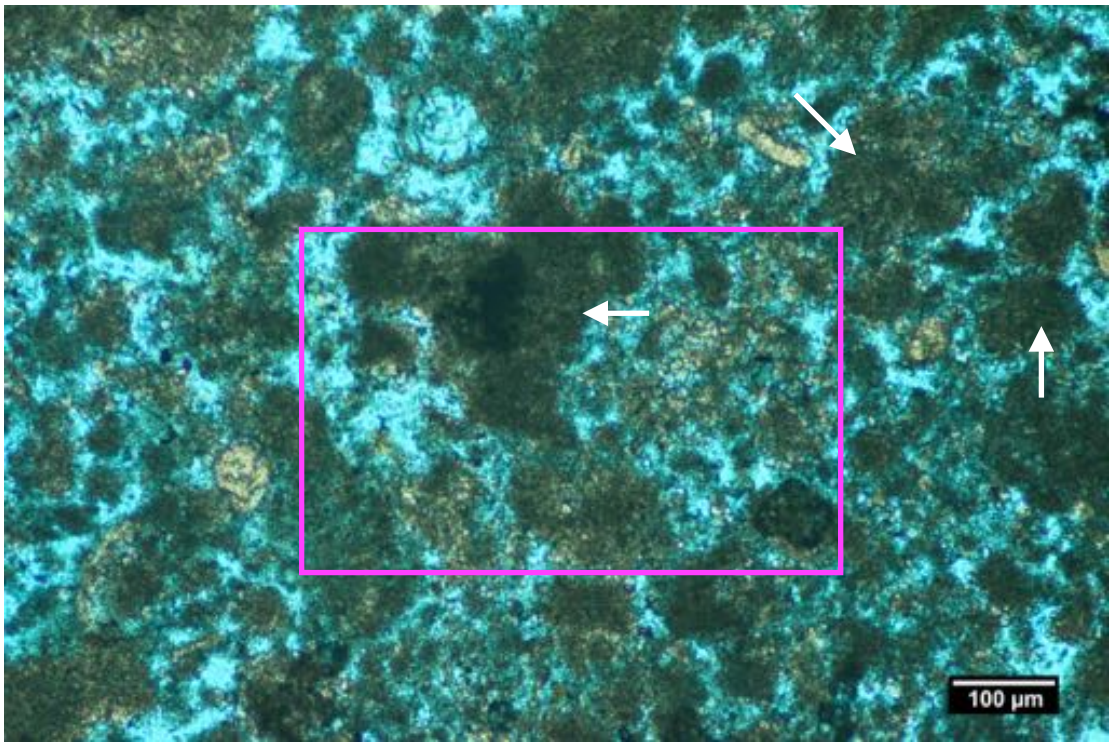


3A. Mollusk shell fragment (yellow <) + abundant calcareous algae grain debris (white <). The highlighted area is detailed in Figure 3B.

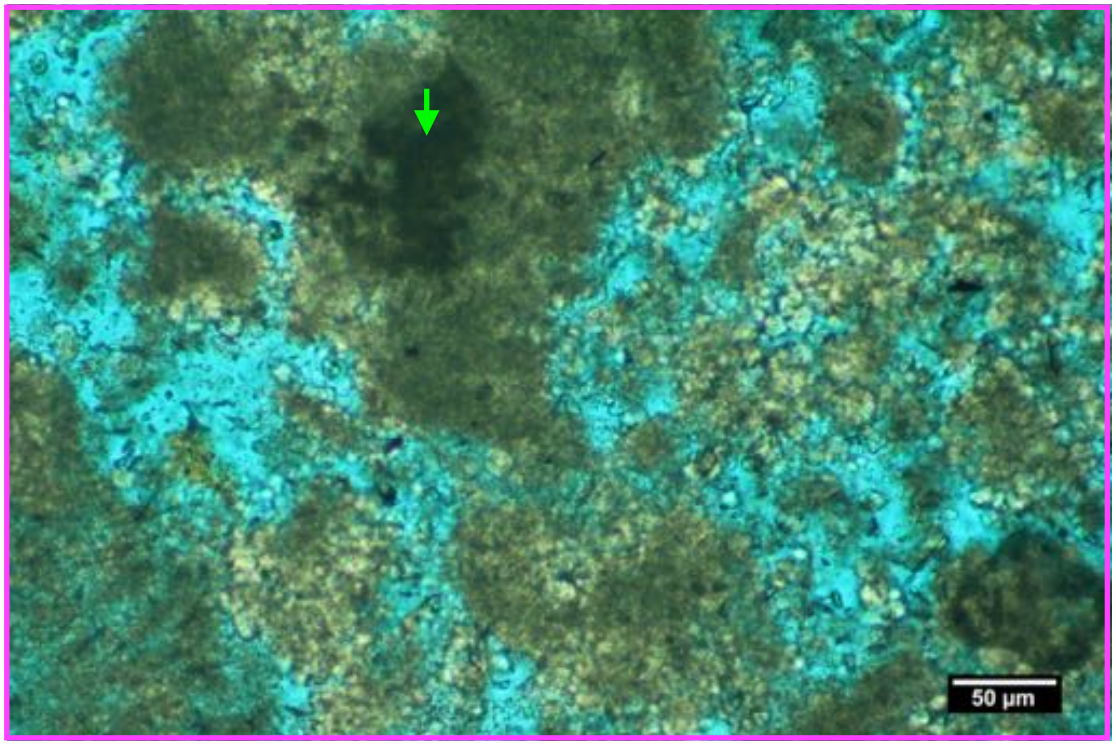


3B. Detail of packstone grain fabric from Figure 3A. Note the minute forum tests (red <) and the calcareous algae plates (white <).

950.4 - 950.5 ft.; MI#21048-03



3C. Void space (blue) accounts for ~40% of the bulk volume in this interval. The algae plates (white <) are comprised of microporous, microcrystalline calcite.



3D. Detailed view of the highlighted area from Figure 3C. Note the cluster of organic matter (black; green <) within the algae plate.

L-63 Continuous Corehole

Boring: M01L63N

950.4 - 950.5 ft

MI#21048-03 - SEM

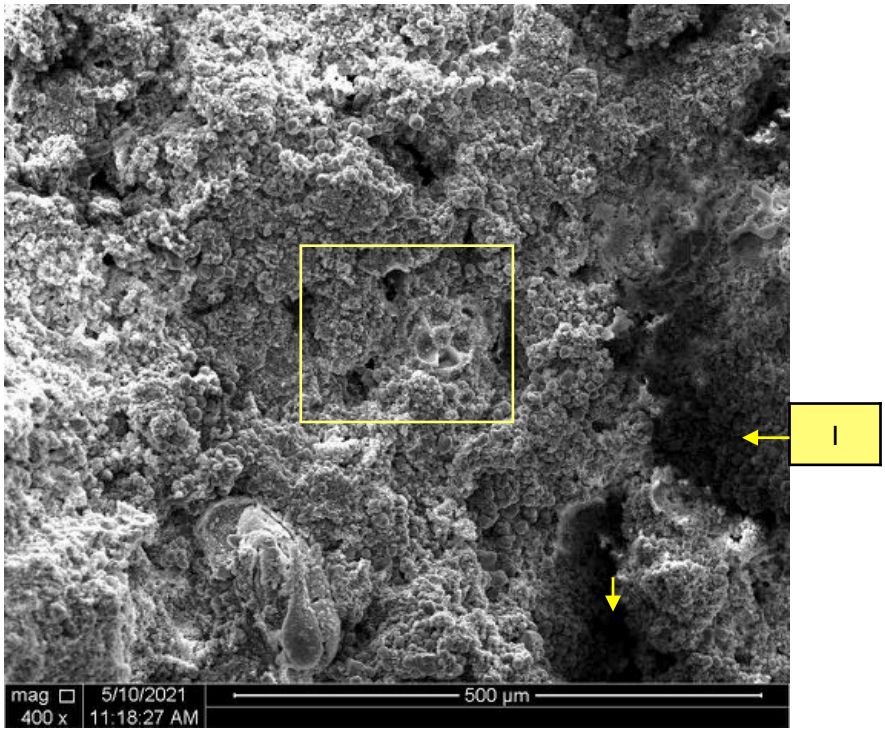
Summary: This core interval is comprised of grain--supported, poorly sorted, fossiliferous, weakly consolidated, matrix cemented, algae-foram lime packstone. Calcareous skeletal grains are poorly sorted and mildly packed, commonly exhibiting rims of very finely crystalline calcite spar cement admixed with clusters of pore-filling lime mud matrix material. The macro pores are well preserved and inter-connected. Interparticle spaces are locally filled with clusters of microcrystalline lime mud +/- very finely crystalline calcite. The lime mud matrix materials are locally replaced with very finely crystalline calcite spar cement owing to aggrading neomorphism.

21048-03 Photo Index: (bookmarks)

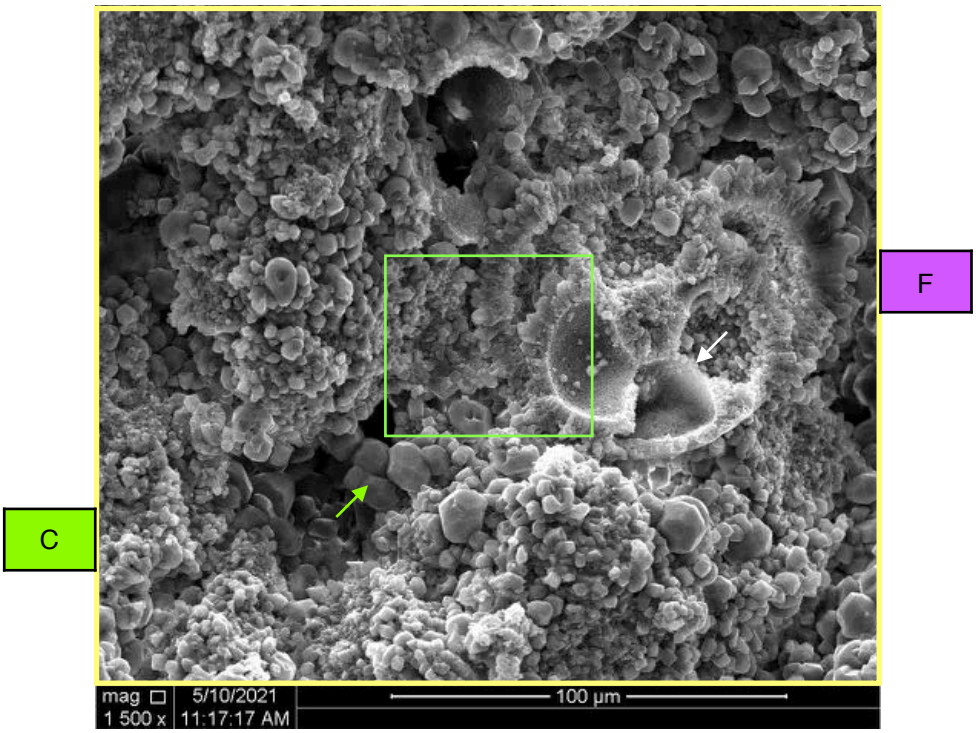
Sample ID	Magnification
21048-03A	400X
21048-03B	1500X
21048-03C	6000X
21048-03D	1000X
21048-03E	4000X
21048-03F	13000X

Calcite spar cement	C
Microcrystalline calcite	M
Inter-particle porosity	I
Foram test	F

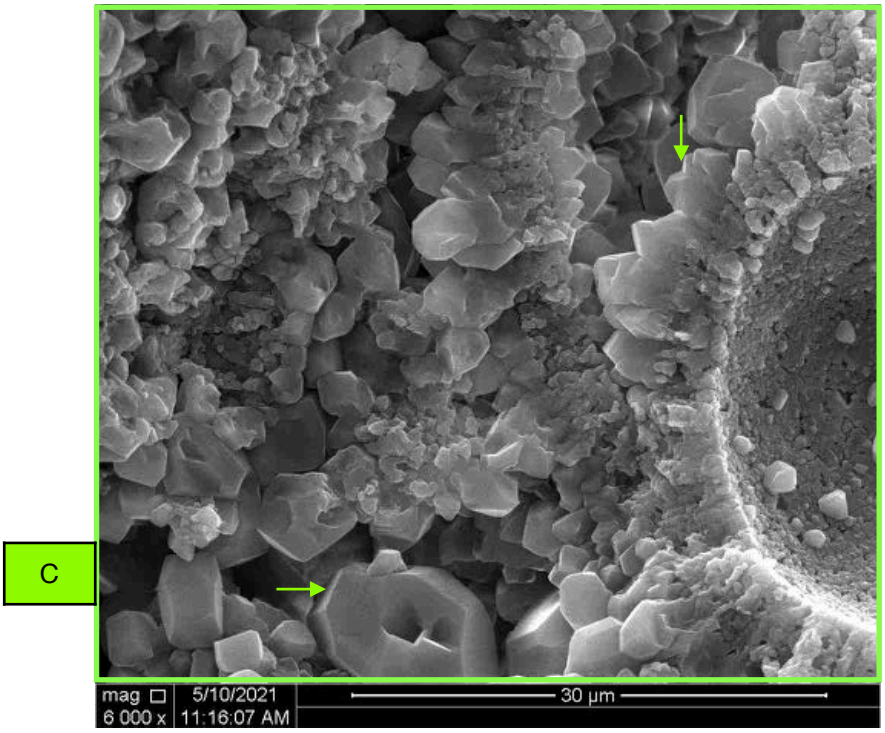
21048-03A 400X



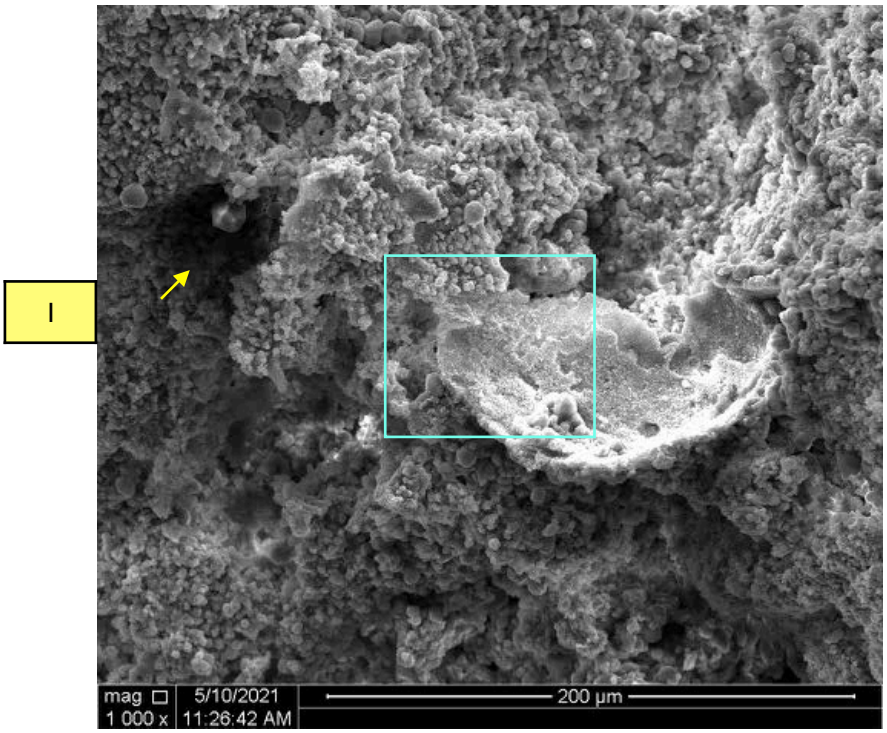
21048-03B 1500X



21048-03C 6000X

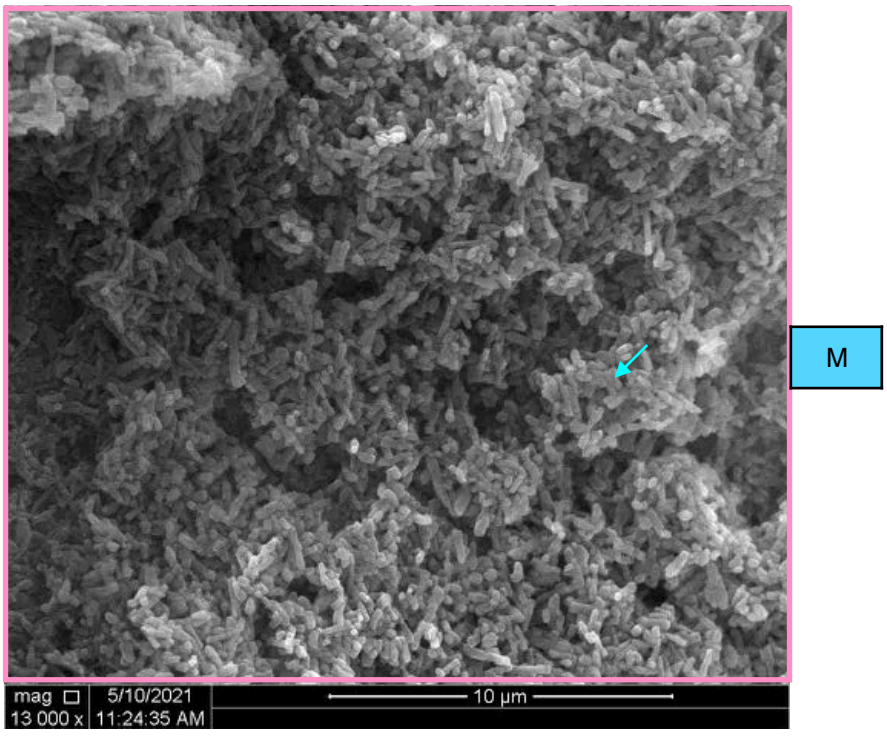


21048-03D 1000X



21048-03E 4000X

21048-03F 13000X



MINERALOGY-INC
WHERE SCIENCE GETS DOWN TO EARTH

L-63N Continuous Corehole

Well: M01L63N

Core Evaluation

Requested by:
Rick Cowles
Stantec

Mineralogy, Inc. Number 21117

Date:
August 23, 2021

Submitted by:

Timothy B. Murphy

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Sample Retention: Samples will be stored for a period of 30 days and thereafter discarded. If additional sample storage time and/or return shipping is required, appropriate charges will be billed to the client.

Introduction

Five core intervals have been submitted for evaluation from the M01L63N project located in South Florida. The cores are representative of selected (~1' thick) intervals from the Lake Okeechobee aquifer system and span an overall depth range from ~ 1154 ft to 1604 ft below ground surface. Sediments from each of these intervals have been assessed for mineralogy and chemical composition, fabric properties, and pore system characteristics. Rock properties testing has included x-ray diffraction mineralogical analysis (XRD), x-ray fluorescence chemical analysis (XRF), porosity and permeability analysis, cation exchange capacity analysis, and acid insoluble residue analysis, and these results are summarized in Appendix I. Petrographic and SEM analysis has been performed to evaluate the mineralogy, fabric & pore system properties for each of the core intervals. Representative images & summaries of the petrographic and SEM evaluations are provided in Appendix II.

Sample ID	Mineralogy, Inc. ID	Testing Protocol
1406.5 - 1407.5 ft.	21117-01	XRD, XRF, CEC, SEM, TSP, Acid Insoluble, Porosity, Hydraulic Conductivity
1450 - 1451 ft.	21117-02	
1505 - 1506 ft.	21117-03	
1603 - 1604 ft.	21117-04	
1154 - 1155 ft.	21117-05	

XRD = X-ray diffraction • XRF = X-ray fluorescence • CEC = Cation Exchange Capacity • SEM = Scanning Electron Microscopy • TSP = Thin Section Petrography

Summary

The results of the core analysis investigation performed for selected intervals from the M01L63N project are noted as follows:

- The results of the x-ray diffraction mineralogical analysis are summarized in Table I. With *increasing burial depth*, the aquifer intervals transition from pure limestone (core 5; 21117-05; 1154-55 ft), to dolomitic limestone (core 1; 21117-01; 1406.5-07.5 ft), to dolomite (core 2, 3 & 4; 1450 - 1604 ft). Classified as a dolomitic limestone, core 1 @ 1407 ft is comprised of calcite (91%) + dolomite (9%). Core 2 (21117-02; 1450-51 ft), core 3 (21117-03; 1505-06 ft), and core 4 (21117-04; 1603-04 ft) are all dolomite-rich intervals (97-99.7%) that contain localized concentrations of calcite (0-3%) and traces of quartz silt (<0.3%).

- Results of the x-ray fluorescence (XRF) chemical analysis are summarized in Table II. The chemical analysis results (generally reported as oxides) compliment the results of the XRD analysis, with rational fluctuations in the relative proportions of CaO / MgO for limestone and dolomite aquifer specimens. The limestone sample from core depth 1154-55 ft exhibits minor amounts of SiO2 (~2.02%), Al2O3 (~1.3%), and K2O (~0.37%) that may be attributed to localized lenses of silt & clay-rich sediment. Minor amounts of iron (Fe2O3 ~0.098-0.291%) and sulfur (~0.23-0.41%) within the sample suite could be indicative of accessory amounts of pyrite.

- Results of the porosity and permeability analysis are summarized in Table III. Horizontal and vertical core plugs have been evaluated for variations in gas permeability, porosity, and grain density. Klinkenberg permeability estimates are also calculated to approximate hydraulic conductivity. The dolomite interval from 1603-1604 ft (21117-04) exhibits the lowest helium porosity (2.18-3.39%) and the smallest Klinkenberg permeability values (0.0012-0.0020 md) for the sample suite and is likely to function as an effective vertical confining unit within the aquifer system. Macro pores within this sample are scattered & isolated within a densely crystallized dolomite groundmass. The limestone core sample from 1154 ft is porous (helium porosity = 38.0 - 38.2%), with a modest Klinkenberg permeability of ~2.18 - 3.39 md. Transmissivity within the limestone is limited due to the relative abundance of intercrystalline microporosity within the overall pore system. The dolomitic limestone (21117-01; 1406.5-07.5 ft) and dolomite aquifer intervals (21117-02; 1450 ft, and 21117-03; 1504 ft) are the most porous & permeable intervals reflected in the sample suite, with void volumes of 16.4-32.7%, and Klinkenberg permeability values of ~5.43-221 md. The core analysis findings indicate a strong influence of sedimentary bedding & fabric properties, especially within the porous dolomites (21117-02; 1450 ft, and 21117-03; 1504 ft). These cores exhibit a ratio of horizontal to vertical (Klinkenberg) permeability that ranges from ~5:1 to 25:1. Grain density values for the calcite-rich limestone core intervals

(1154 ft & 1406 ft) range from 2.66-2.70 g/cc. The dolomite-rich core intervals exhibit grain densities of ~ 2.72-2.85 g/cc.

- Results of the cation exchange & leachate analysis are summarized in Table IV. The analysis of CEC leachate solutions for the limestone core samples (21117-05; 1154-55 ft, and 21117-01; 1406.5-07.5 ft) indicates an overwhelming predominance of exchangeable calcium ions (Ca; ~105-133 meq/100g), relative to leachate concentrations for magnesium (Mg; ~ 4.61 - 6.67 meq/100g), sodium (Na; < 0.9 meq/100g), and potassium (K; < 0.4 meq/100g). In contrast, the three dolomite-rich core intervals (21117-02; 1450-51 ft, 21117-03; 1505-06 ft, and 21117-04 1603-04 ft) exhibit nearly sub-equal proportions of exchangeable calcium (Ca; ~67.7-72.1 meq/100g) and magnesium (Mg; ~ 50.0—63.5 meq/100g) ions. As with the limestone cores, the dolomite intervals exhibit negligible proportions of exchangeable sodium (Na; < 0.7 meq/100g), and potassium (K; < 0.2 meq/100g) ions.

- Results of the acid insoluble residue analysis are summarized in Table V. The acid residue fractions for the limestone core sample from 1154-55 ft (21117-05) indicates a small acid residue fraction (3.50%). The acid residue fraction is consistent with the presence of quartz silt & clay-rich sediment lenses, as implied by the XRF findings for this same aquifer interval (see Table II). The other limestone core interval (1406.5-07.5 ft; 21117-01), and the three dolomite-rich cores (1450-1604 ft; 21117-02, -03, and -04) exhibit small acid residue fractions (0.80-1.05%) that appear to be enriched with respect to organic matter + traces of clay & quartz silt.

- The results of the thin section petrography and SEM analysis are presented in Appendix II. The microscopic analysis for each aquifer interval includes a petrographic data summary, along with representative thin section & SEM photomicrographs. The petrographic summaries provide lithologic classifications based on the carbonate classification nomenclature proposed by Dunham (1962). The petrographic & SEM summaries additionally provide descriptive data related to the carbonate grain composition, matrix and cement mineralogy & texture, and pore system properties. The SEM and petrographic analysis results are collated for each of the aquifer intervals.

- The two calcareous limestone intervals included in the sample suite (21117-05; 1154-55 ft, and 21117-01; 1406.5-07.5 ft) exhibit depositional fabrics that alternate between grain-supported packstone & mud-supported lime wackestone layers. Foraminifera tests and calcareous algae plates are the principal carbonate grain types within the limestone cores. These intervals are microcrystalline, microporous & commonly exhibit loosely crystallized calcite crystals that support scattered foram tests and algae plates. The foram tests commonly incorporate intra-particle voids that are surrounded by thin walls of microcrystalline calcite. Selected foram tests are leached and corroded to yield skel-moldic macropores. The limestone interval between 1406-07.5 ft (21117-01) is locally altered and partially replaced with dolomite. Both limestone core intervals include mixtures of macroporosity (skel-

moldic + intercrystalline macro pores) & intercrystalline microporosity. Both limestone core intervals are permeable & exhibit relatively modest diminishment of transmissivity for vertical versus horizontal flow orientations.

- The three dolomite-rich core intervals (21117-02; 1450-51 ft, 21117-03; 1505-06 ft, and 21117-04 1603-04 ft), are commonly fine to medium-crystalline, subhedral dolomites that contain scattered skel-moldic voids attributed to precursor foram tests. The relative abundance of skel-moldic pores within the dolomites from 1450-1506 ft (21117-02 and 21117-03) are suggestive of grain-rich, precursor skeletal packstone lithotypes. The dolomite interval from 1603-04 ft (21117-04) exhibits a depositional fabric that is relatively non-porous, densely crystallized and microcrystalline. Scattered concentrations of relatively isolated skel-moldic porosity are preserved in this dolomite interval.

Conclusions

The five selected intervals of the Okeechobee aquifer system from the M01L63N project well L-63N) include skeletal-rich, porous & permeable, calcite-rich lime packstone / wackestone intervals with storage capacities that locally range between 32-38%. The porous lime packstone layers commonly exhibit well-interconnected macropores (moldic + intercrystalline voids), while the lime wackestone layers tend to be dominated by intercrystalline micro & macroporosity, together with scattered skel-moldic pores. The dolomite core intervals from 1450-1506 ft (21117-02 and 21117-03) represent the dolomitized equivalents of (precursor) foram - algae lime packstone intervals. These cores are porous, permeable, and generally well-crystallized, with stable & well-adhered dolomite crystals lining the pore walls. These aquifer intervals should serve as ideal storage & recovery intervals within the aquifer system.

The dolomite interval from 1603-04 ft (21117-04) exhibits the smallest pore volume measured for this sample suite (~2.2-3.4%), as well as the most limited permeability values (<0.011 md). This interval is an effective confining unit & consists of densely crystallized dolomite containing scattered isolated macropores.

Appendix I

X-ray Diffraction, X-ray Fluorescence, Porosity & Permeability, Cation Exchange Capacity, & Acid Insoluble Residue

X-ray Diffraction

Table I.1

Client:	Stantec	MI#:	21117
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	X-ray Diffraction

Mineral Constituent	Sample ID	1406.5 - 1407.5 ft.	1450 - 1451 ft.	1505 - 1506 ft.	1603 - 1604 ft.	1154 - 1155 ft.
	MI#	21117-01	21117-02	21117-03	21117-04	21117-05
	Chemical Formula	Relative Abundance (%)				
Quartz	SiO_2	<0.3	<0.3	<0.3	<0.3	
Calcite	$CaCO_3$	91	3		0.5	100
Dolomite	$(Ca,Mg)(CO_3)_2$	9	97	99.7	99.5	
Total		**100**	**100**	**100**	**100**	**100**

X-ray Fluorescence

Table II.1

Client:	Stantec	MI#:	21117
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	X-ray Fluorescence

Sample ID	1406.5 - 1407.5 ft.	1450 - 1451 ft.	1505 - 1506 ft.	1603 - 1604 ft.	1154 - 1155 ft.
MI#	21117-01	21117-02	21117-03	21117-04	21117-05
Elemental Phase	Results (Mass %)				
Na2O	0.0753	0.1469	0.1426	0.1866	ND
MgO	3.137	27.8708	30.2794	29.6179	1.2735
Al2O3	0.0708	0.1359	0.1198	0.2166	1.0591
SiO2	0.3558	0.5282	0.4209	0.5145	2.0198
P2O5	0.08	0.079	0.074	0.0725	0.077
S	0.2485	0.2694	0.2321	0.2995	0.4052
Cl	0.0682	0.0558	0.0414	0.0592	0.0103
K2O	0.0403	0.0596	0.0556	0.0762	0.369
CaO	95.189	70.1418	68.0159	68.1189	93.5628
TiO2	ND	ND	ND	ND	0.0416
Fe2O3	0.134	0.1537	0.0978	0.2117	0.2914
Sr	0.123	0.0713	0.0668	0.0695	0.1792
Mo	ND	ND	ND	0.011	ND
BaO	0.0838	0.0713	0.094	0.0793	0.072

ND = Not Detected

Porosity & Permeability

Table III.1

Client:	Stantec	MI#:	21117
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	Core Analysis

Sample Number	Depth (ft.)	Air Permeability (mD)	Klinkenberg Permeability (mD)	Porosity (%)	Grain Density (g/cc)
1H	1,406.90	77.0	70.0	32.60	2.66
1V	1,406.70	36.0	31.6	32.71	2.70
2H	1,450.30	151	137	23.95	2.77
2V	1,450.10	7.48	5.43	16.44	2.77
3H	1,505.40	234	221	31.02	2.72
3V	1,505.10	53.7	45.8	29.85	2.85
4H	1,604.10	0.0107	0.0020	3.39	2.78
4V	1,604.40	0.0075	0.0012	2.18	2.74
5H	1,154.10	4.44	3.23	38.23	2.70
5V	1,154.90	2.77	1.77	38.03	2.70

Note: Data provided by SCAL, Inc.

Cation Exchange Capacity

Table IV.1

Client:	Stantec	MI#:	21117
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	CEC

1406.5 - 1407.5 ft.; 21117-01

Test	Result	Notes	PQL#
Exchangeable Calcium	133	meq/100g	0.010
Exchangeable Magnesium	6.67	meq/100g	0.010
Exchangeable Potassium	0.059	meq/100g	0.010
Exchangeable Sodium	0.852	meq/100g	0.010

1450 - 1451 ft.; 21117-02

Test	Result	Notes	PQL#
Exchangeable Calcium	69.0	meq/100g	0.010
Exchangeable Magnesium	50.0	meq/100g	0.010
Exchangeable Potassium	0.073	meq/100g	0.010
Exchangeable Sodium	0.504	meq/100g	0.010

1505 - 1506 ft.; 21117-03

Test	Result	Notes	PQL#
Exchangeable Calcium	67.7	meq/100g	0.010
Exchangeable Magnesium	63.0	meq/100g	0.010
Exchangeable Potassium	0.058	meq/100g	0.010
Exchangeable Sodium	0.483	meq/100g	0.010

Method Reference: 40 CFR 136, 261, Method for Chemical Analysis of Water and Waste EPA-600/4-79-020 March 1983

CEC Method Reference: Method of Soil Analysis, Chemical and Microbiological Properties, 2nd Ed.; American Society of Agronomy, Inc.

Soil Science Society of America, Inc. page 160.

**CEC analysis provided by Accurate Laboratories & Training Center; Stillwater, OK*

***PQL= Practical Quantitation Limit*

Cation Exchange Capacity

Table IV.2

Client:	Stantec	MI#:	21117
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	CEC

1603 - 1604 ft.; 21117-04

Test	Result	Notes	PQL#
Exchangeable Calcium	72.1	meq/100g	0.010
Exchangeable Magnesium	63.5	meq/100g	0.010
Exchangeable Potassium	0.121	meq/100g	0.010
Exchangeable Sodium	0.639	meq/100g	0.010

1154 - 1155 ft.; 21117-05

Test	Result	Notes	PQL#
Exchangeable Calcium	105	meq/100g	0.010
Exchangeable Magnesium	4.61	meq/100g	0.010
Exchangeable Potassium	0.320	meq/100g	0.010
Exchangeable Sodium	0.267	meq/100g	0.010

Method Reference: 40 CFR 136, 261, Method for Chemical Analysis of Water and Waste EPA-600/4-79-020 March 1983
CEC Method Reference: Method of Soil Analysis, Chemical and Microbiological Properties, 2nd Ed.; American Society of Agronomy, Inc.
Soil Science Society of America, Inc. page 160.
**CEC analysis provided by Accurate Laboratories & Training Center; Stillwater, OK*
***PQL= Practical Quantitation Limit*

Acid Insoluble Residue

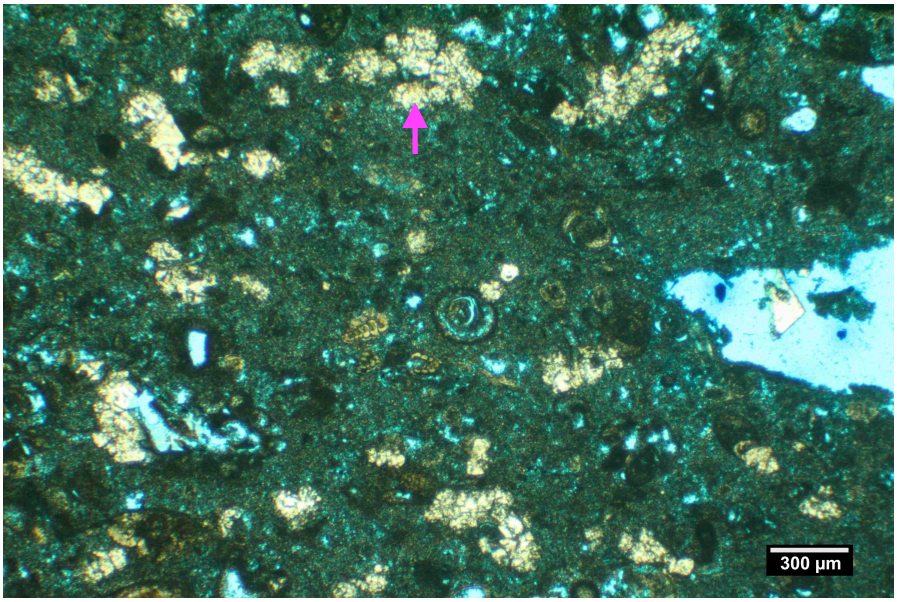
Table V

Client:	Stantec	MI#:	21117
Project:	L-63N Continuous Corehole	P.O.#:	N/A
Location:	Boring: M01L63N	Method:	Acid Insoluble Res.

Depth	Lab ID	Acid Insoluble Residue (%)
1406.5 - 1407.5 ft.	21117-01	0.89
1450 - 1451 ft.	21117-02	0.80
1505 - 1506 ft.	21117-03	0.94
1603 - 1604 ft.	21117-04	1.05
1154 - 1155 ft.	21117-05	3.50

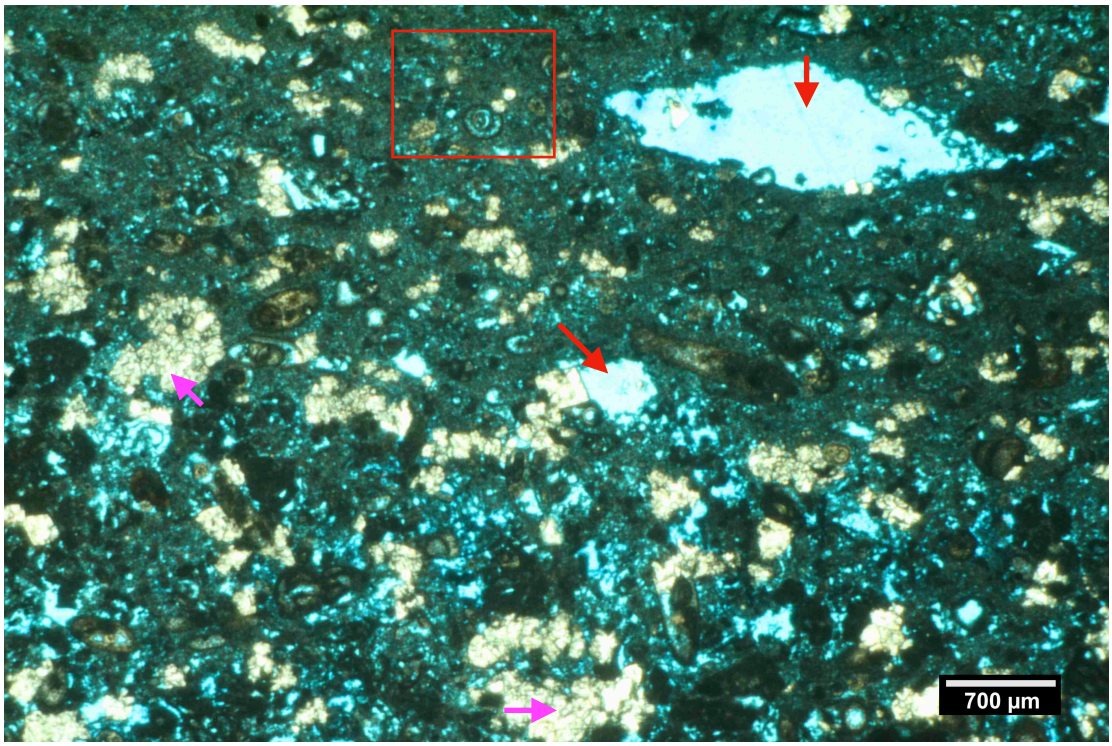
Appendix II
SEM & Petrographic Findings

Petrographic Data Summary - L-63N; Core Depth: 1406.5 - 1407.5 ft.; MI#21117-01

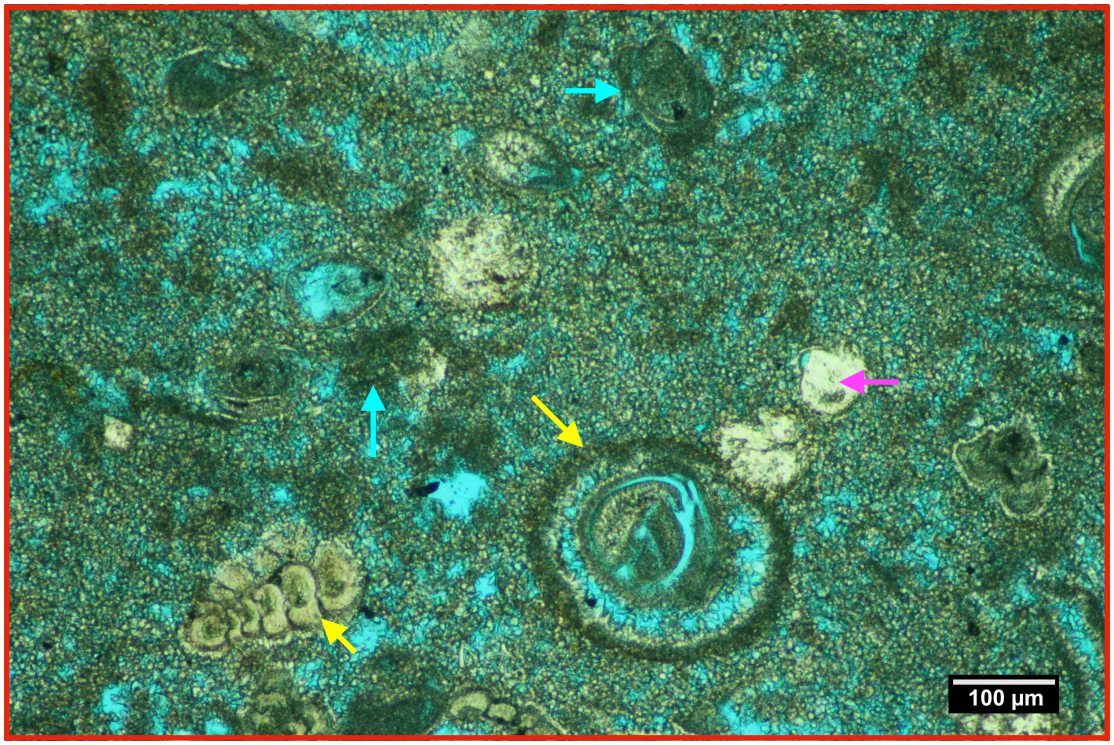
Lithologic Classification: Dolomitic, Foram - Algae Lime Packstone / Wackestone	
Texture	The fabric is variably grain or matrix-supported, mildly packed, porous, and partially re-crystallized with medium-crystalline dolomite cement (magenta <). The limestone is locally cross-bedded and porous, with scattered secondary voids that are preferentially aligned with the bedding. The limestone is microcrystalline with a mean crystal diameter of ~ 0.5-1.5um. Sand-sized Foraminifera tests (comprised of microcrystalline calcite) account most of the carbonate grain materials. The authigenic dolomite is fine to medium crystalline & subehedral, with a mean crystal diameter of ~ 0.15 mm
Detrital Grains / Allochems	1) Foraminifera tests (including miliolid and Amphistegina-like forms) are predominant. The forams locally supplement the total void volume by incorporating significant amounts of intra-particle macro-porosity within the architecture of the skeletal fragments. 2) Calcareous encrusting algae
Matrix	Microcrystalline calcite is common as a pore-filling matrix / cement. The limestone matrix is microporous and contains scattered particles of organic matter +/- traces of detrital clay.

Cements	Dolomite occurs as scattered clusters of medium crystalline, subhedral replacement cement. The dolomite clusters locally incorporate impurities (e.g., iron oxide, organic matter particles). Based on the XRD findings, dolomite comprises ~ 9% of the mineral mass in this aquifer interval. Most of the calcite is present as microcrystalline calcite, however, traces of finely crystalline calcite spar cement are also local present as a pore-lining cement.
Pore Stystem	The pore system includes intercrystalline (macro + micro) porosity, intra-particle porosity, and skel-moldic porosity. Helium porosity values are 32.6-32.7%, with a grain density of 2.66-2.70 g/cm3. The horizontal Klinkenberg permeability is 70.0 md, with a vertical permeability of 31.6 md.

1406.5 - 1407.5; MI#21117-01

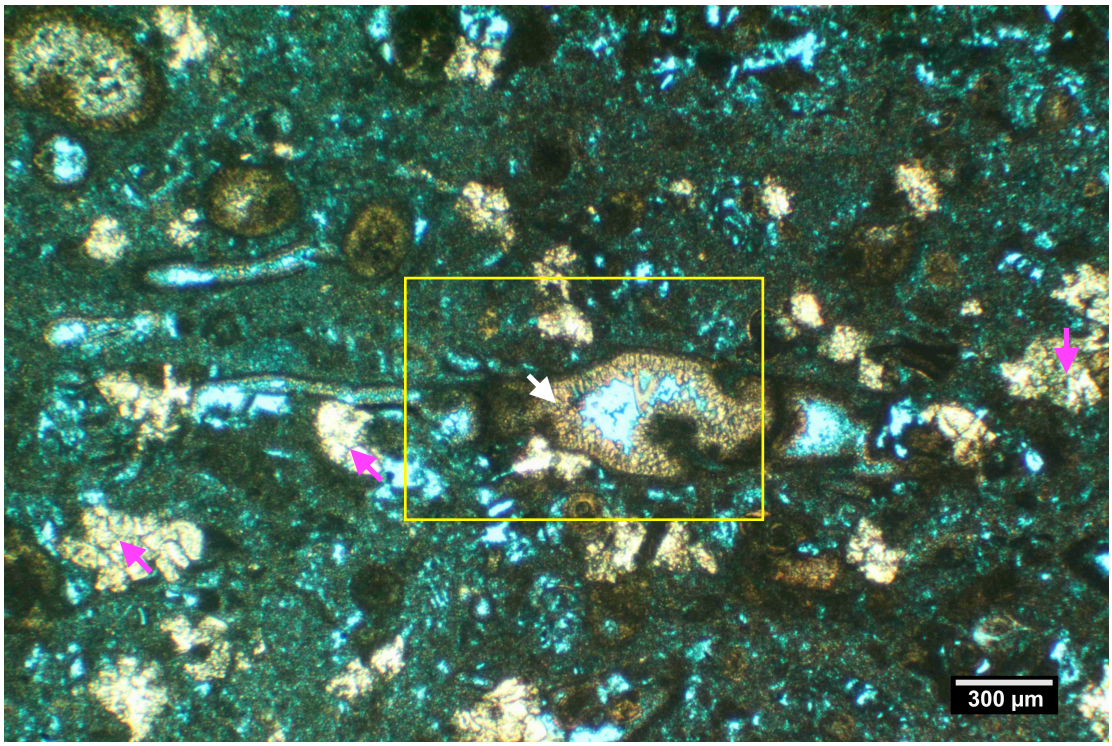


1A. A porous, dolomitic, skeletal lime packstone / wackestone. Note the skel-moldic pores (red <) and the clusters of medium crystalline dolomite cement (white; magenta <).

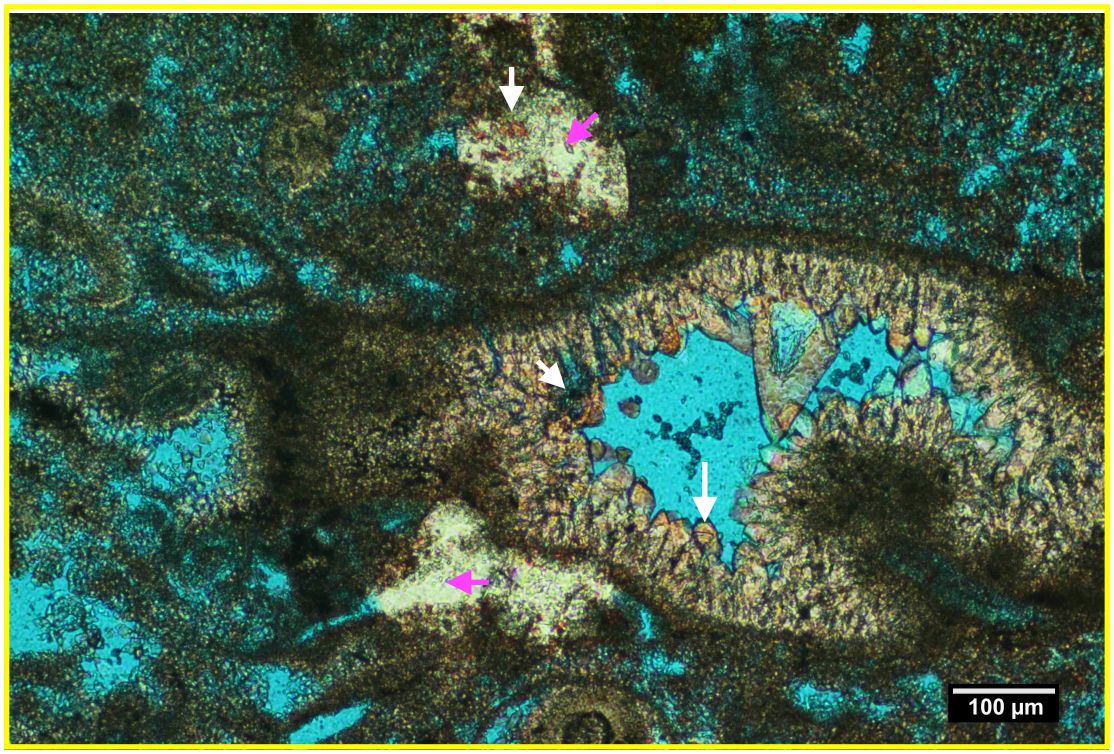


1B. Detailed view of the highlighted area from Figure 1A. Note the foram tests (yellow <) and the calcareous algae (blue <). Also note the localized presence of dolomite as a replacement cement (magenta <).

1406.5 - 1407.5; MI#21117-01



1C. Intra-particle voids locally contain concentrations of authigenic dolomite (white; magenta <) +/- residual traces of calcite spar cement (blue <).



1D. Detailed view of the highlighted area from Figure 1C. The red-stained areas (white <) correspond to remnants of calcite spar. Note how the pore-filling dolomite has locally engulfed the calcite remnants (white; magenta <).

L-63N Continuous Corehole

Boring: M01L63N

1406.5-1407.5 ft.

MI#21117-01 - SEM

Summary: This aquifer interval is characterized as a porous, dolomitic, foram - algae lime packstone. The sedimentary fabric is grain-supported, cross-bedded, mildly packed, porous, and partially re-crystallized with medium-crystalline dolomite cement. Microcrystalline calcite is present as infiltrated matrix material locally separating (&/or in-filling) the skeletal grains. Sand-sized Foraminifera tests (comprised of microcrystalline calcite) are the principal carbonate grain type. The XRD analysis indicates a mineral composition consisting of calcite (91%), dolomite (9%), and traces of quartz silt (<0.3%). Subhedral crystals of fine to medium crystalline, authigenic dolomite are present as secondary pore-filling cements that occupy selected interparticle macro-pores (e.g., Figures 1A through 1C, and 1G - 1H). Authigenic dolomite also occurs as intra-particle void-filling cement that locally in-fills the skel-moldic pores (see Figure 1D-1F).

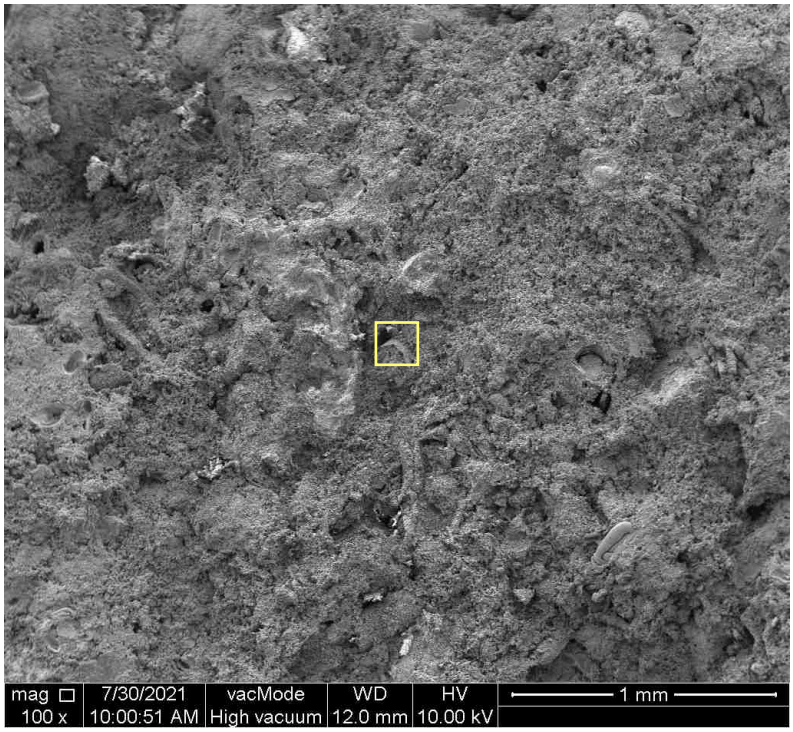
The pore system includes a well inter-connected network of intercrystalline (macro + micro) porosity, intra-particle porosity, and skel-moldic porosity. Helium porosity values comprise ~ 32.6-32.7%. The horizontal (Klinkenberg) permeability is 70.0 md, with a vertical permeability of 31.6 md.

21117-01 Photo Index:

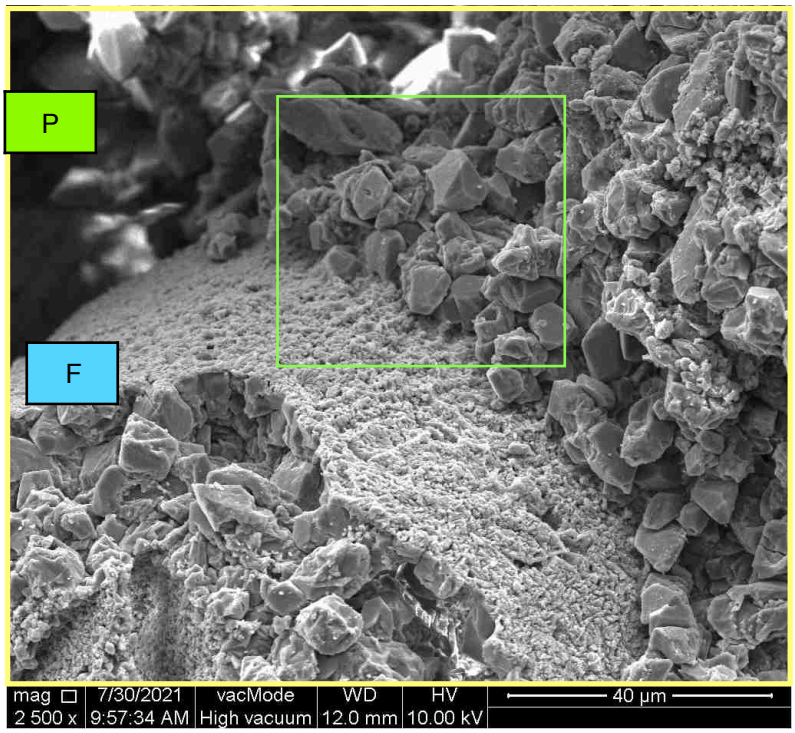
Sample ID	Magnification
21117-01A	100X
21117-01B	2500X
21117-01C	7000X
21117-01D	300X
21117-01E	1200X
21117-01F	5000X
21117-01G	1300X
21117-01H	5000X

Macro-porosity	P
Foraminifera test	F
Authigenic Dolomite	D
Microcrystalline calcite	uC

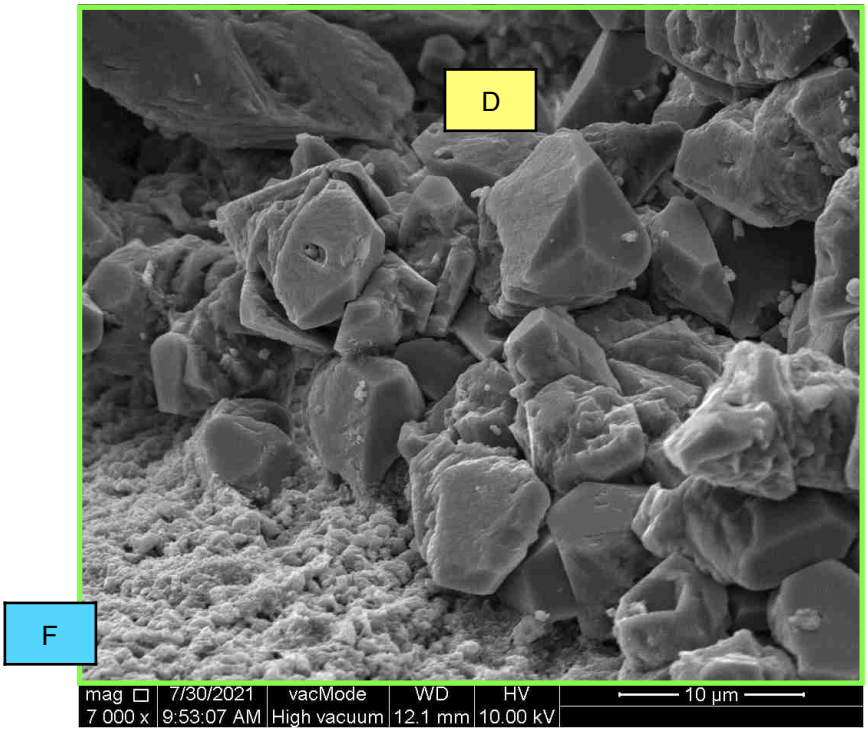
21117-01A 100X



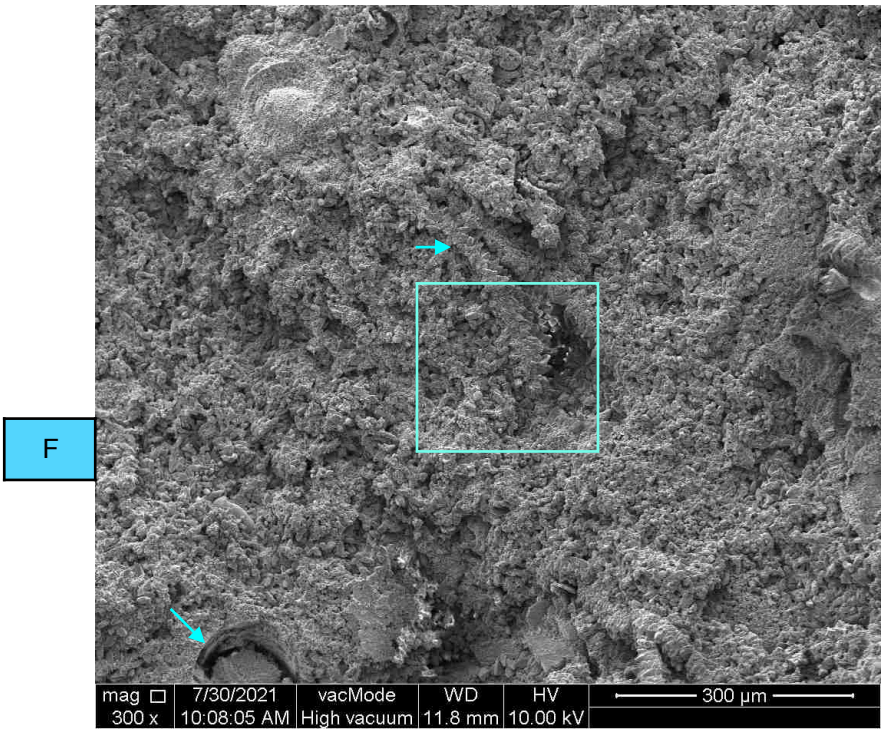
21117-01B 2500X



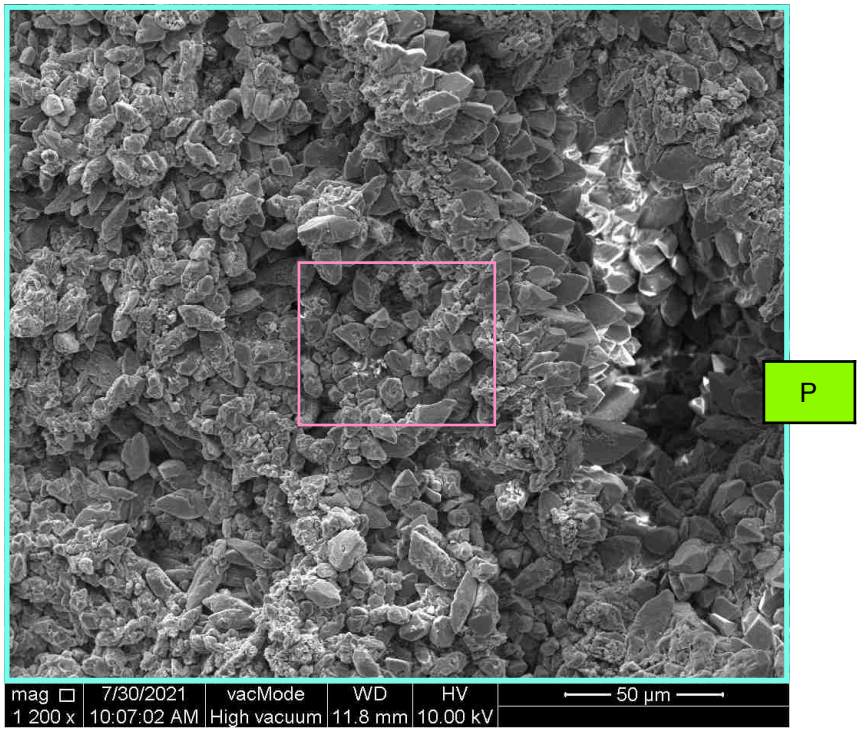
21117-01C 7000X



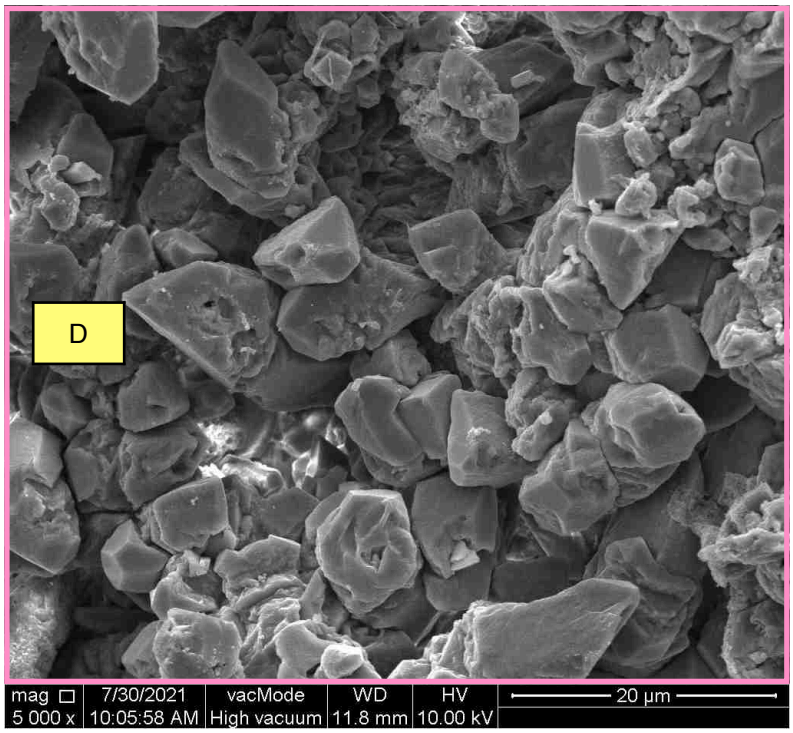
21117-01D 300X



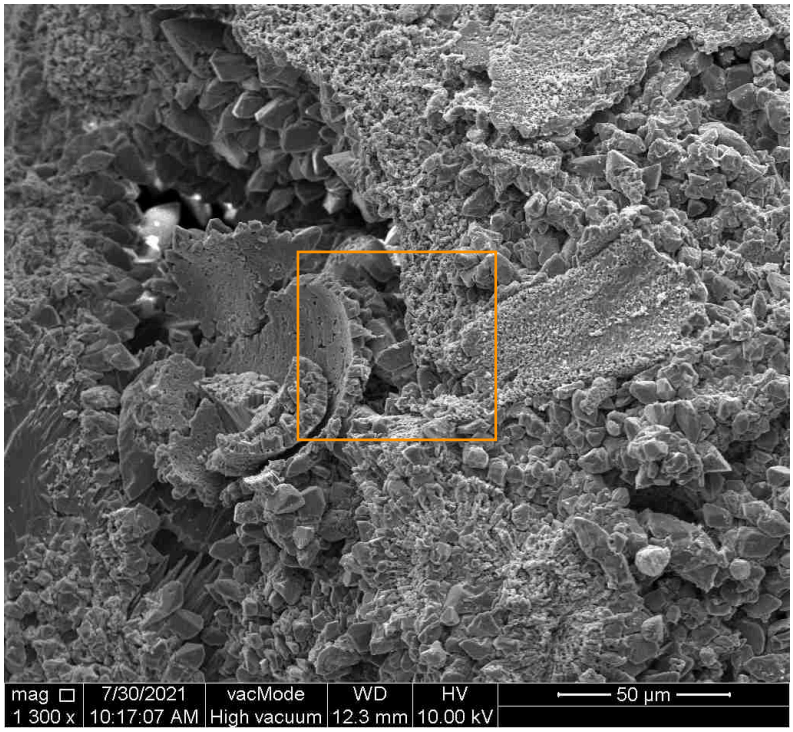
21117-01E 1200X



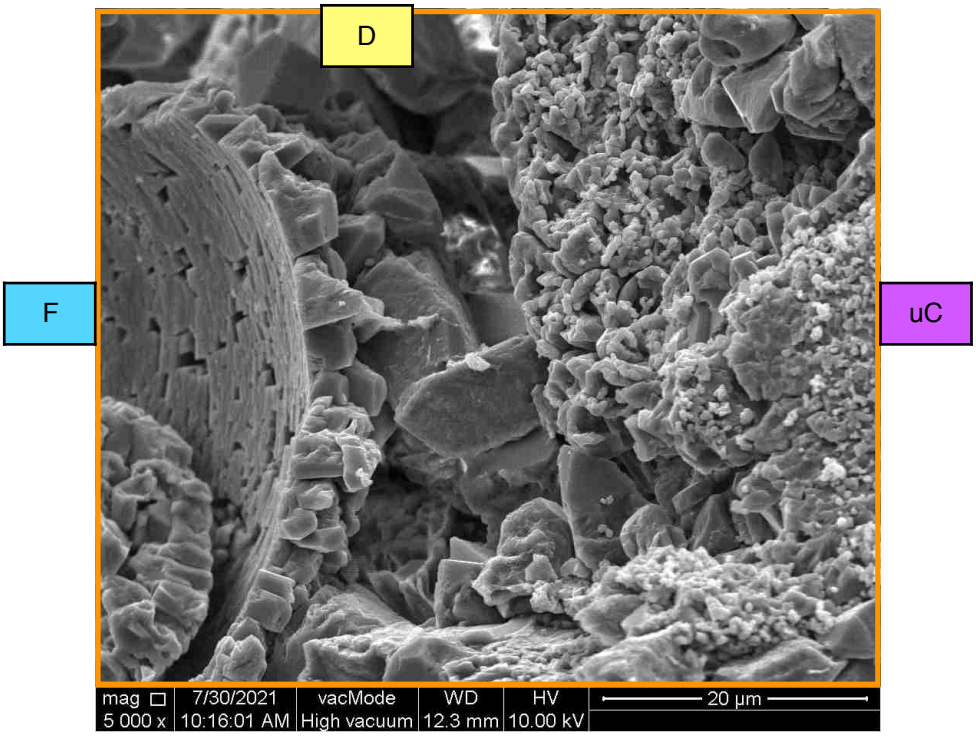
21117-01F 5000X



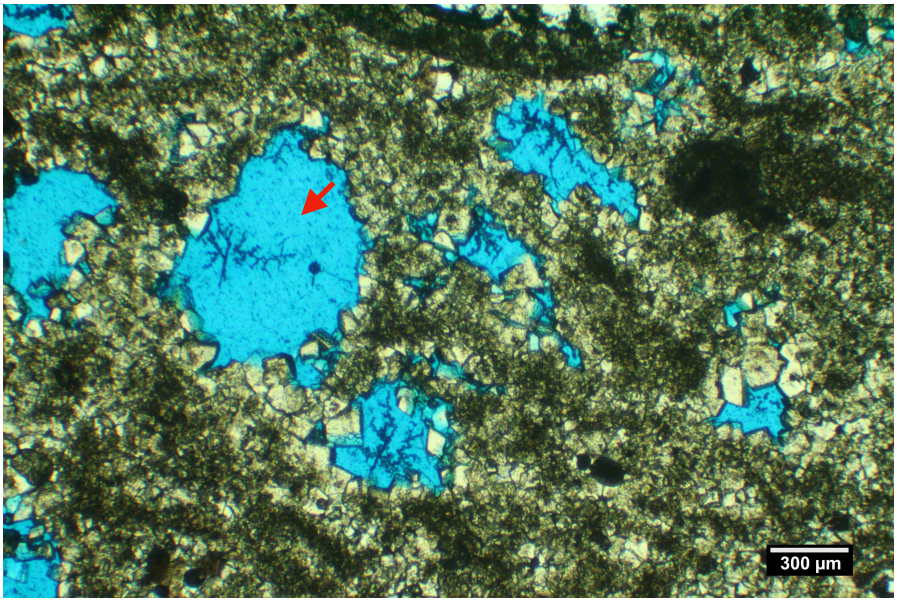
21117-01G 1300X



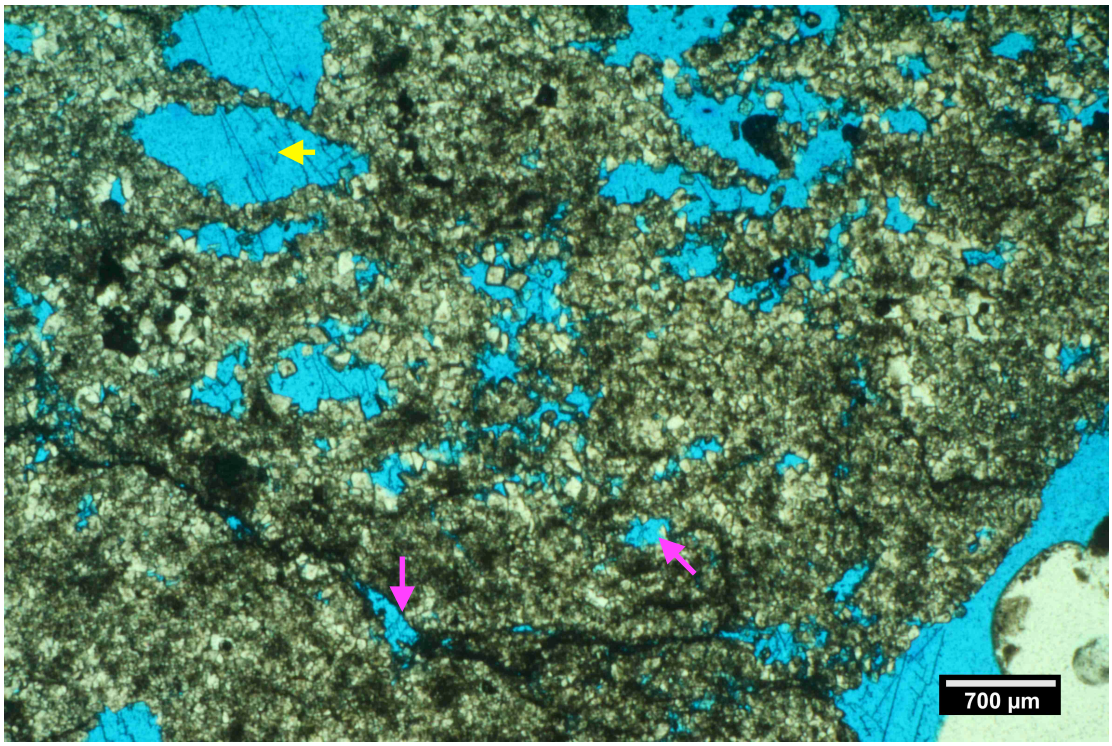
21117-01H 5000X



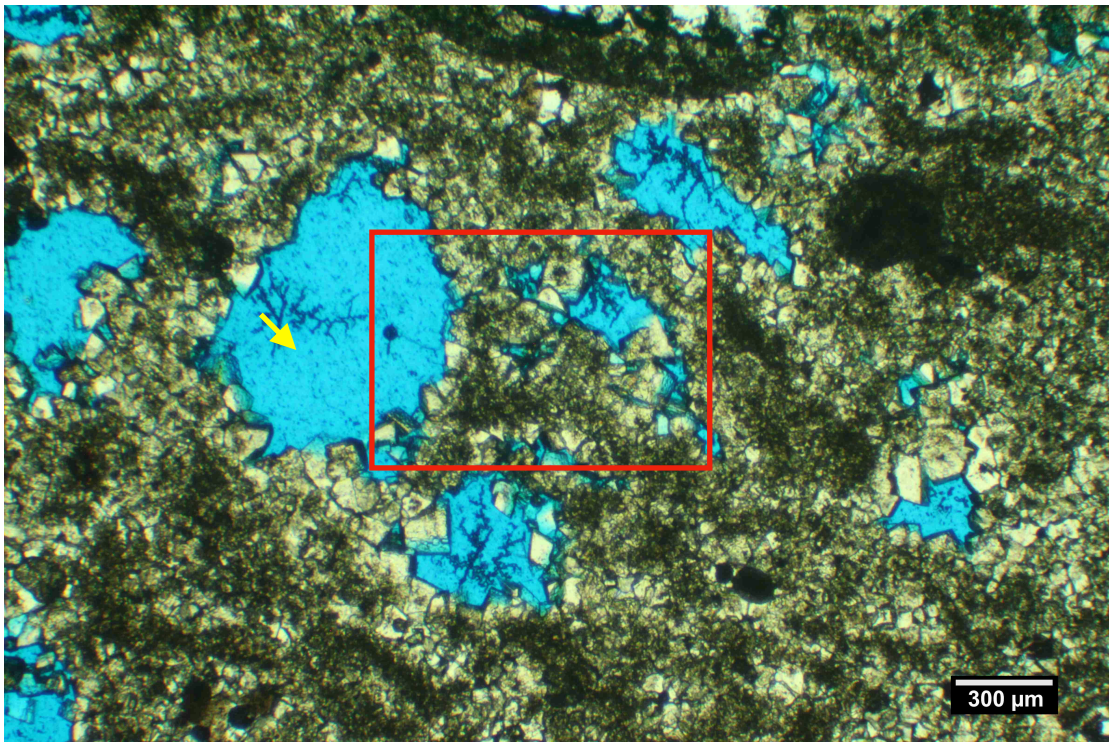
Petrographic Data Summary - L-63N; Core Depth: 1450 - 1451 ft.; MI#21117-02

Lithologic Classification: Dolomite	
Texture	The aquifer interval is comprised of fine to medium-crystalline, subhedral dolomite. The mean crystal diameter of the dolomite is ~ 0.04-0.06 mm. All of the calcareous skeletal grains have been either replaced with dolomite cement or dissolved. The dolomite fabric is cross-bedded and porous, with scattered secondary voids that are preferentially aligned with the bedding. The secondary grain molds (blue; red <) are separated by fine to medium crystalline dolomite that is densely interlocked and microporous.
Detrital Grains / Allochems	1) Dolomite-replaced calcareous grains include algae plates, foram tests, and mollusk shell fragments. Minor amounts of & glauconite pellets are also locally present. 2) Phosphatic bone material (as fluorapatite) 3) Calcareous encrusting algae (dolomite-replaced) 4) Glauconite pellets
Matrix / Cements	Fine to medium crystalline dolomite has replaced the interparticle matrix + cement + allochems.
Pore Stystem	The pore system includes scattered skel-moldic pores & intercrystalline (macro + micro) porosity. Helium porosity values are 16.4-24.0%, with a grain density of 2.77 g/cm3. The horizontal Klinkenberg permeability is 137.0 md,, with a vertical permeability of 5.43 md.

1450 - 1451; MI#21117-02

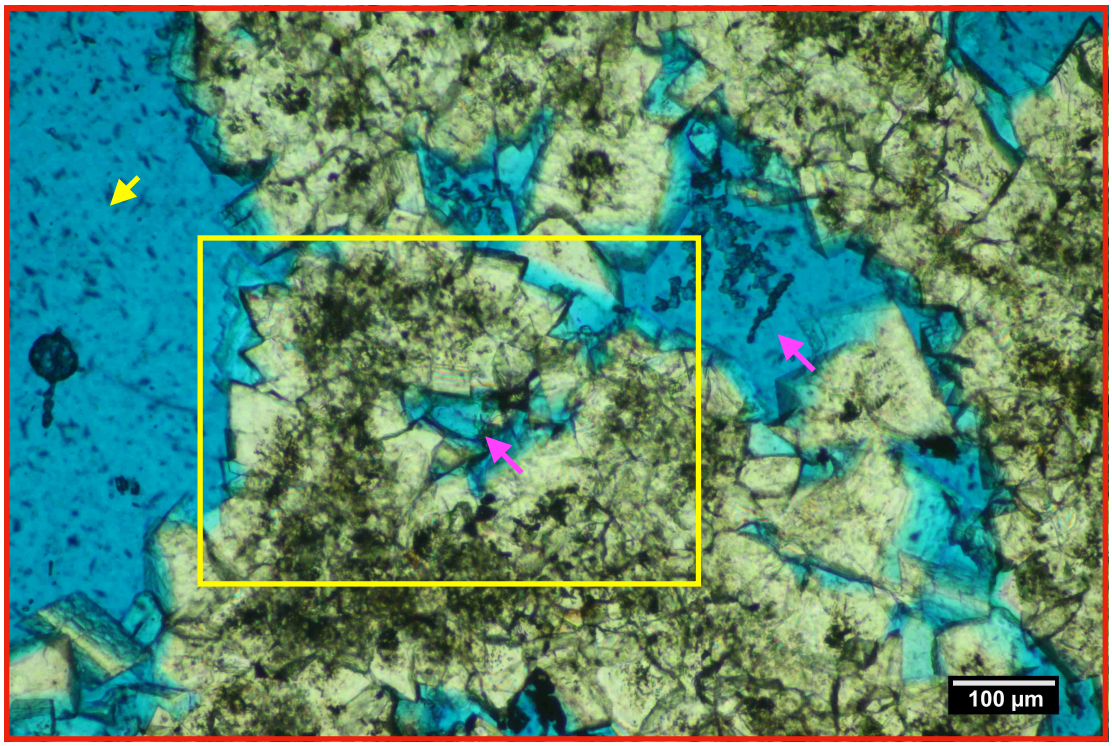


2A. The dolomite fabric is medium crystalline, subhedral, and densely interlocked, with well-preserved skel-moldic (yellow <) and inter-particle (magenta <) macro-pores.

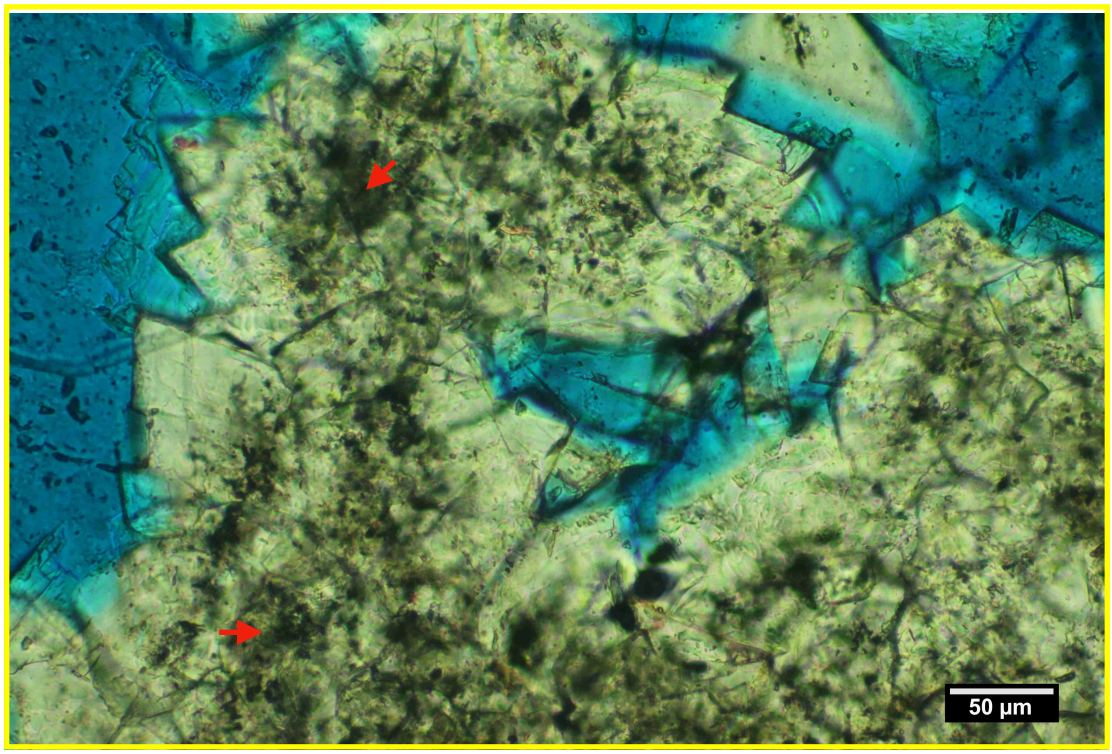


2B. The dolomite contains inclusions of microporosity & undifferentiated opaque particles which make the crystals appear dark or 'cloudy' in transmitted light. Note the large skel-moldic voids (blue; yellow <). The highlighted area is detailed in Figure 2C.

1450 - 1451; MI#21117-02



2C. The pore system includes large, skel-moldic pores (blue; yellow <), as well as interparticle & intercrystalline macropores (blue; magenta <).



2D. Detailed view of the highlighted area from Figure 2C. Replacement of microcrystalline calcite has locally encapsulated micropores & impurities (e.g., particles of organic matter, iron oxide cement, etc.; red <) within the dolomite fabric.

L-63N Continuous Corehole

Boring: M01L63N

1450-1451 ft.

MI#21117-02 - SEM

Summary: The aquifer interval is comprised of fine to medium-crystalline, subhedral dolomite. The mean crystal diameter of the dolomite is ~ 0.04-0.06 mm. The pre-cursor limestone fabric was grain-supported, cross-bedded and porous. Dolomite replacement of the limestone has resulted in a densely crystallized microporous groundmass, with scattered secondary macro pores. The skel-moldic pores are typically rimmed by euhedral to subhedral dolomite crystals. Selected crystal surfaces are draped with organic matter (e.g., Figure 2F)

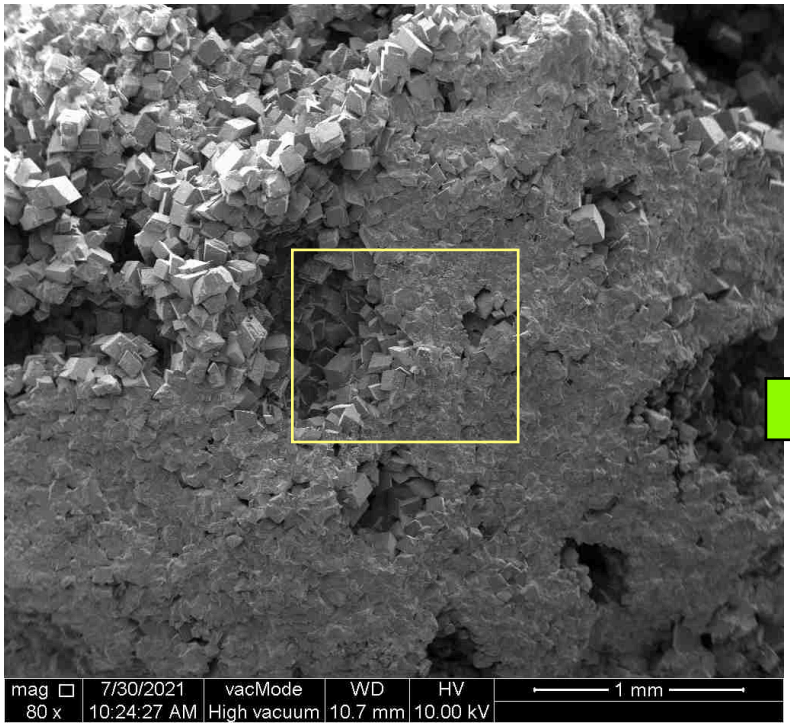
Helium porosity values range between 16.4-24.0%, with a grain density of 2.77 g/cm^3. The horizontal (Klinkenberg) permeability is 137.0 md,, with a vertical permeability of 5.43 md.

21117-02 Photo Index:

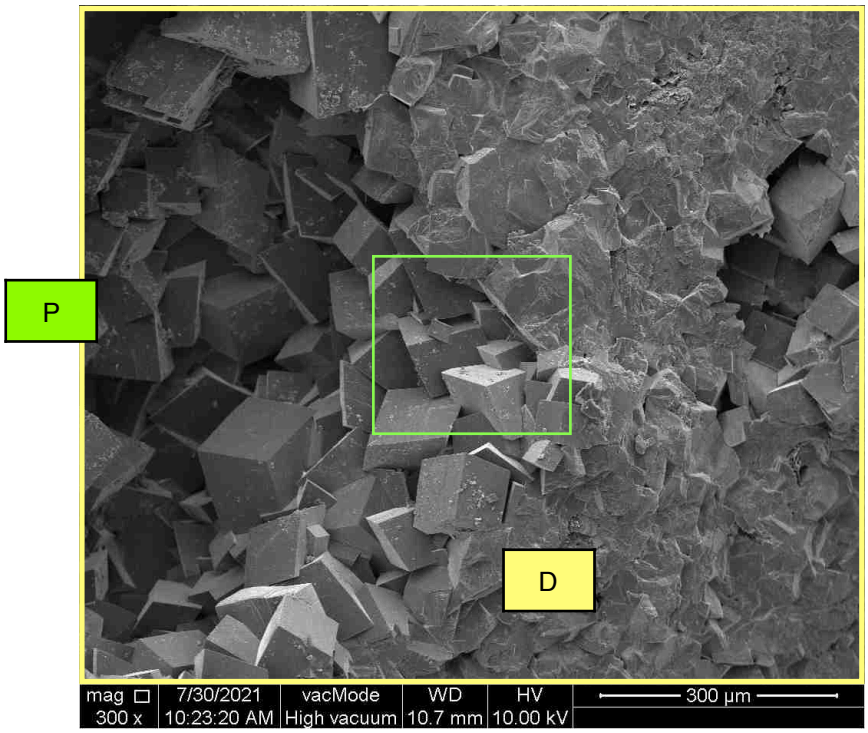
Sample ID	Magnification
21117-02A	80X
21117-02B	300X
21117-02C	1200X
21117-02D	300X
21117-02E	1300X
21117-02F	5000X

Macro-porosity	P
Foraminifera test	F
Authigenic Dolomite	D
Amorphous Material	A

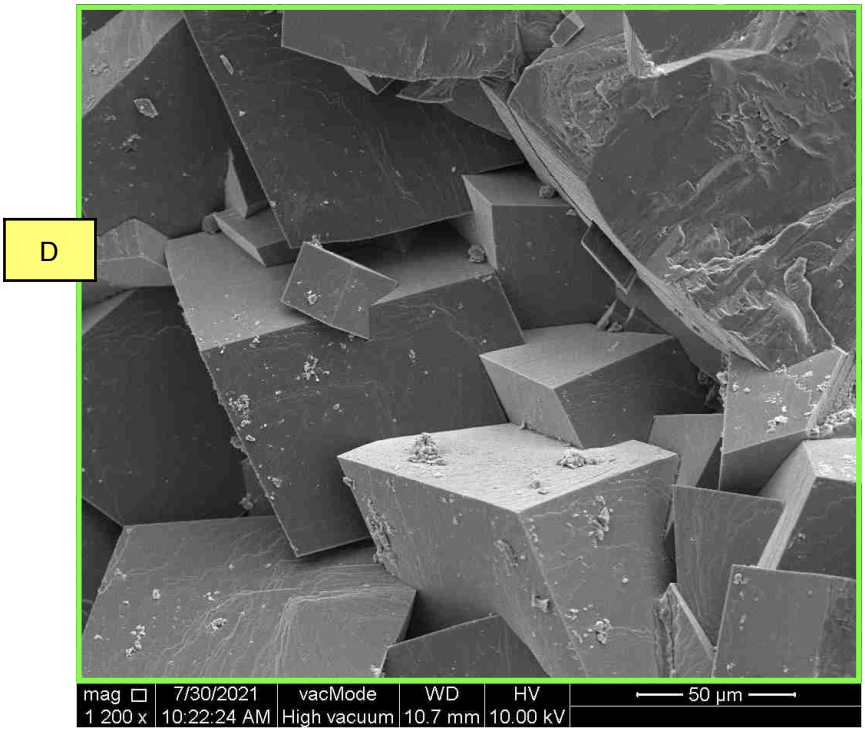
21117-02A 80X



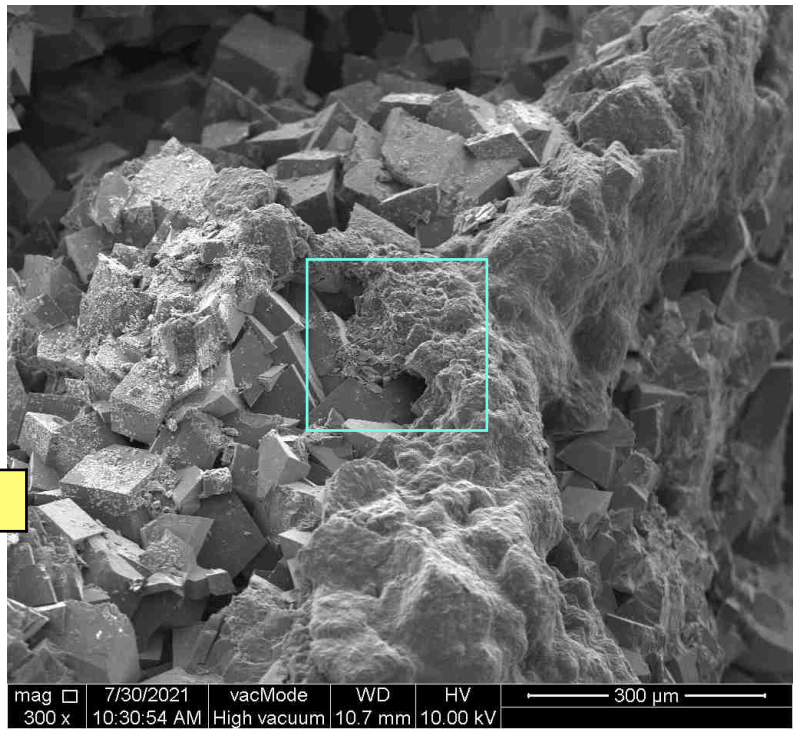
21117-02B 300X



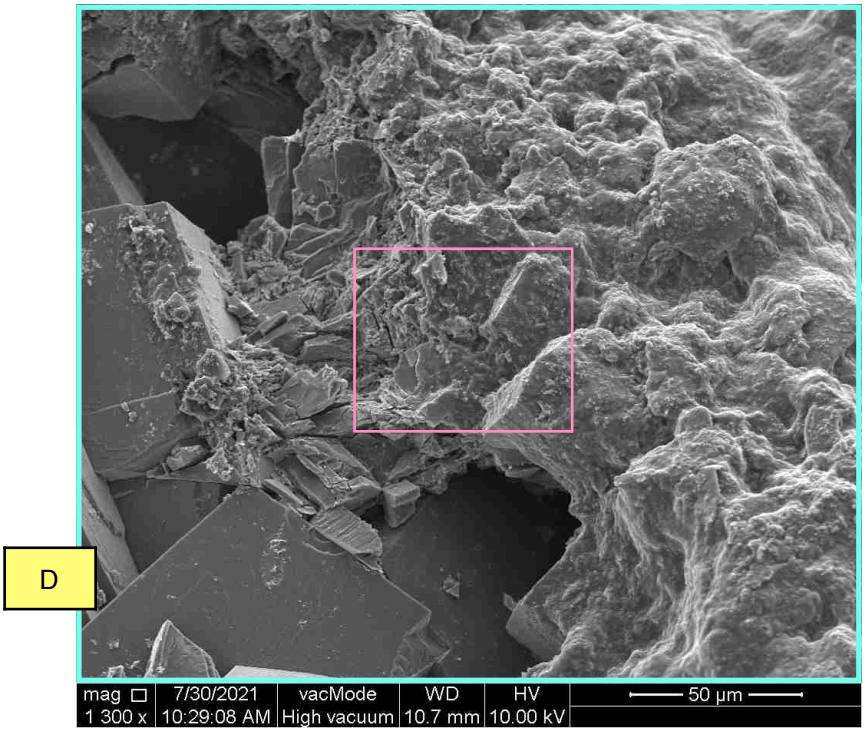
21117-02C 1200X



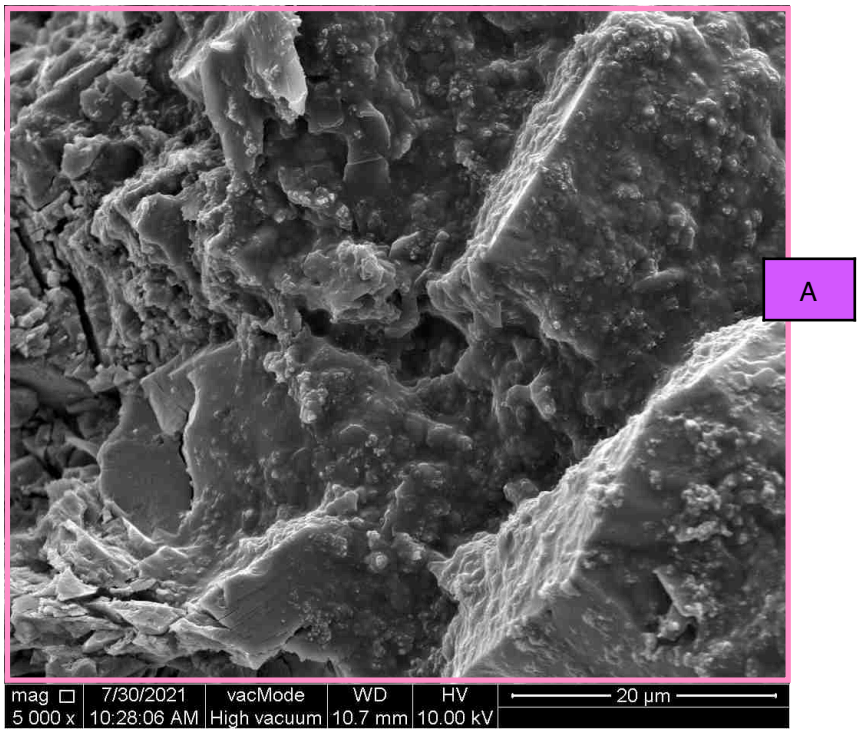
21117-02D 300X



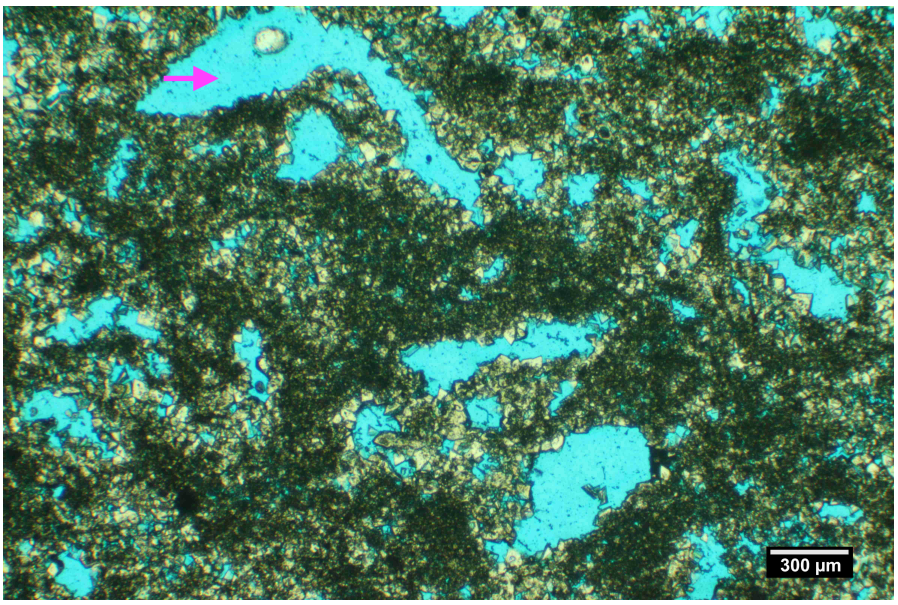
21117-02E 1300X



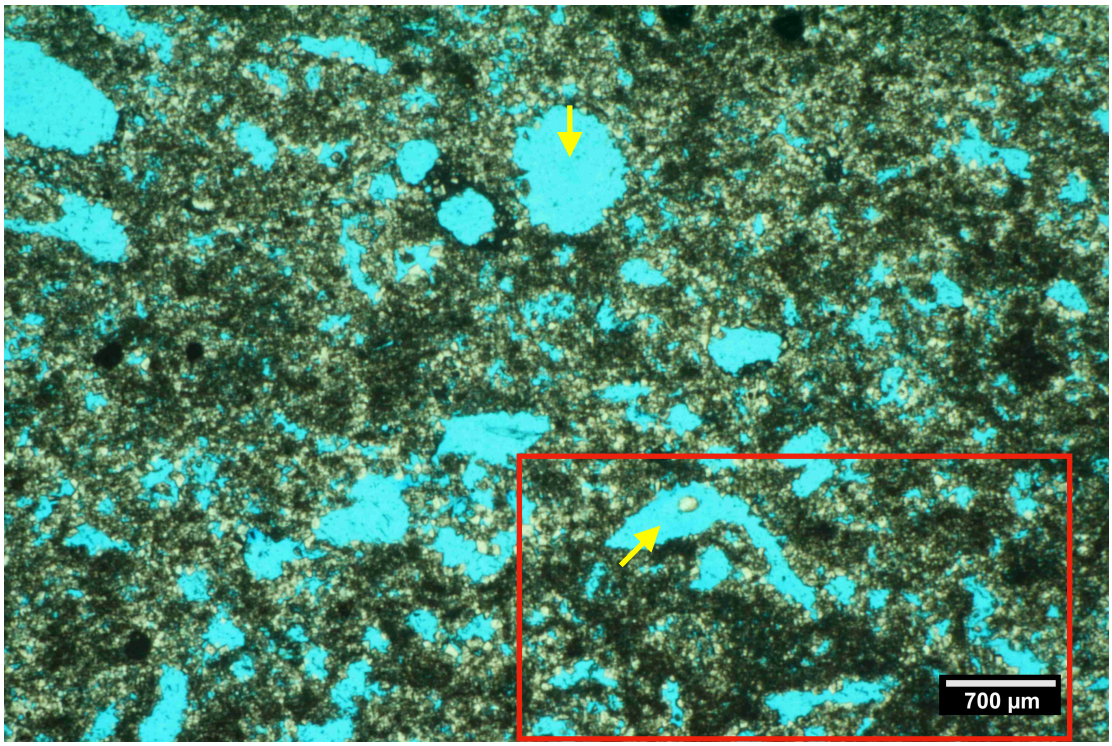
21117-02F 5000X



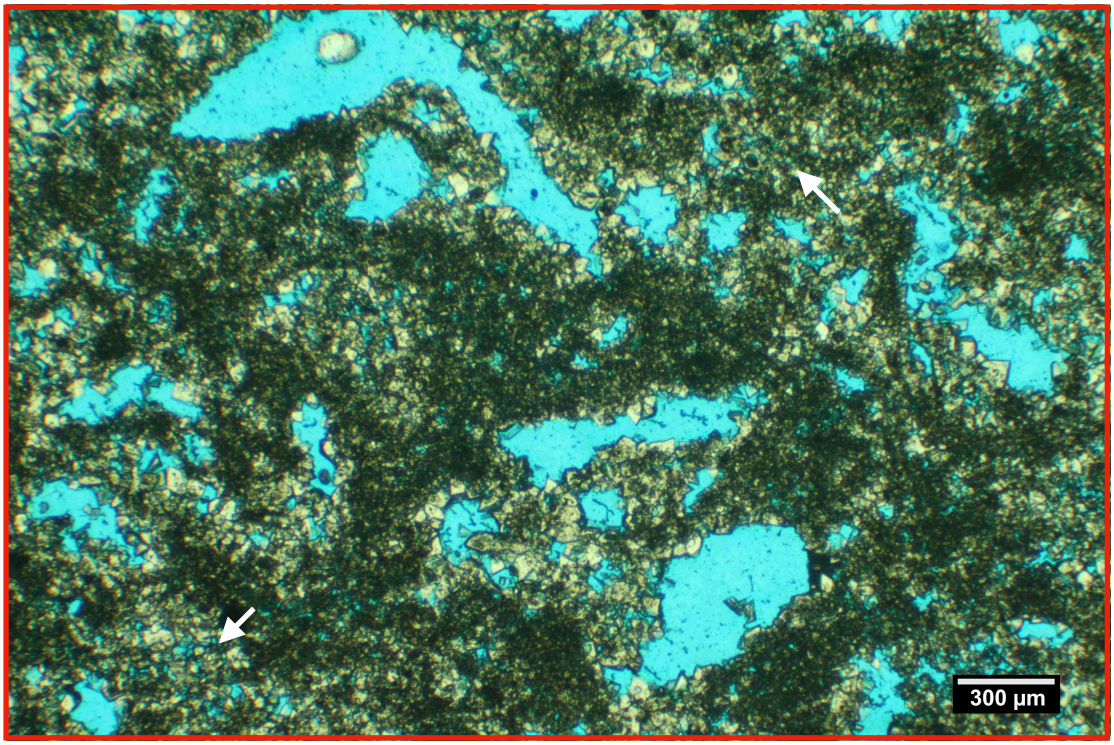
Petrographic Data Summary - L-63N; Core Depth: 1505 - 1506 ft.; MI#21117-03

Lithologic Classification: Dolomite	
Texture	The aquifer interval is comprised of finely-crystalline, subhedral dolomite. The mean crystal diameter of the dolomite is ~ 20-25 um. The precursor (calcareous) skeletal grains have been either replaced with dolomite cement or dissolved. The dolomite fabric is cross-bedded and porous, with scattered secondary voids that are preferentially aligned with the bedding. The secondary grain molds (blue; magenta <) are separated by finely crystalline dolomite that is densely interlocked and microporous.
Detrital Grains / Allochems	1) Dolomite-replaced calcareous grains appear to include algae plates, foram tests, mollusk shell fragments, and undifferentiated skeletal grain fragments. Minor amounts of & glauconite pellets are also locally present. 2) Phosphatic bone material (as fluorapatite) 3) Calcareous encrusting algae (dolomite-replaced) 4) Glauconite pellets
Matrix / Cements	Finely crystalline dolomite has replaced the interparticle matrix + cement + allochems.
Pore Stystem	The pore system includes scattered skel-moldic pores & intercrystalline (macro + micro) porosity. Helium porosity values are 29.9-31.0%, with a grain density of 2.72-2.85 g/cm3. The horizontal Klinkenberg permeability is 221 md,, with a vertical permeability of 45.8 md.

1505 - 1506; MI#21117-03

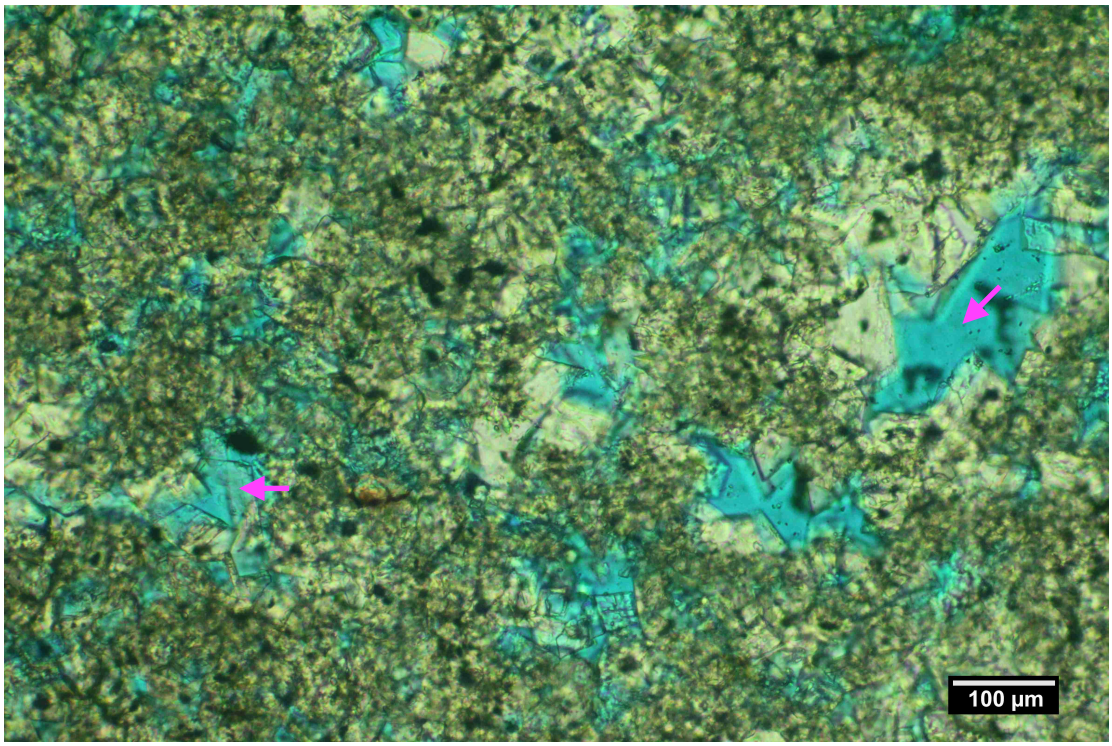


3A. A porous, finely crystalline dolomite, with an abundance of large skel-moldic secondary pores (blue; yellow <). The highlighted area is detailed in Figure 3B.

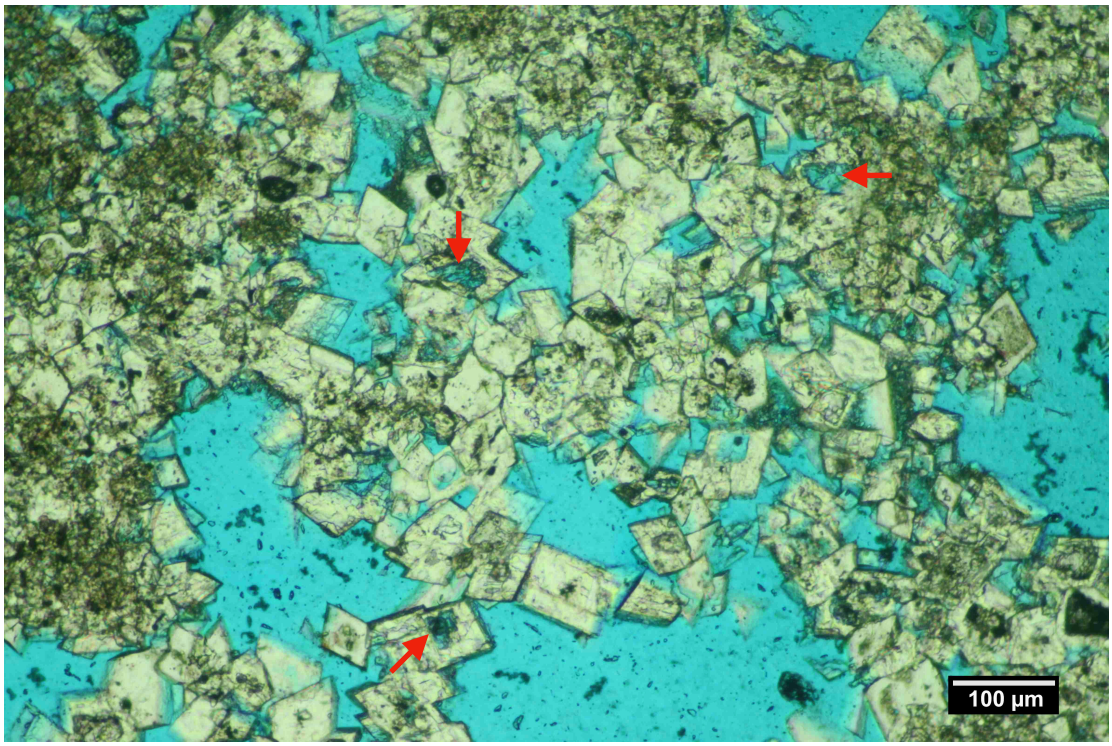


3B. The dolomite separating the skel-moldic pores is finely crystalline, subhedral, and microporous. Relatively porous portions of the groundmass are mottled light blue (white <).

1505 - 1506; MI#21117-03



3C. Locally significant amounts of intercrystalline macroporosity (blue; magenta <) are present throughout the groundmass of the dolomite.



3D. A significant percentage of the dolomite crystals exhibit intra-crystalline dissolution voids (red <). This type of secondary porosity within dolomite aquifers is characterized as dolo-moldic void space.

L-63N Continuous Corehole

Boring: M01L63N

1505-1506 ft.

MI#21117-03 - SEM

Summary: This aquifer interval is characterized as a porous, finely crystalline, subhedral dolomite. The dolomite matrix is moderately to densely interlocked and incorporates large skel-moldic voids along with common intercrystalline macro & micropores. Selected portions of the dolomite are leached and exhibit indications of secondary dissolution. The dissolution has locally resulted in etched dolomite crystals + traces of dolo-moldic porosity (e.g., Figure 21117-03E & 03F).

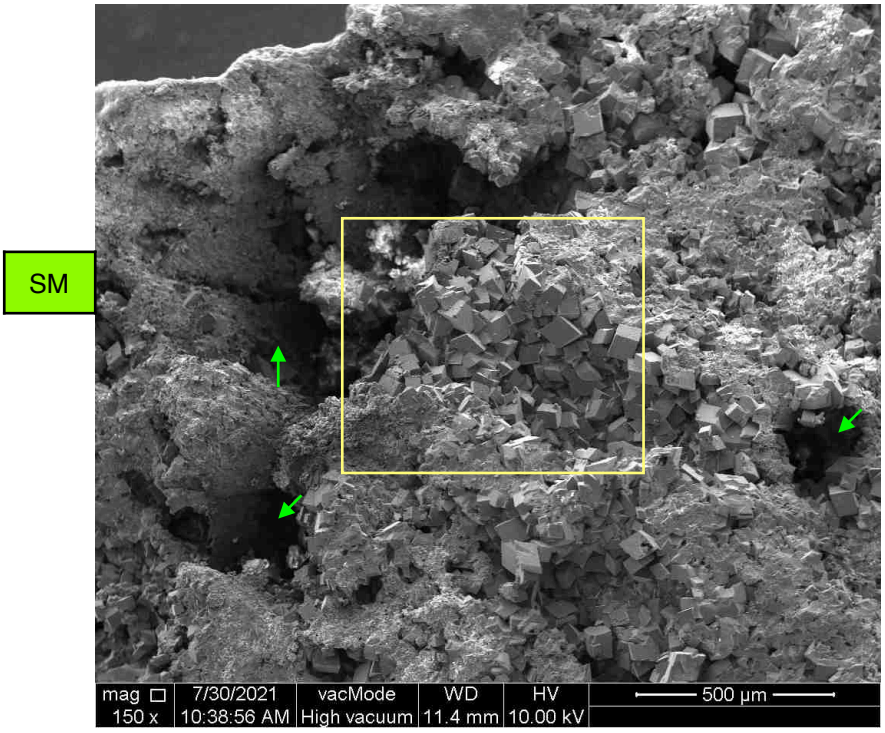
Helium porosity values range between ~29.9-31.0%. The horizontal Klinkenberg permeability is 221 md,, with a vertical permeability of 45.8 md.

21117-03 Photo Index:

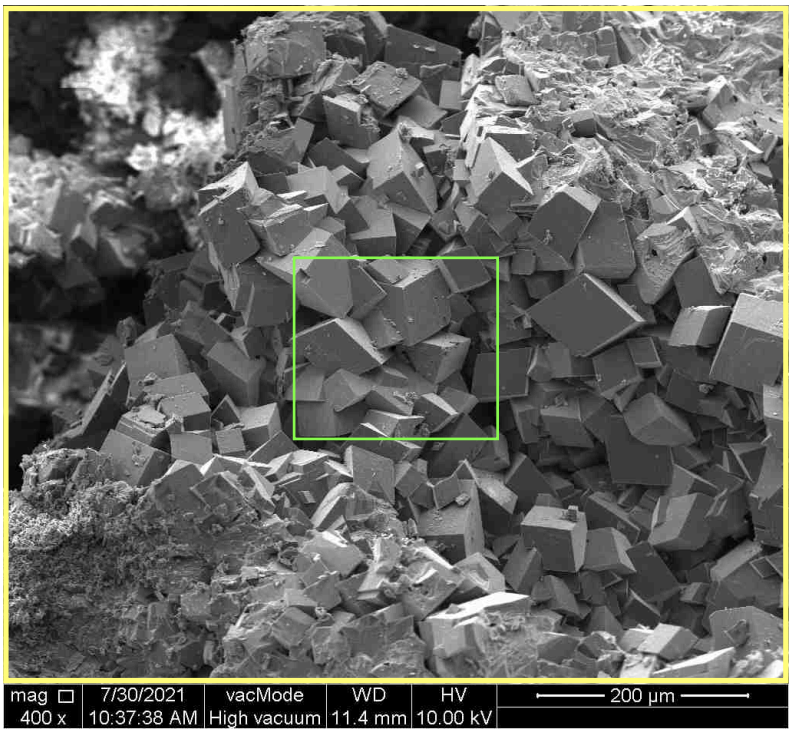
Sample ID	Magnification
21117-03A	150X
21117-03B	400X
21117-03C	1600X
21117-03D	400X
21117-03E	1300X
21117-03F	4000X

Skel-moldic porosity	SM
Dolo-moldic porosity	DM
Authigenic Dolomite	D
Intercrystalline porosity	BP

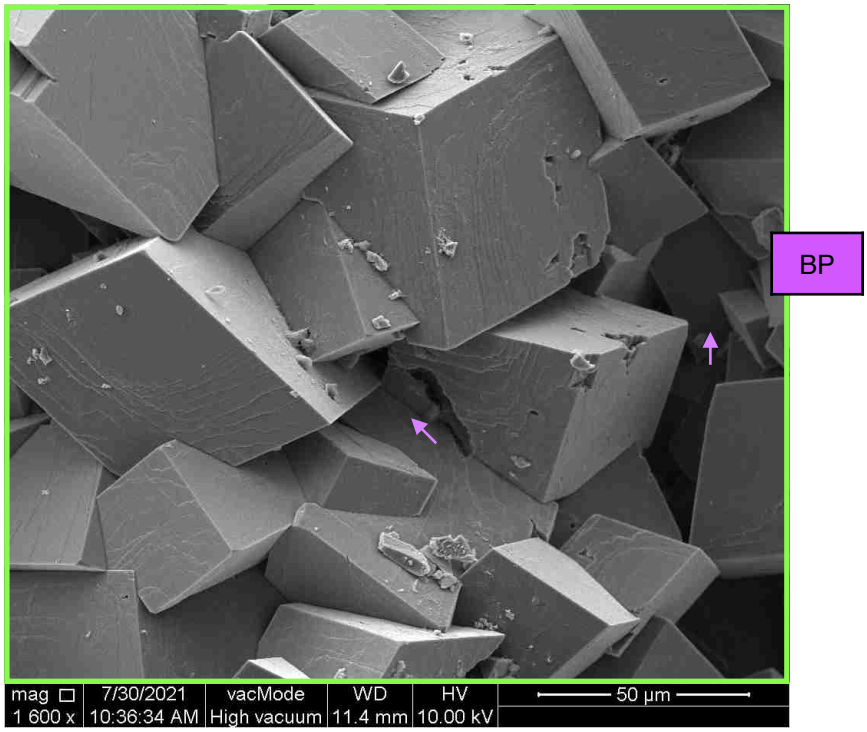
21117-03A 150X



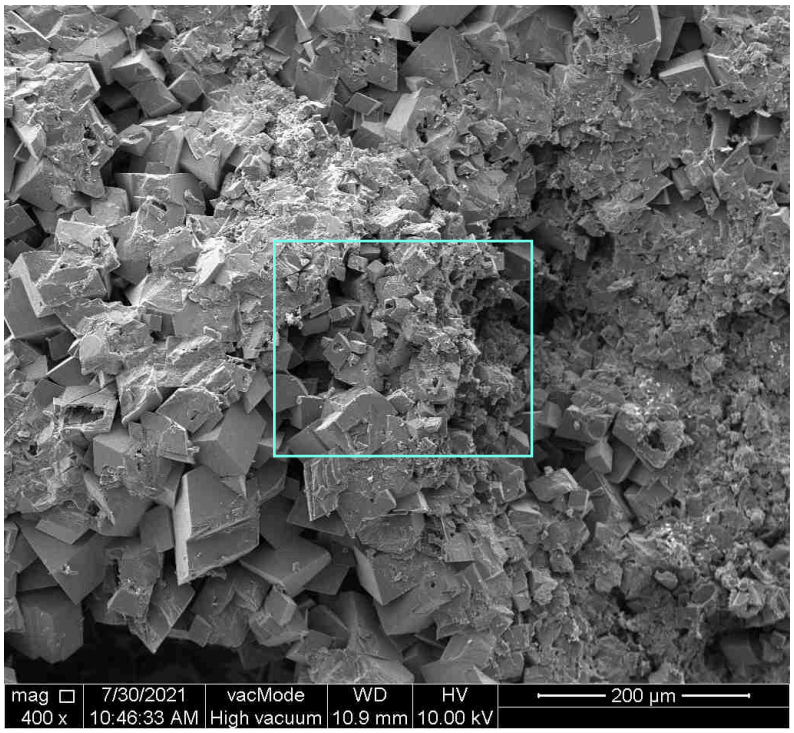
21117-03B 400X



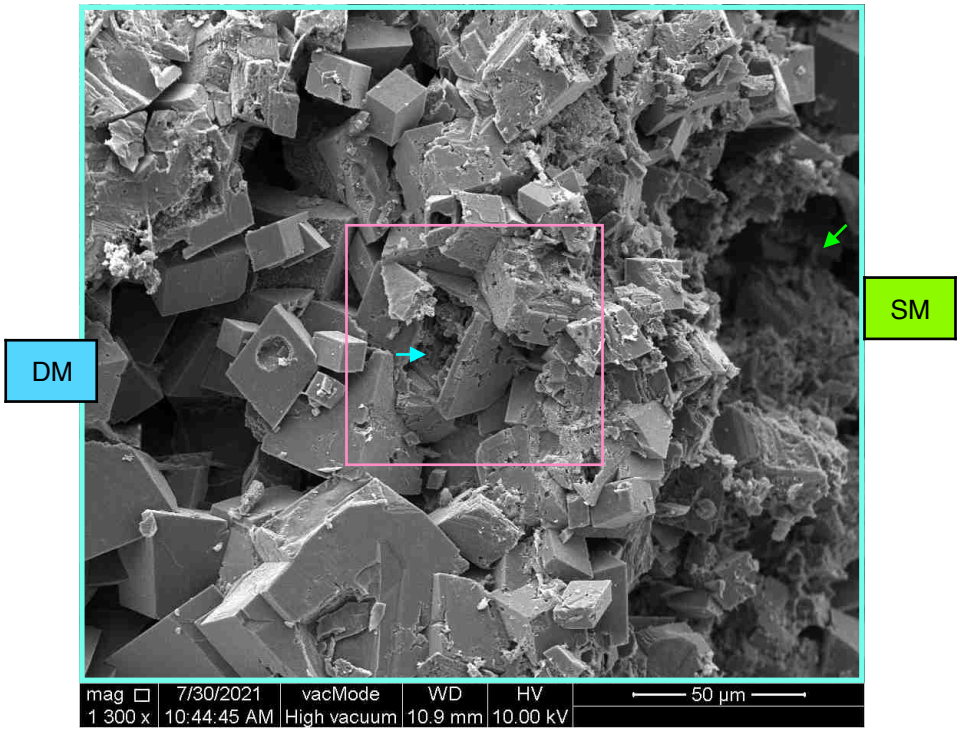
21117-03C 1600X



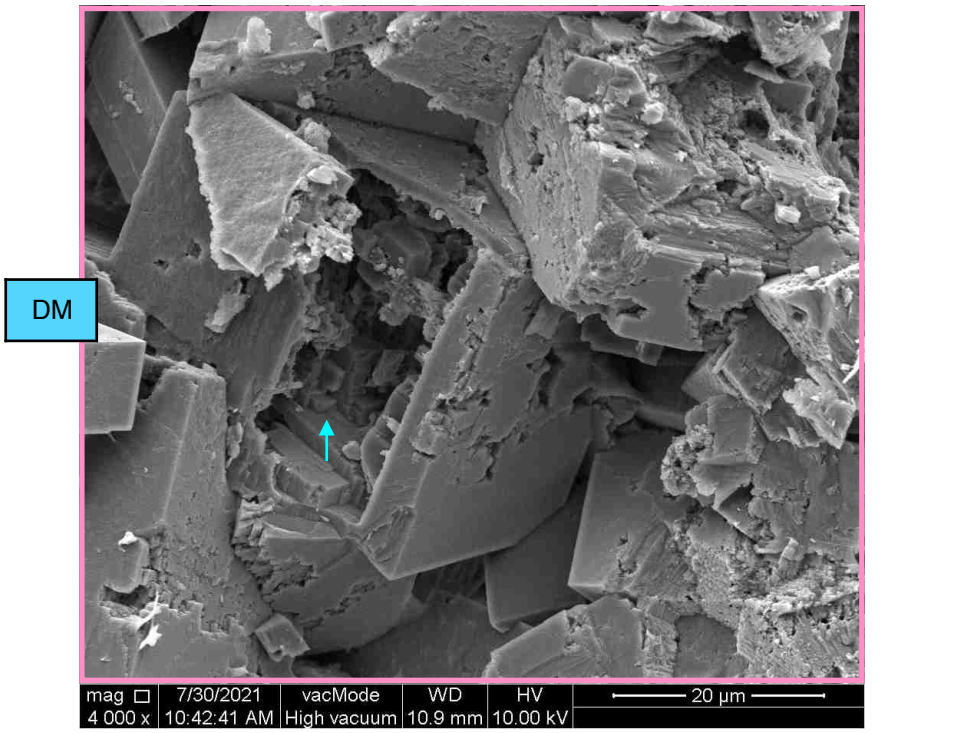
21117-03D 400X



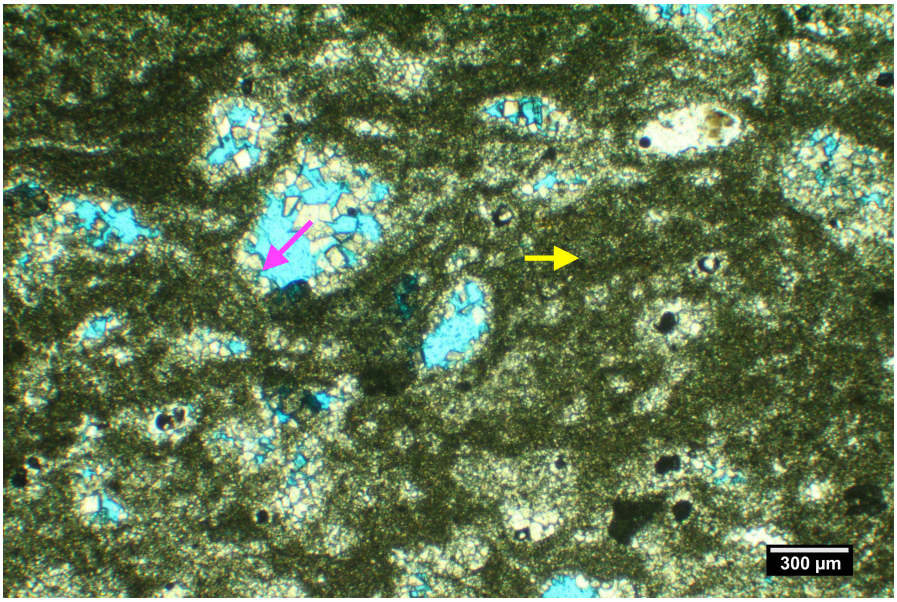
21117-03E 1300X



21117-03F 4000X

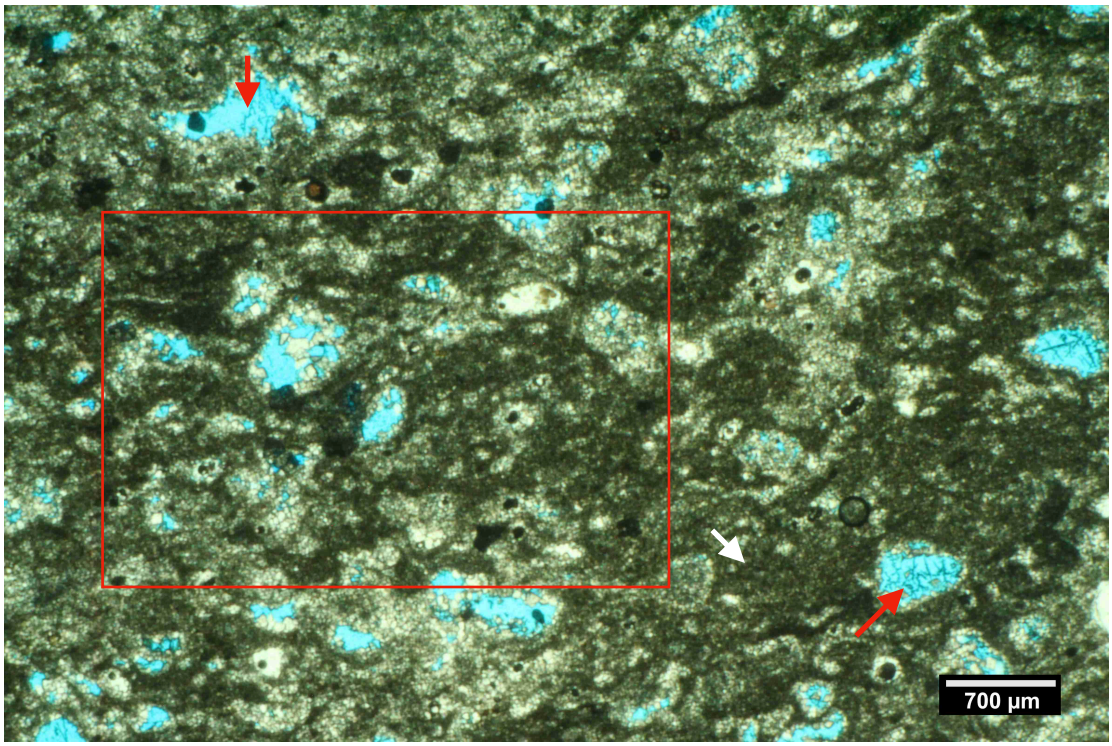


Petrographic Data Summary - L-63N; Core Depth: 1603 - 1604 ft.; MI#21117-04

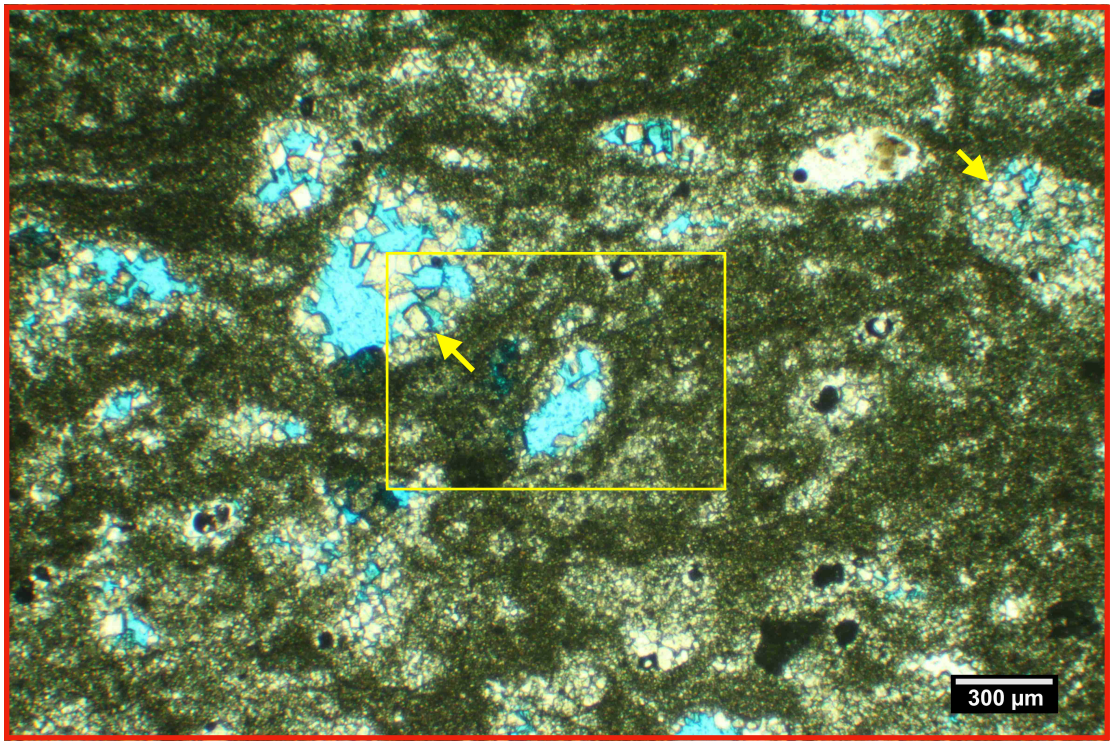
Lithologic Classification: Dolomite	
Texture	The fabric is parallel to cross-bedded, variably matrix and/or grain-supported, mildly packed, locally porous, and re-crystallized with microcrystalline to very finely crystalline dolomite cement (yellow <). The skel-moldic pores are commonly rimmed with fine to medium-crystalline, euhedral dolomite cement (magenta <). Bands of relatively porous dolomite (with common to abundant skel-moldic porosity) alternate with layers of relatively non-porous, matrix-supported dolomite. A few elliptical concentrations of dolomitic mudstone are present as steinkerns. The dolomite matrix exhibits a mean crystal diameter of ~ 1-4 um. The pore-lining authigenic dolomite is fine to medium crystalline, with a mean crystal diameter of ~ 40-60 um.
Detrital Grains / Allochems	1) Dolomite-replaced calcareous grains appear to include algae plates, foram tests, mollusk shell fragments, and undifferentiated skeletal grain fragments. Minor amounts of & glauconite pellets are also locally present. 2) Phosphatic bone material (as fluorapatite) 3) Calcareous encrusting algae (dolomite-replaced)
Matrix / Cements	Finely crystalline dolomite has replaced the interparticle matrix + cement + allochems.

Pore Stystem	The pore system is unevenly distributed and includes scattered skel-moldic pores & intercrystalline (macro + micro) porosity. The void volume ranges between ~2.2-3.4% for the vertical and horizontal core plugs, with Klinkenberg permeability values of 0.0020 - 0.0012 md. The estimated pore volume within the thin section is ~8-10%. The secondary macro-pores are poorly interconnected and are commonly separated by densely crystallized dolomite cement.

1603 - 1604; MI#21117-04

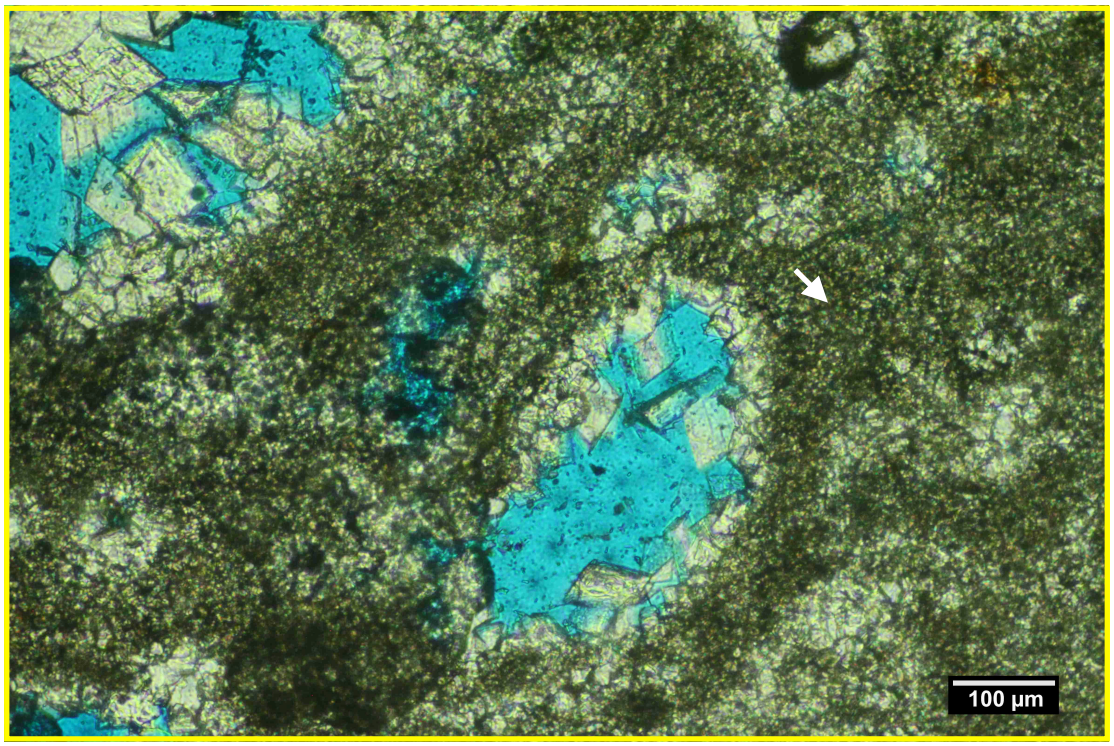


4A. Secondary skel-moldic dissolution voids (blue; red <) distributed in a matrix of very finely crystalline dolomite (white <).

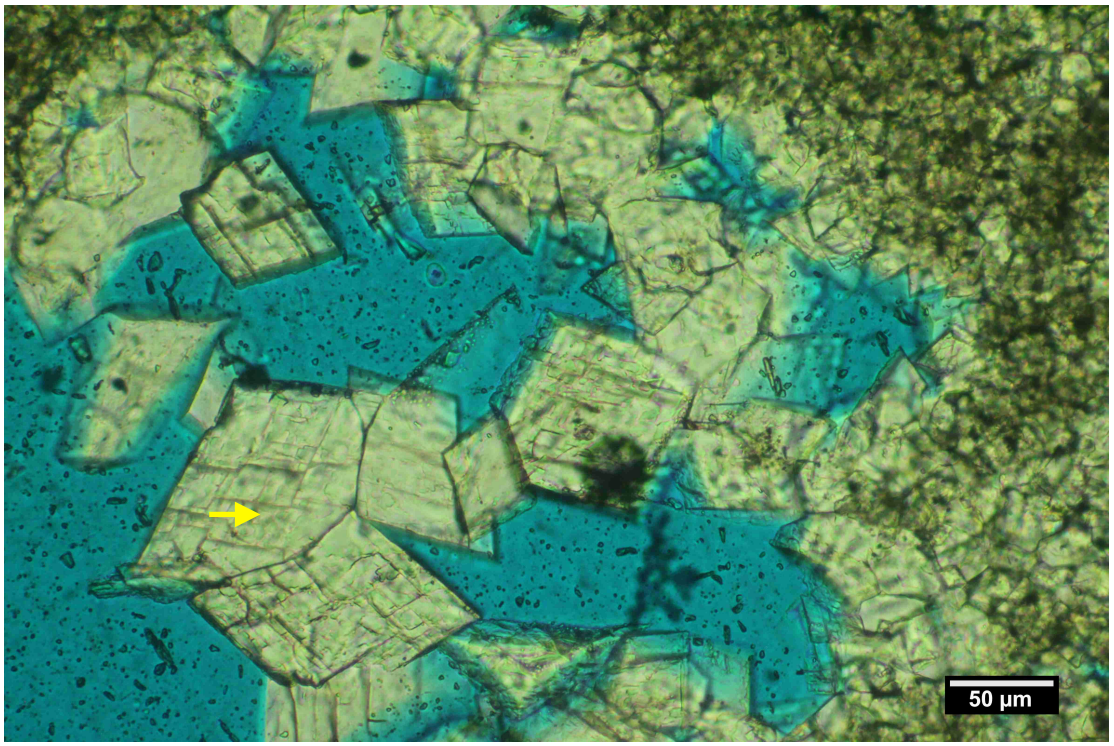


4B. The skel-moldic pores are partially in-filled with subhedral to euhedral crystals of pore-filling dolomite cement (yellow <).

1603 - 1604; MI#21117-04



4C.The dolomite matrix (white <) that comprises the bulk of the interval is very densely crystallized, microporous, and relatively impermeable.



4D. Subhedral to euhedral crystals of authigenic dolomite (yellow <) partially filling a secondary skel-moldic pore.

L-63N Continuous Corehole

Boring: M01L63N

1603-1604 ft.

MI#21117-04 - SEM

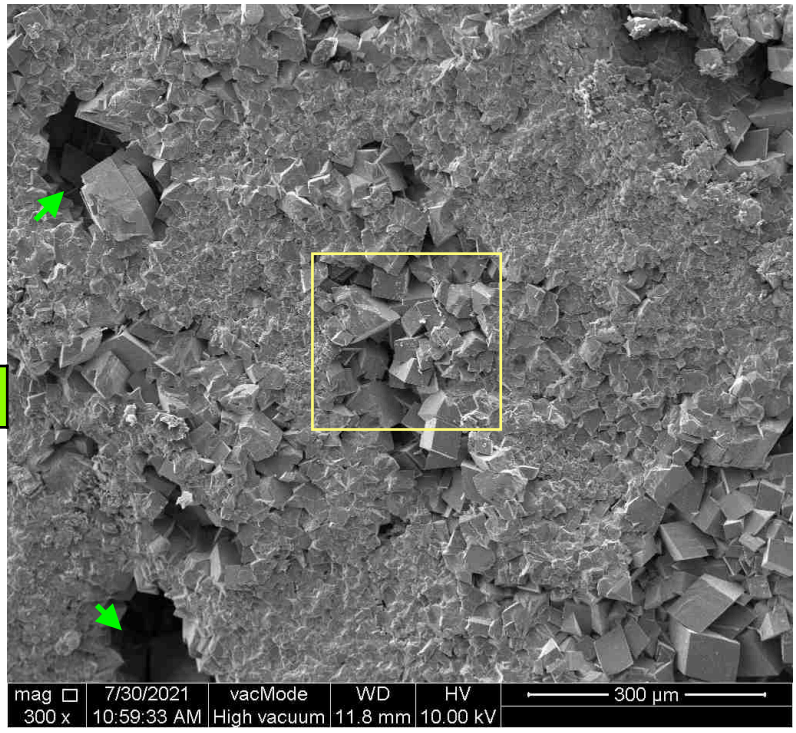
Summary: The aquifer interval is comprised of densely crystallized, microcrystalline dolomite that contains scattered (residual) skel-moldic macroporosity. The skel-moldic pores are commonly rimmed & partially filled with fine to medium-crystalline, (euhedral) dolomite cement. Bands of relatively porous dolomite (i.e., with increased concentrations of residual skel-moldic porosity) alternate with layers of relatively non-porous, matrix-supported dolomite. The dolomite matrix is microcrystalline, with a mean crystal diameter of ~ 1-4 um. The pore-lining authigenic dolomite is fine to medium crystalline (x ~ 40-60 um). Traces of microcrystalline pyrite (?) cement are locally present as a late stage precipitate (e.g., see Figure 4C). The pore system is unevenly distributed and includes skel-moldic & intercrystalline (macro + micro) porosity. The core void volume ranges between ~2.2-3.4% (for the vertical and horizontal core plugs), with Klinkenberg permeability values of 0.0020 - 0.0012 md. The estimated pore volume within the thin section is ~8-10%. The secondary macro-pores are poorly interconnected and are commonly separated by densely crystallized & tightly interlocked dolomite cement.

21117-04 Photo Index:

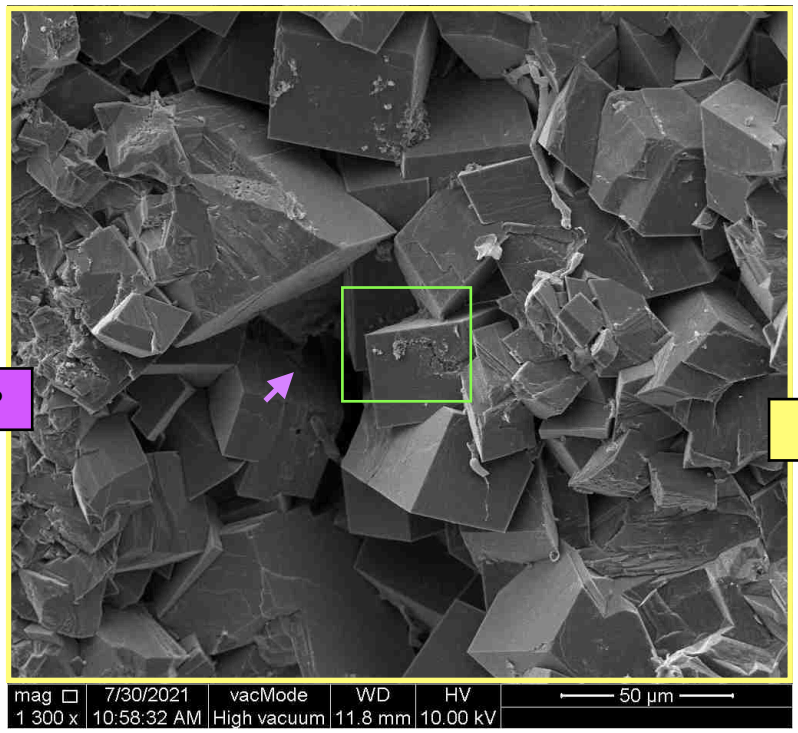
Sample ID	Magnification
21117-04A	300X
21117-04B	1300X
21117-04C	10000X
21117-04D	400X
21117-04E	1500X
21117-04F	5000X

Skel-moldic porosity	SM
Microcrystalline pyrite (?)	P
Authigenic Dolomite	D
Intercrystalline porosity	BP

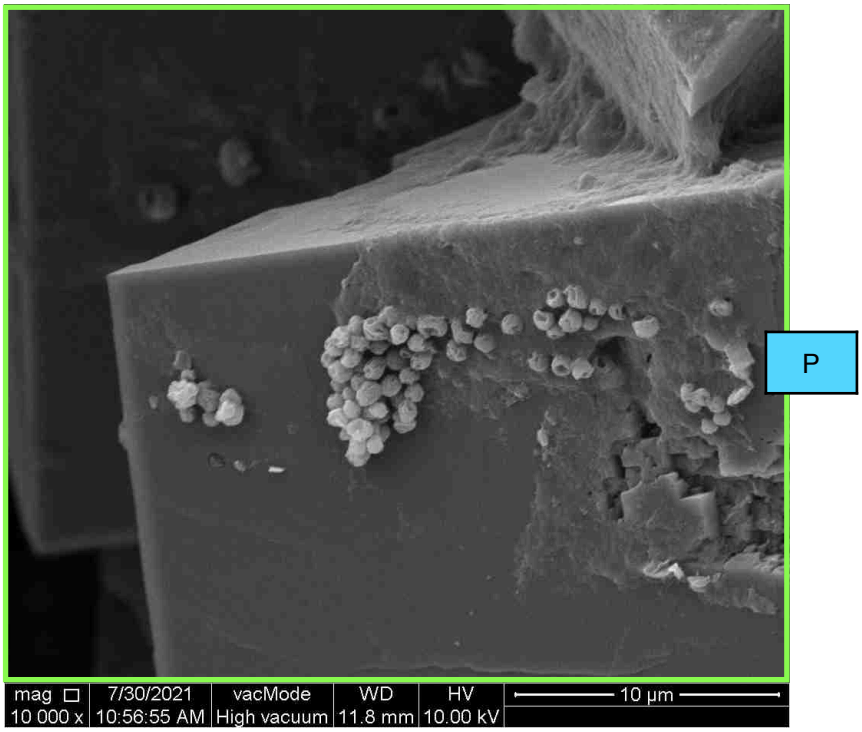
21117-04A 300X



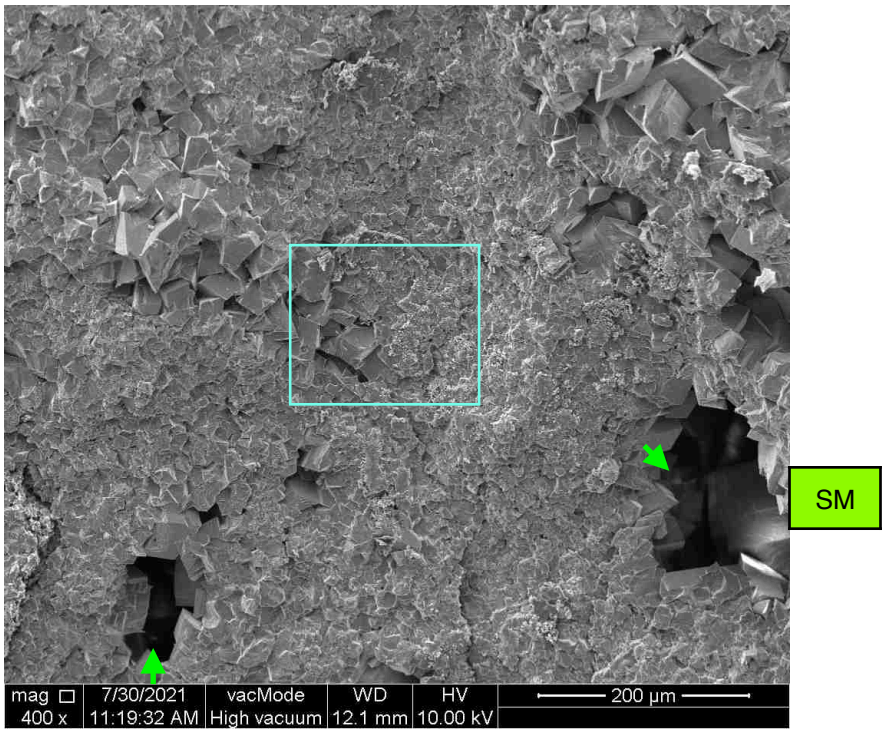
21117-04B 1300X



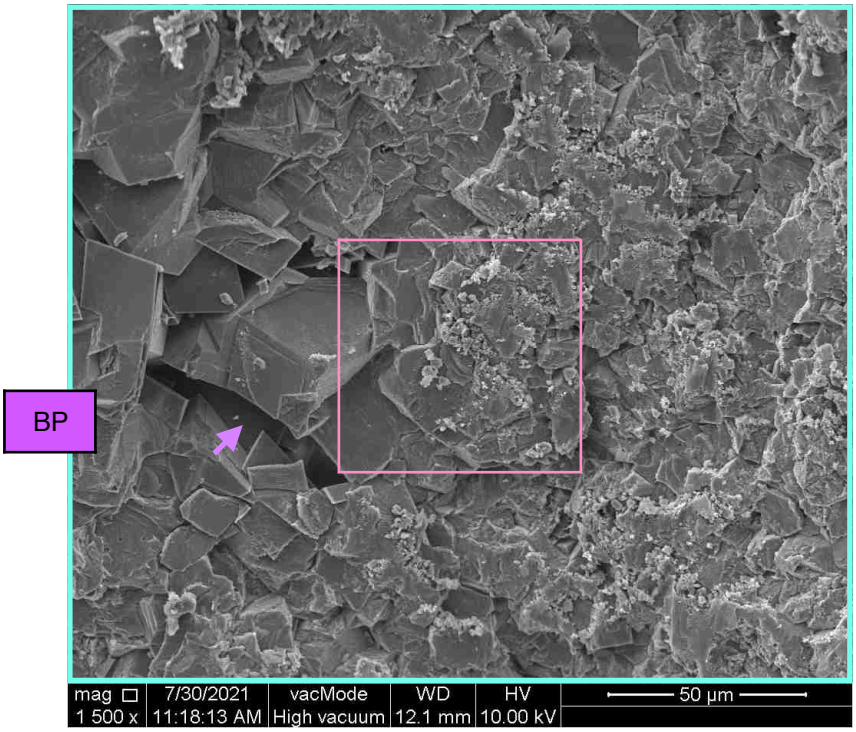
21117-04C 10000X



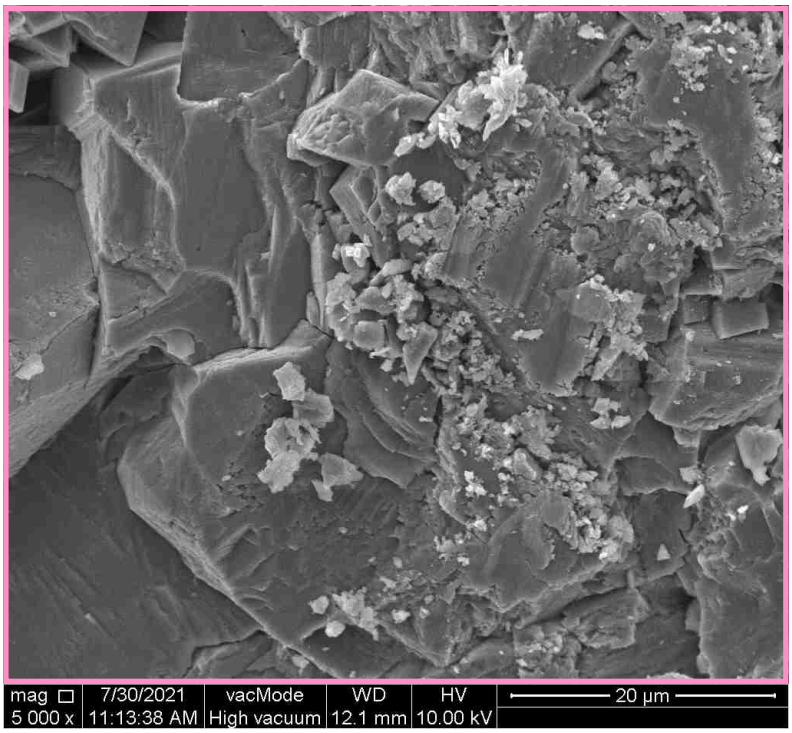
21117-04D 400X



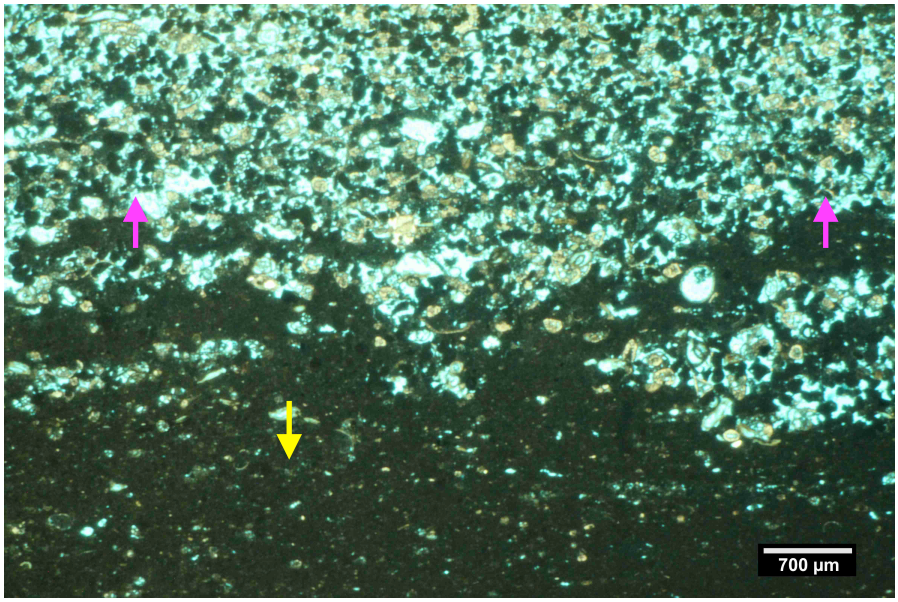
21117-04E 1500X



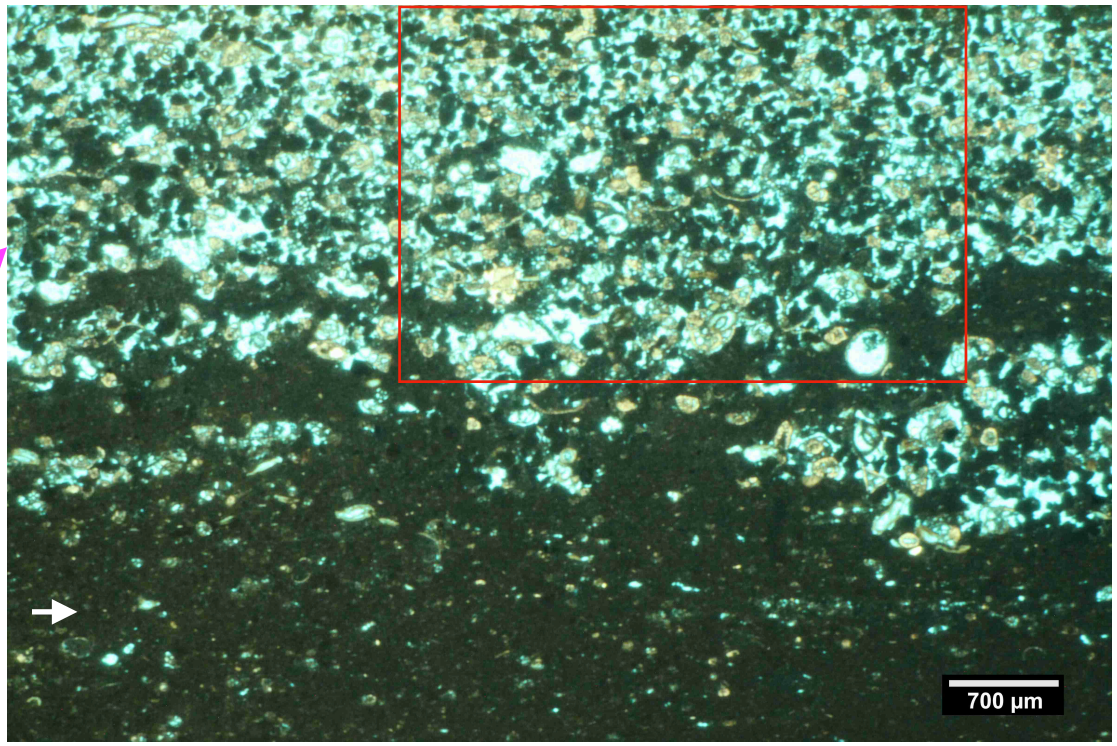
21117-04F 5000X



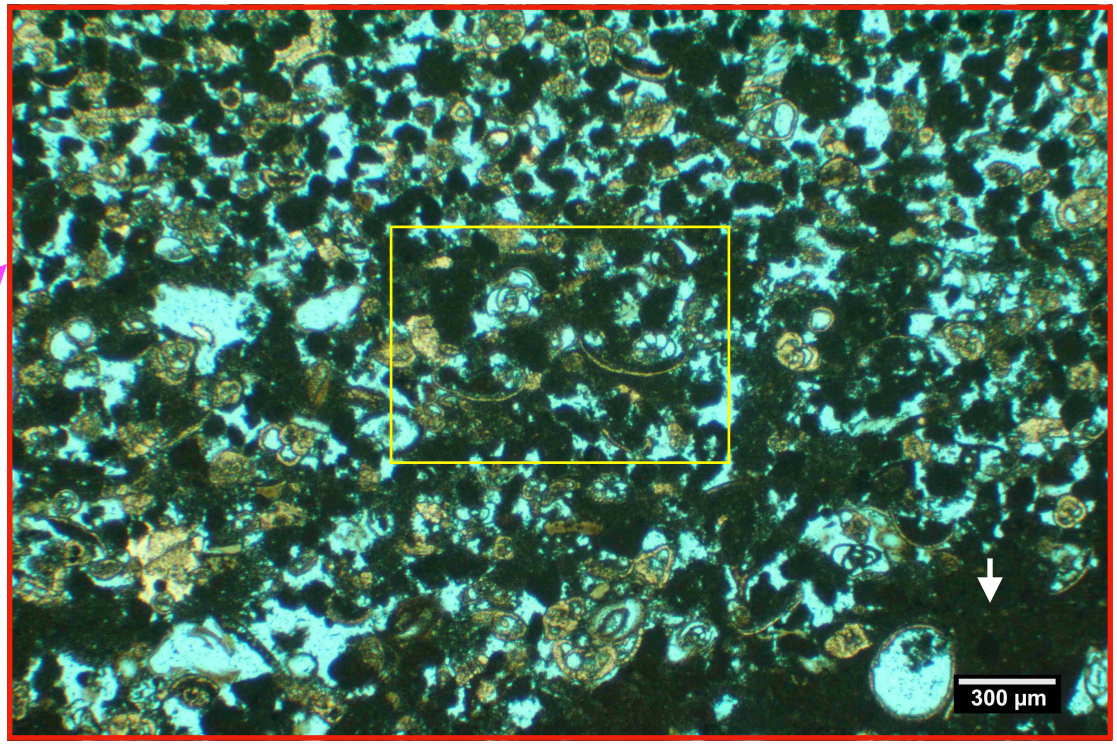
Petrographic Data Summary - L-63N; Core Depth: 1154 - 1155 ft.; MI#21117-05

Lithologic Classification: Foram - Algae Lime Packstone / Wackestone	
Texture	The grain-supported sediment layers (magenta <) are comprised of macro-porous, foram and algae-rich skeletal lime packstone. Layers of matrix-rich, microporous, foram lime wackestone (yellow <) are interbedded with the skeletal lime packstone intervals. The limestone is microcrystalline with a mean crystal diameter of ~ 0.5-1.5um. Foraminifera tests and calcareous algae plates range from coarse silt to very fine sand-sized carbonate grain materials.
Detrital Grains / Allochems	1) Foraminifera - locally with intra-particle macro-porosity 2) Calcareous algae
Matrix / Cements	Microcrystalline calcite is ubiquitous as a pore-filling matrix / cement within the lime wackestone interbeds. The interbeds of grain-supported limestone exhibit scattered clusters of infiltrated microcrystalline calcite cement.
Pore Stystem	The pore system includes intercrystalline (macro + micro) porosity, intra-particle porosity, and skel-moldic porosity. A significant percentage of the total available *macro* pore volume within this limestone interval is concentrated within the grain-rich lime packstone interbeds. Helium porosity values are 38.0-38.2%, with a grain density of 2.70 g/cm3. The horizontal Klinkenberg permeability is 3.23 md, with a vertical permeability of 1.77 md.

1154 - 1155; MI#21117-05

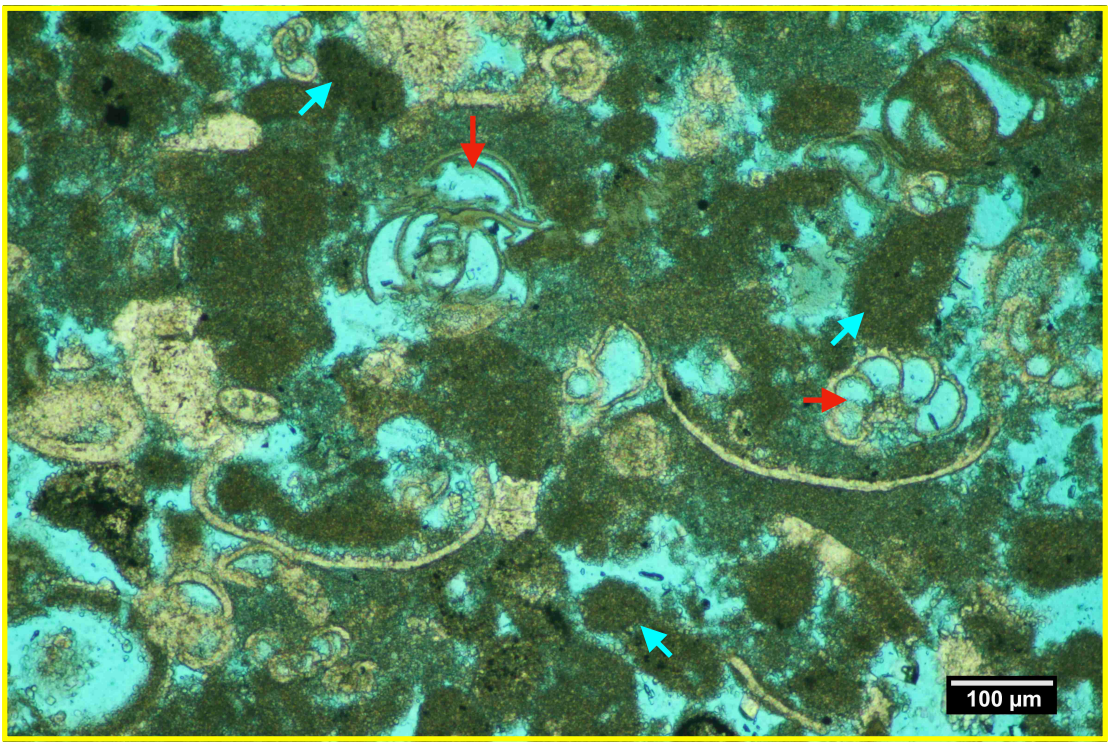


5A. Foram-algae lime packstone / wackestone. The skeletal packstone layers (magenta <) are abundantly macroporous compared to the matrix-rich wackestone (white <) layers.

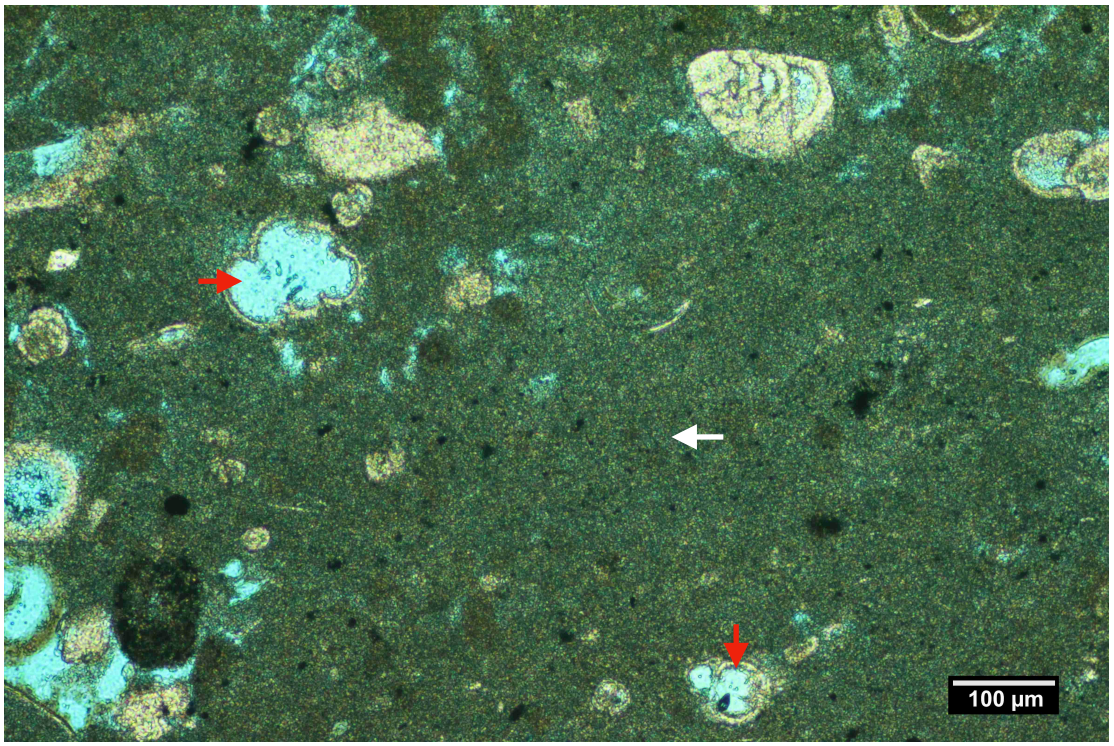


5B. Detailed view of the highlighted area from Figure 5A, near the transition from matrix-rich lime wackestone (white <) to grain-supported skeletal lime packstone (magenta <).

1154 - 1155; MI#21117-05



5C. Detailed view of the highlighted area from Figure 5B. Calcareous algae plates (blue <) & foram skeletal fragments (red <) comprise the bulk of the grain materials.



5D. A detailed view of the microcrystalline lime mud matrix (white <) that dominates the groundmass in the matrix-rich lime wackestone lithotype. Note the scattered skel-moldic pores associated with the foram tests (blue; red <).

L-63N Continuous Corehole

Boring: M01L63N

1154-1155 ft.

MI#21117-05 - SEM

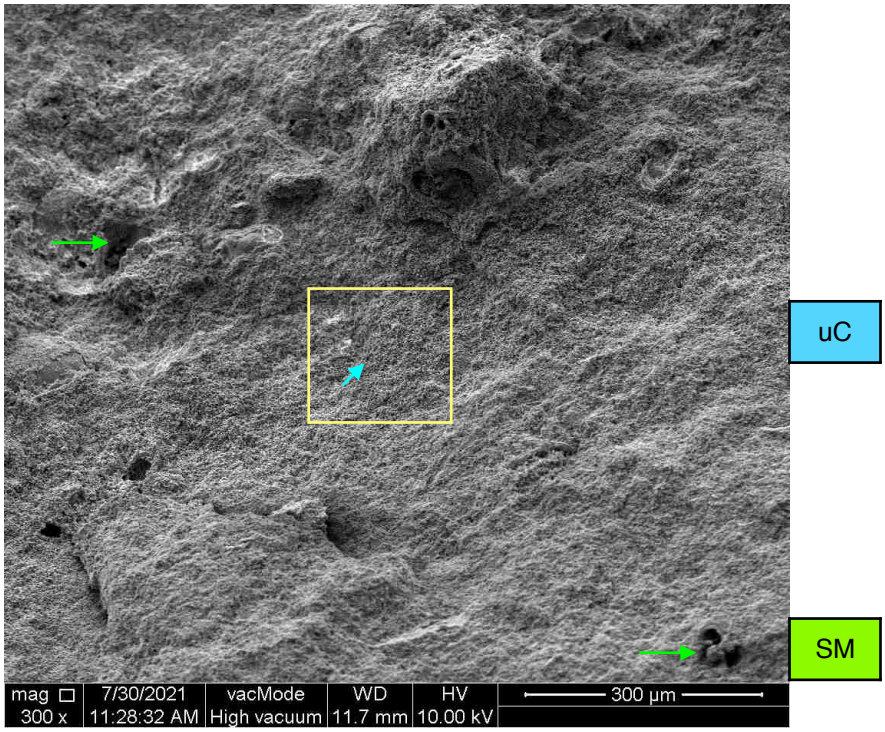
Summary: This limestone sample is characterized as a form - algae lime wackestone. The overall aquifer interval includes layers of interbedded skeletal-rich lime packstone. The skeletal lime wackestone lithotype is matrix-supported and contains scattered foram tests and calcareous algae plates. Scattered pockets of skel-moldic and intercrystalline macro porosity are locally associated with clusters of skeletal grain material. The limestone is microcrystalline with a mean crystal diameter of ~ 0.5-1.5um. Fine sand-sized foraminifera tests and calcareous algae plates are the principal allochem grain types. The lime wackestone materials are moderately porous and exhibit a mixture of skel-moldic pores, intercrystalline microporosity, and minor amounts of intercrystalline macro porosity. Conversely, the grain-rich lime packstone interbeds (not reflected in the SEM specimen prepared for this interval) are abundantly macro porous and exhibit large amounts of residual inter-particle and intra-particle porosity (including *secondary* skel-moldic voids). The pore system is unevenly distributed between the grain-rich lime packstone & wackestone lithotypes, & may contribute to heterogeneous flow properties for this portion of the aquifer. The helium porosity measured for this interval ranges between ~38.0-38.2% (for the vertical and horizontal core plugs), with Klinkenberg permeability values of 1.77-3.23 md. Heterogeneous flow properties across the interval are likely due to the Selected interbeds of skeletal lime packstone

21117-05 Photo Index:

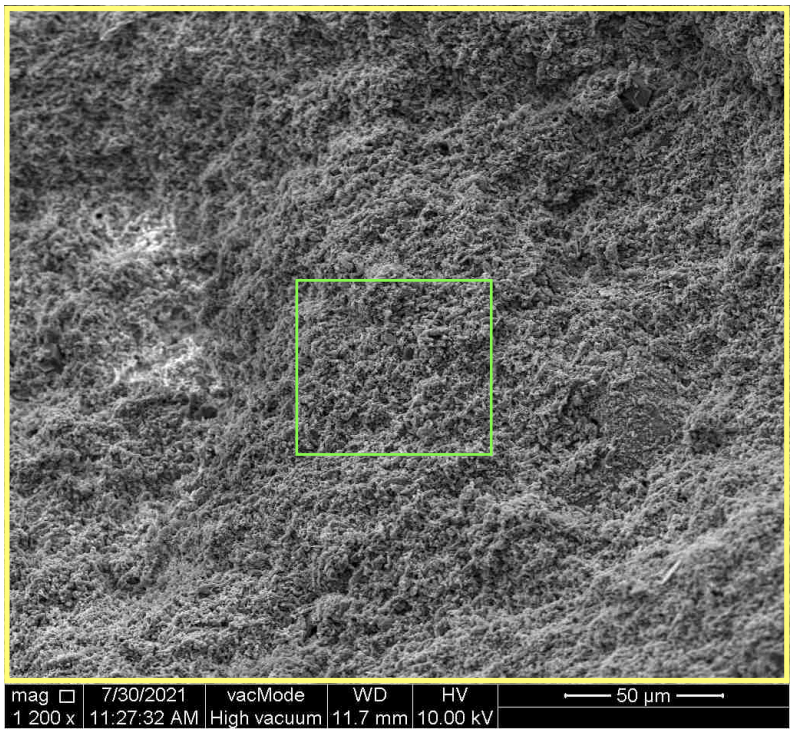
Sample ID	Magnification
21117-05A	300X
21117-05B	1200X
21117-05C	5000X
21117-05D	10000X
21117-05E	1000X
21117-05F	4000X

Skel-moldic porosity	SM
Microcrystalline calcite	uC
Foram Test	F
Intercrystalline microporosity	uP

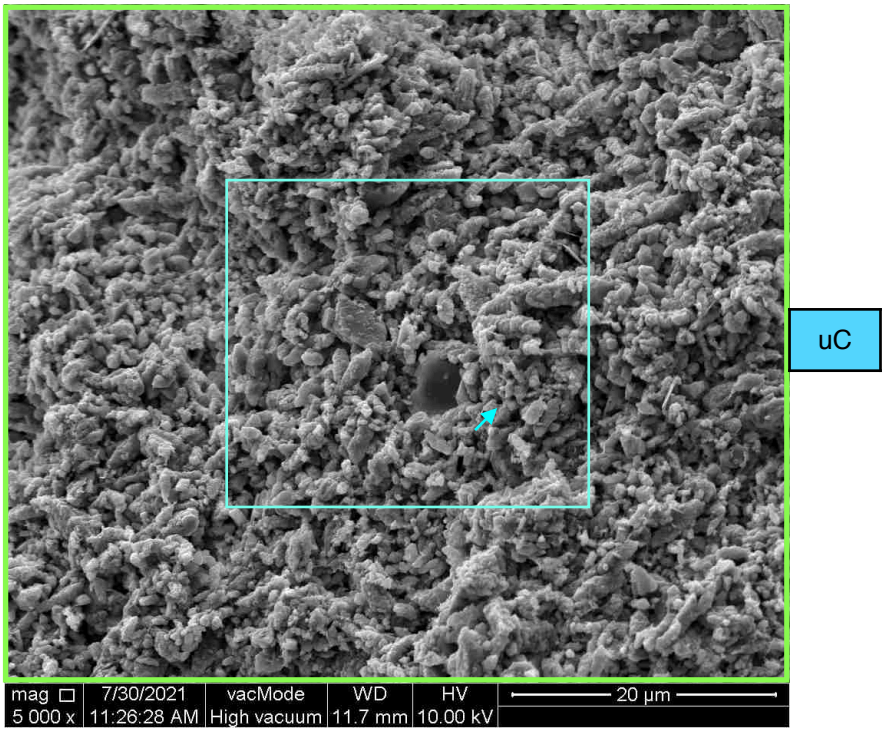
21117-05A 300X



21117-05B 1200X



21117-05C 5000X



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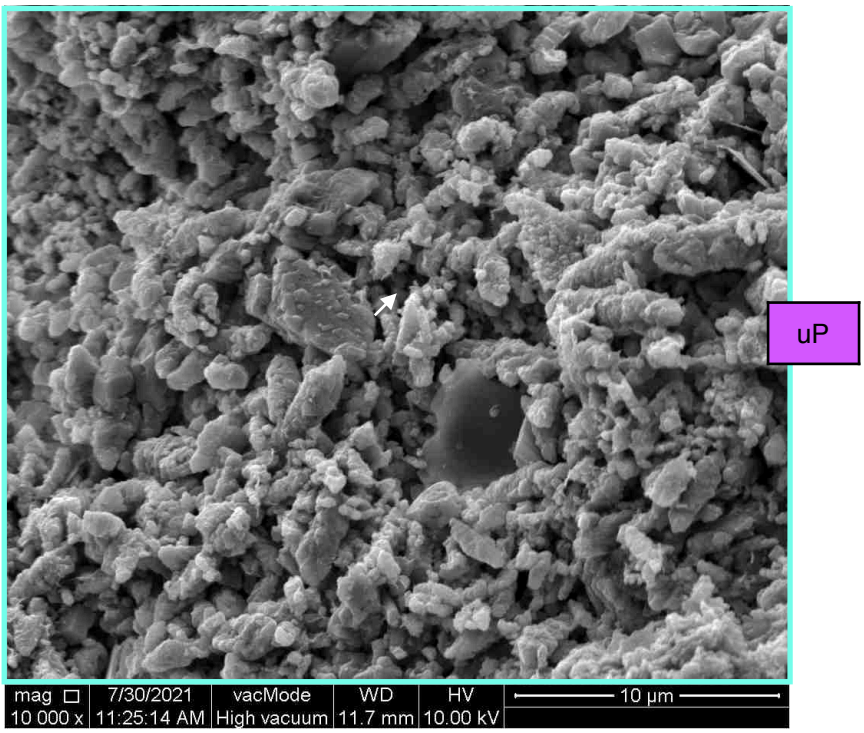

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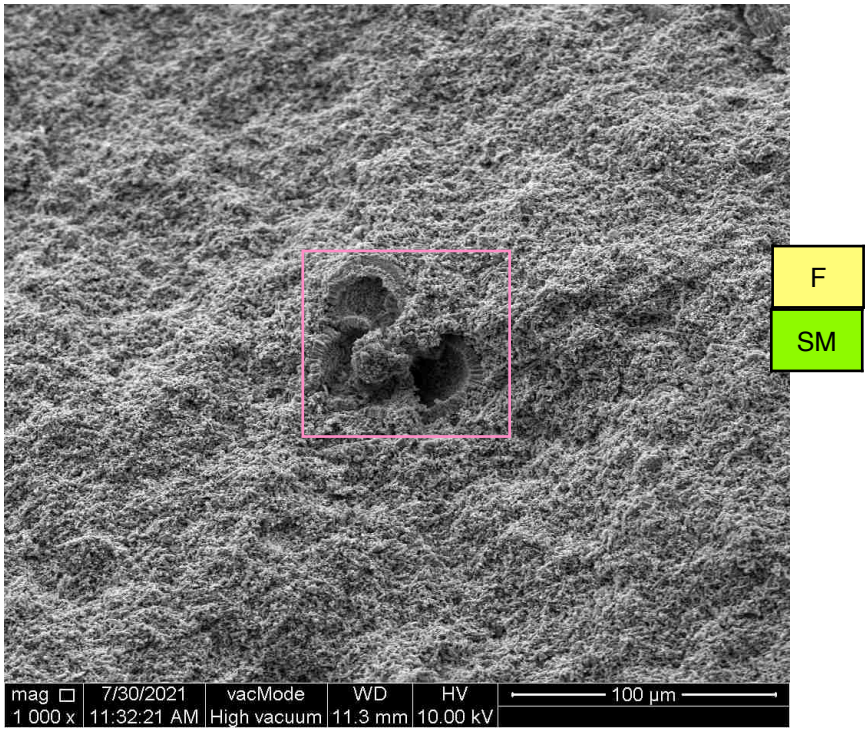

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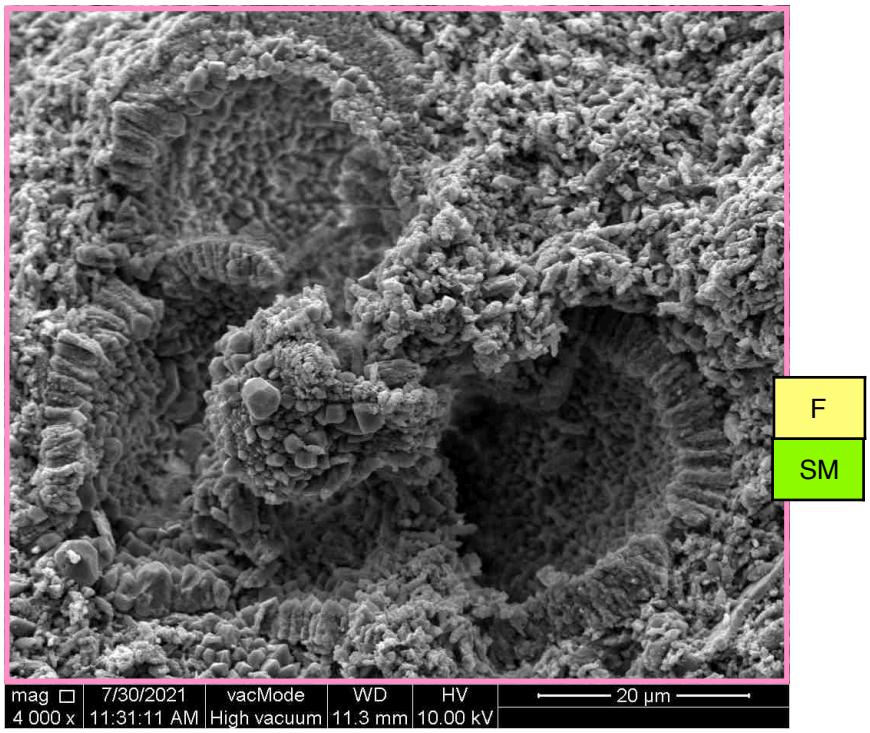

APPENDIX E:
AQUIFER STORAGE AND RECOVERY ECOLOGICAL RISK ASSESSMENT MOBILE LABORATORY DESIGN AND COST ESTIMATE

Aquifer Storage and Recovery (ASR) Ecological Risk Assessment (ERA)

Mobile Laboratory Design and Cost Estimate FINAL

December 2021
ECT No. 210668-0400

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
Contract No. 4600003423-WO47R1
West Palm Beach, Florida

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Gainesville, Florida 32607
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1.0 Introduction

As part of the original Comprehensive Everglades Restoration Plan (CERP) Regional ERA, studies were conducted to understand the potential ecotoxicological impacts of ASR recovered water discharges on receiving water body ecology. For these studies, one ASR pilot well (Kissimmee River ASR [KRASR]) was available for use in the bioconcentration/ecotoxicological studies; thus, the Regional ERA risk characterization was based on data generated from one ASR well. Following release of the ASR Regional Study Final Technical Data Report (SFWMD and USACE, 2013) and CERP ASR Regional Study Final Report (SFWMD and USACE, 2015), the National Research Council (NRC) reviewed the documents in 2015. The NRC concurred with the report findings of expected low to minimal impacts but identified some uncertainties and topics that warranted continued investigation (NRC, 2015).

To address the input from the NRC, SFWMD and the U.S. Corps of Engineers (USACE) developed the 2021 ASR Science Plan (Plan). This Plan describes a suite of potential additional studies to be conducted to provide additional quantitative data. These studies will evaluate new ASR wells being implemented in a phased manner (SFWMD and USACE, 2021). The Plan was developed to address the technical uncertainties of the regional risks of large-scale ASR implementation as identified by the NRC (NRC, 2015).

The NRC noted that the acute/chronic toxicity of the recovered ASR water and the bioconcentration potential of arsenic and other trace metals likely would differ with a target storage volume approach and different geochemical conditions in the aquifers to be used, and that more study was needed on the water quality changes under the conditions generated by new ASRs. The peer review panel (PRP) to the Plan also noted that more research was needed into the ecological and ecotoxicological impacts of discharging ASR recovered water to the Kissimmee River, Lake Okeechobee, the Greater Everglades, and canals (Arthur *et al.*, 2020).

To address the concerns of the NRC and PRP, additional toxicity and bioconcentration studies focused on arsenic, other select trace metals, and stressors will be developed using standard laboratory tests, field mesocosm, or *in situ* field exposures to quantify longer-term effects using relevant bioindicators, e.g., mussels. The studies will be completed at multiple well locations to evaluate potential differences in local groundwater and aquifer geochemistry during the storage process and effects of different storage durations and recovery volumes.

Currently, no ASR wells are cycling. The KRASR is expected to be reinitiated in 2022 following completion of the testing of several treatment technologies. Prior to the KRASR coming online, SFWMD has requested ECT to design and construct a mobile laboratory with the capabilities to run bioconcentration studies (mussels, fish, etc.) at multiple locations (ASR wells) within the Lake Okeechobee Watershed Restoration Project area as stated in the Plan. The design of the proposed mobile laboratory builds upon the design of the laboratory used for previous studies, with improvements to accommodate the new scope of services.

This report includes the preliminary design and cost estimate of the ASR mobile bioconcentration laboratory (Appendices A, B, and C). This laboratory can be transported to multiple ASR sites to conduct the studies previously described. The estimated costs presented are for construction of one mobile laboratory. However, if additional laboratories are needed in the event multiple ASR wells/well

clusters are in recovery over the same period, additional mobile laboratories can be constructed using the design and material costs estimates provided here (updated for material cost fluctuations, as appropriate).

2.0 Laboratory Design And Function

The laboratory will be a 20-foot trailer outfitted to include features and components necessary to run ecotoxicity and bioconcentration studies in the field. The laboratory will be easily transported to different ASR well sites, as needed.

2.1 General Layout

The 20-foot trailer will be manufactured by a reputable supplier (Wells Cargo or equivalent). The trailer "shell" will be constructed to accommodate the plumbing and electrical needs of the laboratory. Appendix A presents the design drawings of the laboratory described. Appendix B provides an itemized list of components.

The power supply will be carefully integrated into the design with standard, ground fault circuit interrupter (GFCI) electrical outlets placed on both the inside and outside of the trailer to run various pumps, heaters, a cooler, a mini refrigerator, and various testing equipment. Externally, there will be a rear access door to allow larger objects (i.e., desk, water bath stands, etc.) to be moved in and out of the trailer. The laboratory will include two climate control units, capable of both heating and cooling, and two windows with blinds to allow for control of ambient light. On the interior there will be two water-resistant benches. One will be at laboratory bench height for specimen preparation and processing, and the other bench will be at a standard sitting height to be used as a desk. Each bench will have multiple drawers, and there will be overhead cabinets for storage. The bench-height desk will allow for a mini refrigerator to be stored beneath for items requiring refrigeration (Figure 1). There will be a deep work sink with connections for water supply. The trailer will have four large shelves (two on each side) to hold water baths with a capacity to house up to twelve 10-gallon tanks for exposures to different recovered/recharge water mixtures (Figure 2).

Figure 1. Example of Interior of Mobile Laboratory

Figure 2. Example of Water Baths

2.2 Water and Air Supply

The exposure system design will include a head tank water bath that is temperature-controlled using a chiller/heater. In this water bath there will be two 20-gallon tanks that will be fed recovered ASR water and recharge water from external holding tanks, dependent upon which stage of cycle the ASR well is in. Each water type will then be pumped from the head tanks into 6-inch polyvinyl chloride (PVC) pipes that can distribute water to up to 24 different test aquaria (exposure vessels) (Figure 3). The PVC pipe distribution system will be equipped with compression couplings and cleanout T's to allow for installation, removal, and maintenance. The 10-gallon test aquaria will be located on either side of the trailer in water baths on two levels, six up top and six below, for a total of 24 test aquaria. These water baths will not only collect the overflow from the aquaria but will also have a standpipe to maintain approximately 4 to 6 inches of water to help regulate water temperature within the test aquaria.

Figure 3. Example of Temperature-controlled Head Tanks

The bioconcentration tests will be conducted under flow-through conditions, and the recovered water and/or recharge waters will be gravity-fed to each test aquaria. Each aquarium will be equipped with a standpipe to maintain the tank volume to approximately 8 gallons. Expected flow rate of this flow-through system will be set to allow for a minimum of five tank replacements a day. Any unused test water will be returned to the head tanks to be circulated again. The water turnover from the test aquaria will be piped to the exterior of the laboratory for discharge to the ground or permitted point of discharge.

All test aquaria will be aerated to maintain proper dissolved oxygen and pH measurements.

Located on the side of the trailer will be an awning door that will provide access to the area housing the pumps. Within this cabinet will be a chiller, with a temperature range of 60 to 80 degrees Fahrenheit (°F), two air pumps, and the water pumps. One water pump will provide flow through the chiller for the water baths for the head tanks, while the other two pumps will feed test waters to the head tanks from external sources. This area will be accessible both from the outside and inside of the trailer (Figure 4).

Figure 4. Example Exterior of Mobile Laboratory and External Holding Tanks with Exterior Access to Pump House

Three 500-gallon open top carboy tanks will also be provided and placed outside the trailer (Figure 4). One carboy will receive water directly from the ASR recovered water outfall (via jet-pump), and two other 500-gallon carboys will be used to store surface (recharge) water collected from upstream of the ASR outfall, outside the influence of the discharge. These two carboys will be connected with a siphon to effectively create 1,000 gallons of recharge water storage capacity, which will be needed to supply the bioconcentration studies. Supply to head tanks from the external carboys will be controlled via float switches. A 450-gallon truck tank and additional 500-gallon tank on a trailer will be used to collect the recharge water from upstream of the ASR site. These carboys will be filled from a predetermined location upstream of the ASR using a generator and jet-pump system (Figure 5).

Figure 5. Recharge Water Collection System

2.3 Analytical Measurements

The trailer will be outfitted with the necessary water quality measurement instruments and dissection tools needed for bioconcentration studies. Included will be a YSI multiparameter meter for *in situ* water quality measurements that will be taken once every day during the study. The laboratory will be outfitted with a small refrigerator that can be used to keep samples cold prior to shipping.

3.0 Estimated Cost

The estimated cost of the mobile laboratory summarized here is a combination of the trailer shell, internal components, external tanks, and recharge water collection components (Table 1, materials described in the preceding sections). The estimated costs were estimated from materials purchased during construction of the original mobile laboratory (based on current market costs) and include updated design considerations. Appendix B contains a detailed breakdown of the estimated materials, including costs.

Two quotes were obtained for construction of the trailer shell: Wells Cargo and Cargo Mate (Appendix C). Both options include the same base trailer and electrical components, the only difference being location of manufacturer and cost. For budgeting purposes, the higher cost is included in this estimate. However, the final choice for trailer construction will be dependent upon updated costs and procurement time.

Table 1 also presents the estimated total cost for purchasing the materials and equipment to run the mobile laboratory.

Table 1. Estimated Mobile Laboratory Cost

Item	Description	Estimated Cost
Trailer	Shell of mobile laboratory (high estimate)	$25,409.82
Mobile Laboratory	Combination of anticipated components needed to fully build out the mobile bioconcentration laboratory	$26,922.41
Contingency	Costs to cover potential un-anticipated equipment modifications/additions	$2,000.00
Estimated Total		**$54,332.23***

*Labor costs to procure the trailer or procure and construct the internal components are not included in these costs.

4.0 References/Bibliography

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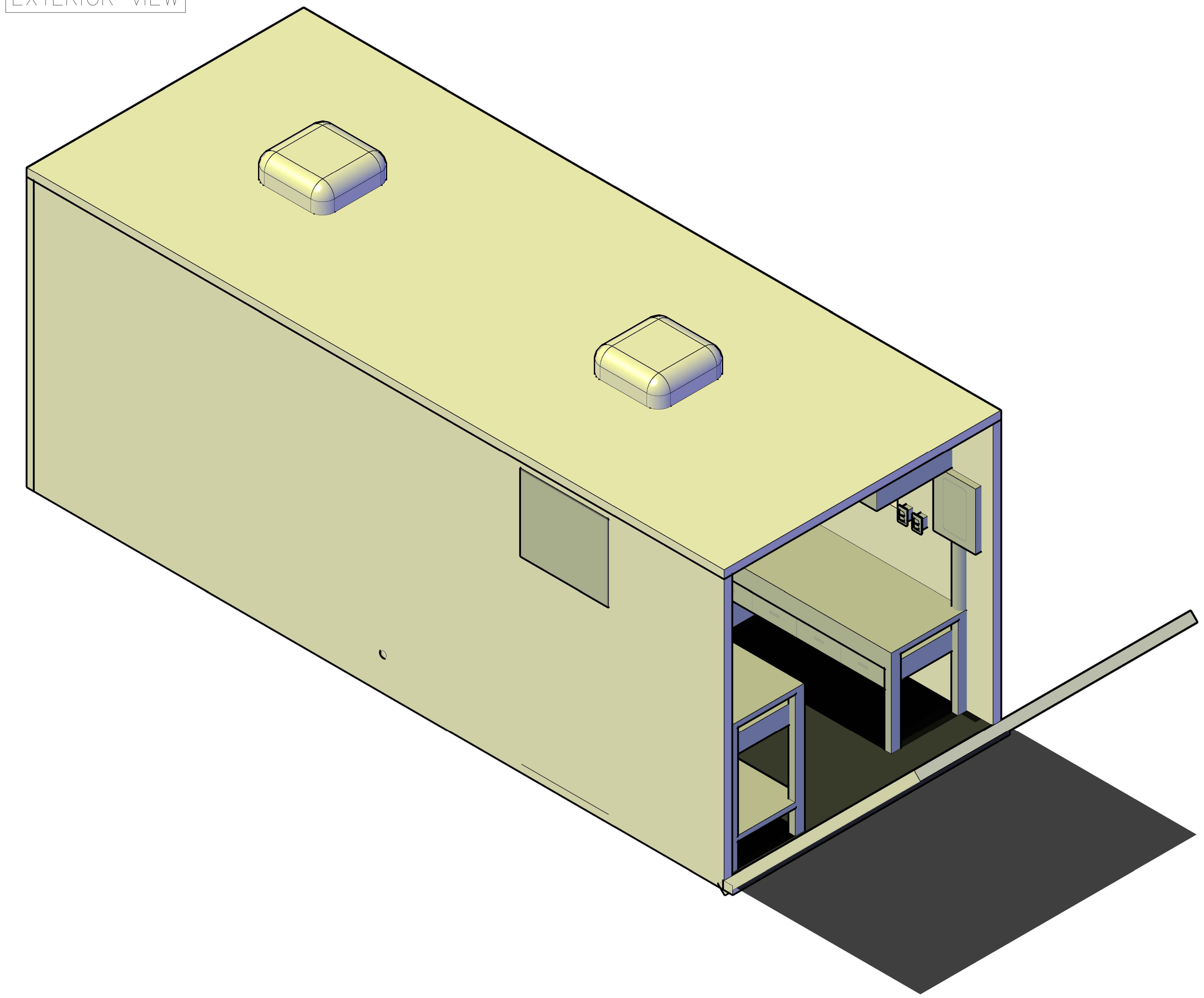
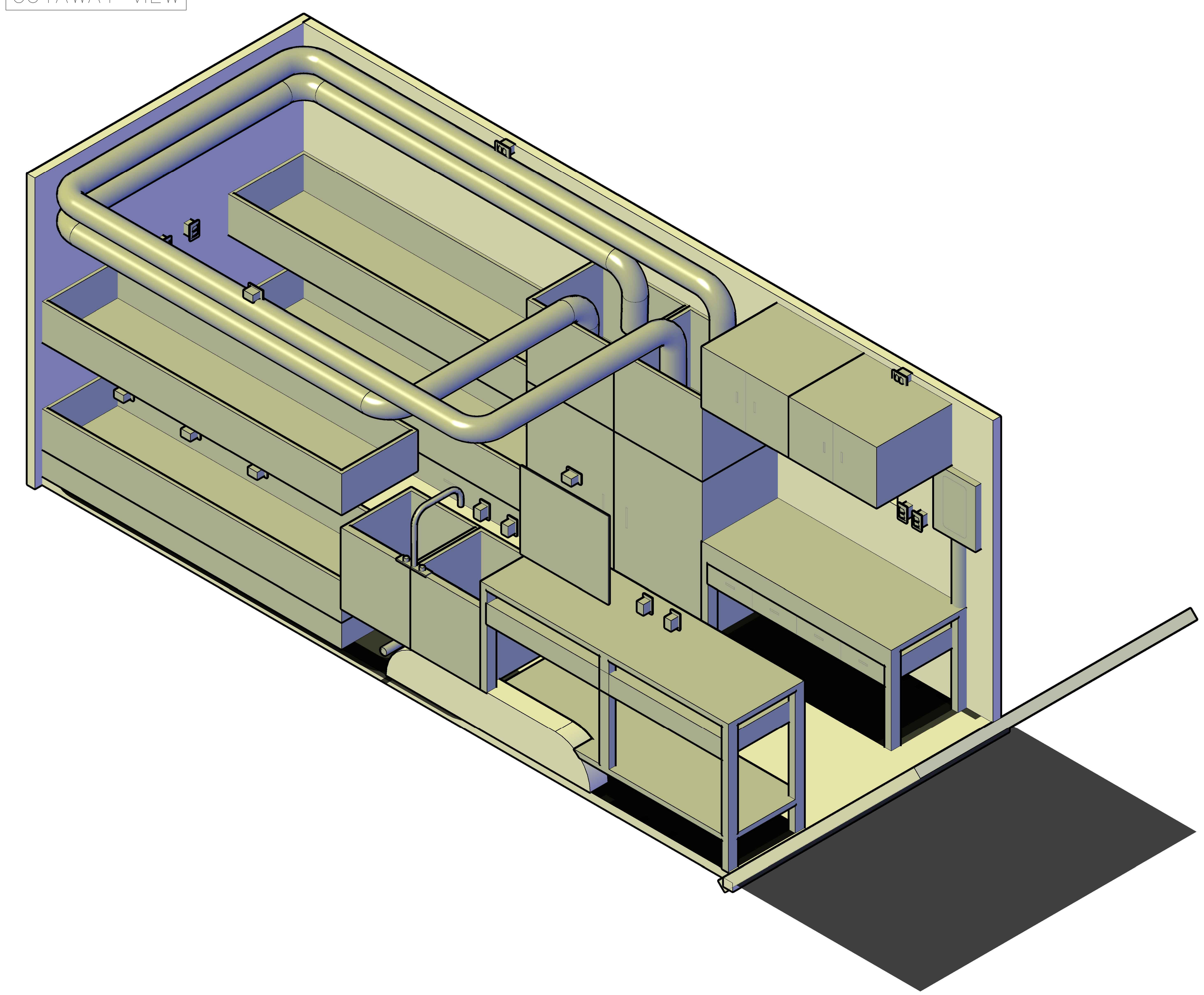
Appendix A Trailer Design Drawings

EXTERIOR VIEW



CUTAWAY VIEW



ECT Environmental Consulting & Technology, Inc.
Address
City, State Zip
Phone: (XXX) XXX-XXXX
www.ectinc.com

10/5/2021 11:00 AM by Jake Kurey

MOBILE LAB DESIGN

ECT PROJECT No.:	21-0668
DESIGNED BY:	JM
DRAWN BY:	JK
CHECKED BY:	CM
APPROVED BY:	JM
CONCEPT PLAN	10-04-2021

CONCEPTUAL TRAILER LAYOUT

N

SCALE: 1" = 20' @ 22 X 34

0 10 20 40

C1.01

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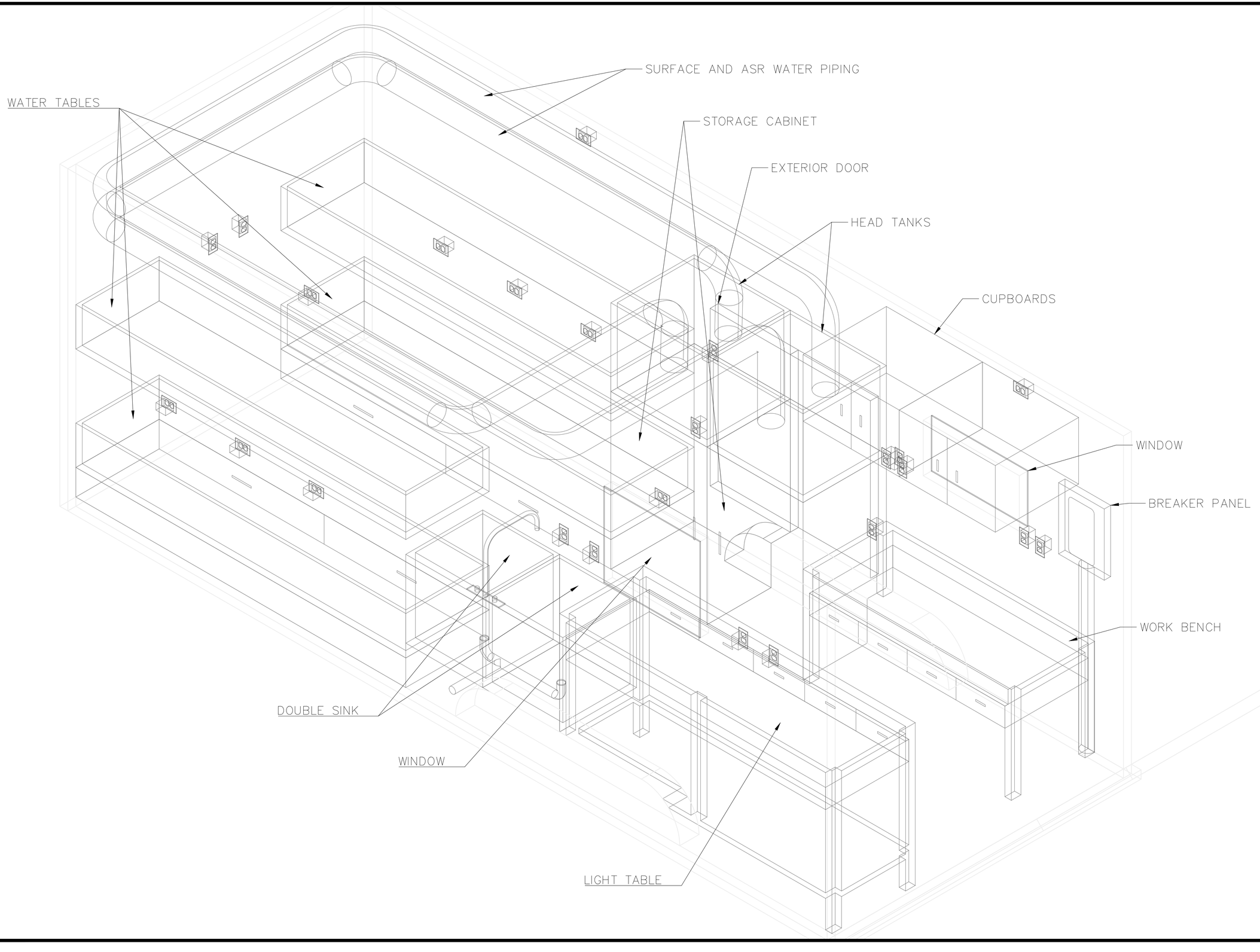

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10/5/2021 11:00 AM by Jake Hurley

MOBILE LAB DESIGN

ECT PROJECT No.:	21-0668
DESIGNED BY:	JM
DRAWN BY:	JK
CHECKED BY:	CM
APPROVED BY:	JM
CONCEPT PLAN	10-04-2021

OVERALL VIEW

N

SCALE: 1" = 10' @ 22 X 34

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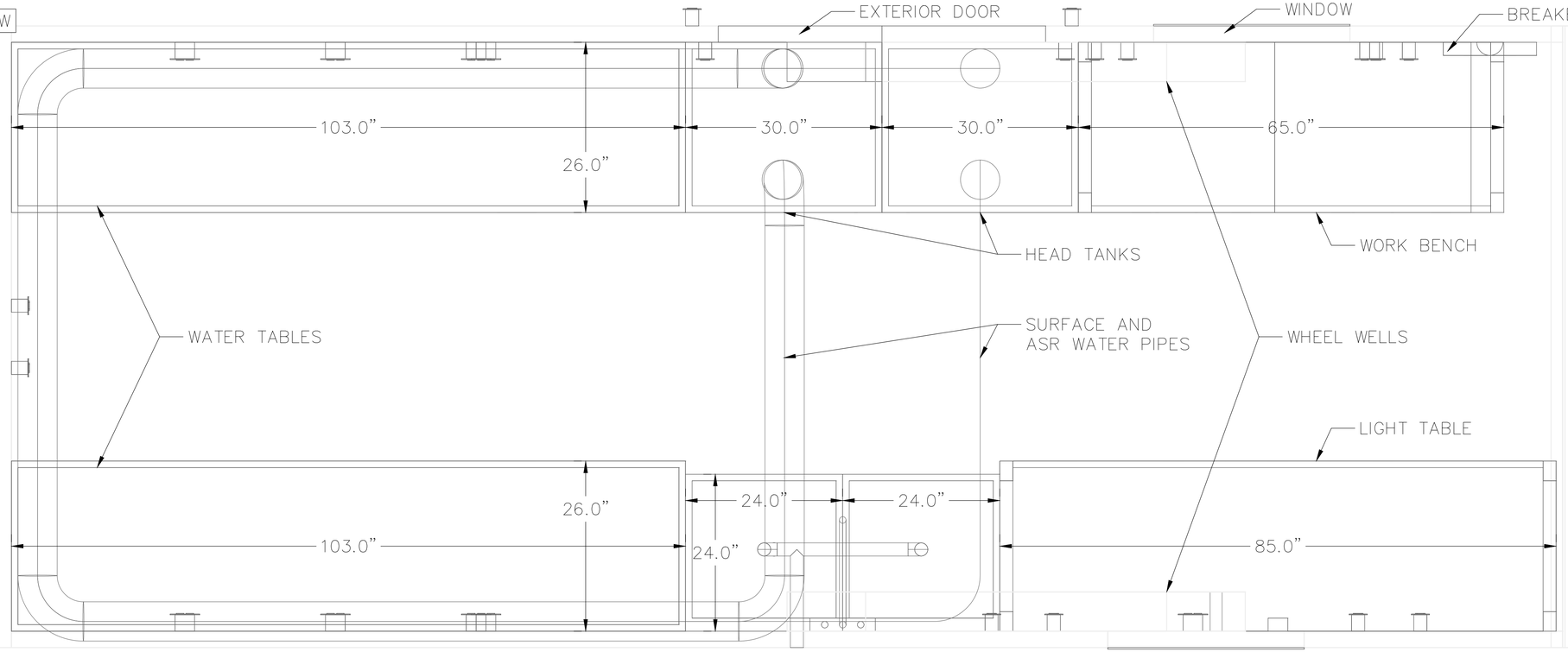
TOP EXTERIOR VIEW

TOP INTERIOR VIEW



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10/5/2021 11:00 AM by Jake Hurley

MOBILE LAB DESIGN

ECT PROJECT No.:	21-0668
DESIGNED BY:	JM
DRAWN BY:	JK
CHECKED BY:	CM
APPROVED BY:	JM
CONCEPT PLAN	10-04-2021

TOP VIEW

N

SCALE: 1" = 10' @ 22 X 34

0 5 10 20

C1.03

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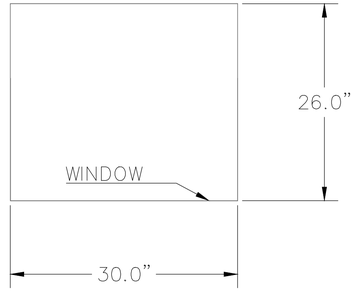
LEFT EXTERIOR VIEW



LEFT INTERIOR VIEW

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10/5/2021 11:00 AM by Jake Kurey

MOBILE LAB DESIGN

ECT PROJECT No.:	21-0668
DESIGNED BY:	JM
DRAWN BY:	JK
CHECKED BY:	CM
APPROVED BY:	JM
CONCEPT PLAN	**10-04-2021**

LEFT SIDE VIEW

N

SCALE: 1" = 10' @ 22 X 34

0 5 10 20

C1.04

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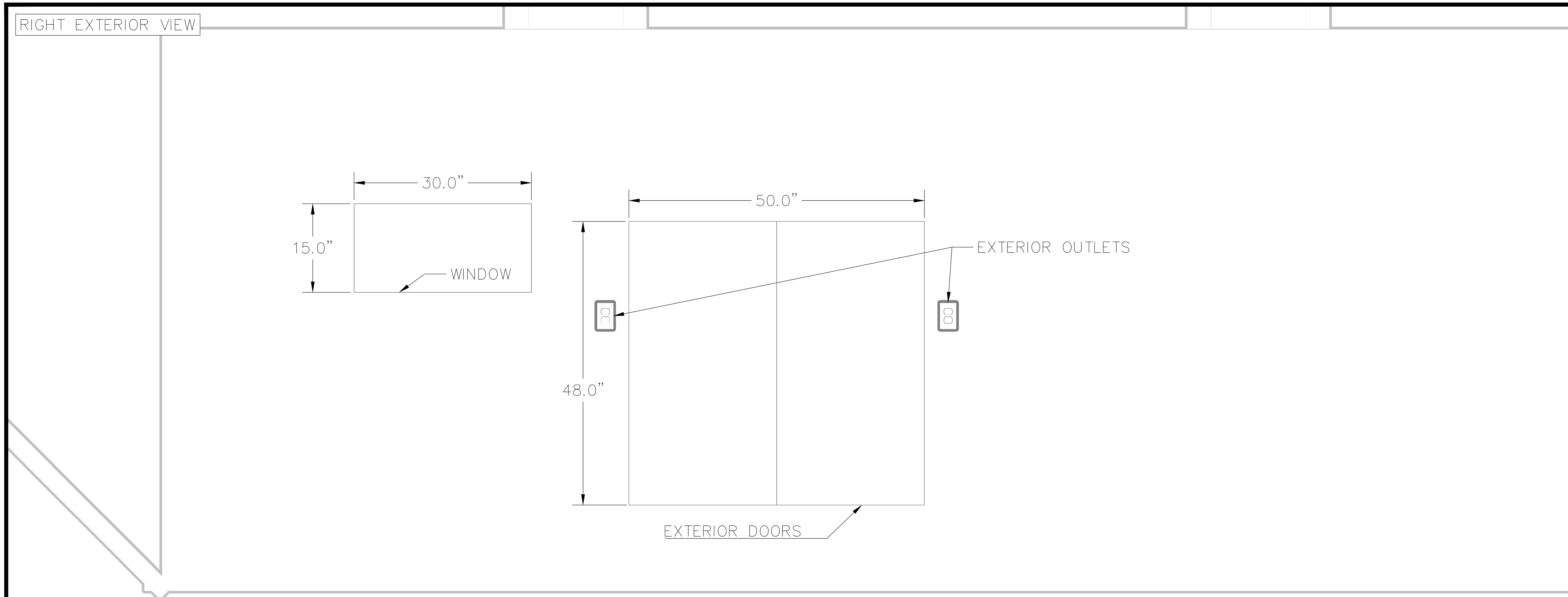

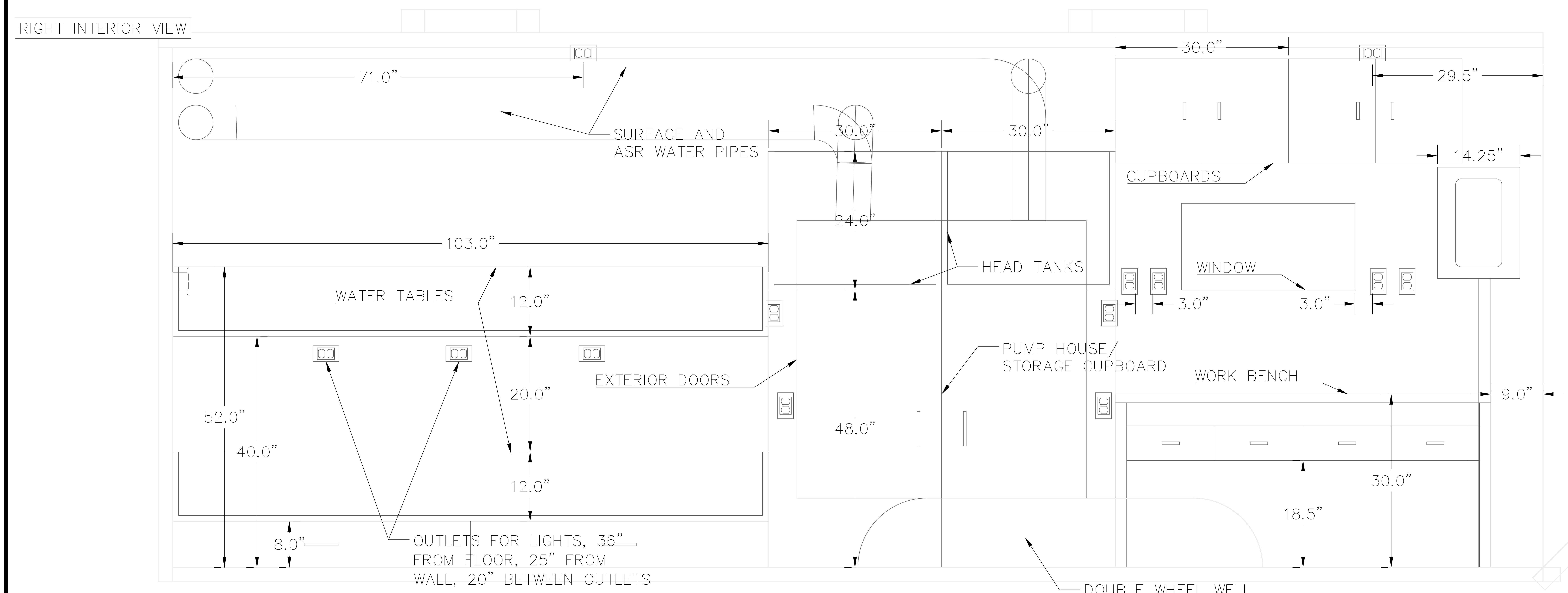

ECT Environmental Consulting & Technology, Inc.
Address
City, State Zip
Phone: (XXX) XXX-XXXX
www.ectinc.com

10/5/2021 11:00 AM by Jake Kurey

MOBILE LAB DESIGN

ECT PROJECT No.:	21-0668
DESIGNED BY:	JM
DRAWN BY:	JK
CHECKED BY:	CM
APPROVED BY:	JM
CONCEPT PLAN	10-04-2021

RIGHT SIDE VIEW

N

SCALE: 1" = 10' @ 22 X 34
0 5 10 20

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C1.05

Appendix B Detailed Cost Table

Table A. Trailer Cost Options

Unit	Description	Cost
Wells Cargo	Trailer company local	$25,409.82
Texas Trailer Sales and Service	Farther trailer company cheaper price	$23,502.38

Source: ECT, 2021

Table B. Laboratory Component Cost

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
Mobile Water Supply							
OP0500-56	500-gallon open top tank	500-gallon flatbed tank	$1,048.99	1	$1,048.99	National Tank Outlet	
PU0450-62	450-gallon truck tank	450-gallon truck tank	$705.99	1	$705.99	National Tank Outlet	
	Generator for supply pump	Generator	$1,500	1	$1,500	Lowes	

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
PT806F	Non-kink tubing, black 3/4"/19 mm inside diameter, 100' coil	100-ft non-kink tubing	$88.37	3	$265.11	Home Depot	
W40HD	Magnetic drive pumps, ¾ MNPT, 120W, 115/60 Hz	Recharge water supply pump	$239.23	1	$239.23	Aquatic Ecosystems	
1720C07	True union swing check values, 3/4"	Check valves	$23.21	2	$46.42	Aquatic Ecosystems	
	Ball Value, 3/4"	Ball valves	$3.35	6	$20.10	Aquatic Ecosystems	
External Water Supply							
PL1U	Float switch, 115V, 13 running amps	Float switches	$70.19	2	$140.38	Aquatic Ecosystems	

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
OP0500-56	500-gallon open top tank	500-gallon open top tank	$1,048.99	3	$3,146.97	National Tank Outlet	
	PVC for siphon between tanks	PVC for siphon between tanks	$300.00	1	$300.00	Home Depot	
1720C07	True Union swing check values, 3/4"	Check valves	$23.21	2	$46.42	Aquatic Ecosystems	
	Ball valve, 3/4"	Ball valve	$3.35	6	$20.10	Aquatic Ecosystems	
PT806F	Non-kink tubing, black 3/4"/19-mm inside diameter, 100' coil	100 ft non-kink tubing	$88.37	3	$265.11	Home Depot	
W40HD	Magnetic drive pumps, ¾-MNPT, 120W, 115/60 HZ	Jet pump	$239.23	2	$478.46	Aquatic Ecosystems	

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
Electrical							
APJ10477	Crouse Hinds ARKTE PLG CAB GRIP/NEO Bush FA	Electrical supply	$1,592.15	1	$1,592.15	GraybaR	
	Lighting	Lighting	$25.00	4	$100.00	Home depot	
Interior Plumbing Components							
PT806	Non-kink tubing, black 3/4"/19 mm i.d., 100' coil	Tubing	$88.37	3	$265.11	Aquatic Ecosystems	
1720C07	True Union swing check values, 3/4"	Check valves	$23.21	2	$46.42	Aquatic Ecosystems	
Maxi-Jet 600	Maxi-jet powerhead, 8W, 160 pgh, 53" pumping height	Pumps from headtanks to water supply lines	$21.99	2	$43.98	Maxi-Jet Powerhead 600-marineland Bulk Reef Supply	

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
MSK714	Miniature stopcocks, 1/2" 14-mm	Control valves	$2.81	12	$33.72	Aquatic Ecosystems	
	½-inch inside diameter, ⅝-inch outside diameter, 10- ft clear vinyl tubing	Water tubing	$5.94	10	$59.40	Home Depot	
B36	Tubing brush	Tubing brush	$4.98	2	$9.96	Aquatic Ecosystems	
SNP19	Plastic clamps	Plastic clamps	$0.81	30	$24.30	Aquatic Ecosystems	
	10-gallon tanks with standpipes	10-gallon tanks with standpipes	$20.00	30	$600.00	Petco	
	20-gallon head tanks	20-gallon head tanks	$50.00	2	$100.00	Petco	

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
	Glass for head tank	Glass for head tank	$200.00	1	$200.00	Shea Glass	
	Head tank bath box		$500.00	1	$500.00	Hydrosphere	
	Water baths	Water baths	$700.00	4	$2,800.00	Hydrosphere	
1720C07	True Union swing check values, 3/4"	Check valves	$23.21	2	$46.42	Aquatic Ecosystems	
	Ball Value, ¾-inch	Ball values	$3.35	6	$20.10	Aquatic Ecosystems	
A50112	Discharge hose, 1 ½-inch	Discharge hose, 1 ½-inch	$57.54	1	$57.54	Home Depot	
	PVC	Overhead PVC water supply channels	$1,000.00	1	$1,000.00	Home Depot	

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
Air Supply							
AS30S	Air diffusers, 12-inch L	Diffusers	$24.09	4	$48.18	Aquatic Ecosystems	
	Air filter Model 9933-11 higher flow DAU	Air filtration	$500	1	$500	Parker-Balston	
	Oil free air pump	Air supply	$100.00	1	$100.00	Bulk Reef Supply	
	Clear PVC tubing 1/4" Outer diameter	Feed lines, ¼-inch outside diameter	$40.03	1	$40.03	Home Depot	
	PVC piping	Air supply line manifold	$5.00	5	$25.00	Home Depot	

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
	Air control valves	Control valves	$2.06	6	$12.36	Bulk Reef Supply	
Temperature Control							
JH800	800-Watt TH titanium heating element	Titanium Heater	$57.99	2	$115.98	Finnex Bulk Reef Supply	
JTC	HC-810M temperature control	Temperature control	$43.99	2	$87.98	Finnex Bulk Reef Supply	
SNP6	Plastic clamps	Plastic clamps	$0.81	50	$40.50	Aquatic Ecosystems	
AE3f	Delta Star aquarium chiller	Heater/chiller	$963.56	1	$963.56	Aquatic Ecosystems	
MD7	Mag drive pump, 700-gph, 60-W	Jet pumps to circulate headtank water through chiller	$94.99	2	$189.98	Aquatic Ecosystems	 MD2 - MD7

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
PT806A	Non-kink tubing, black ¾-inch /19-mm inside diameter, 100' coil	Tubing	$88.37	3	$265.11	Home Depot	
YSI PRoDSS	YSI PRoDSS, 4-m cable, pH sensor	Multiparameter Probe	$5,514.75	1	$5,514.75	Fondriest	
Others							
	Cabinets for head tank (36 × 24)	Cabinets for head tank (36 × 24)	$200.00	1	$200.00	Home Depot	
	Extra cabinets (36 × 18)	Extra cabinets (36 × 18)	$200.00	2	$400.00	Home Depot	
	Desk large	Desk large	$650.00	1	$650.00	Adorama	

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
	Utility sink	Utility sink	$100.00	1	$100.00	Lowes	
	Desk small	Desk small	$650.00	1	$650.00	Adorama	
	Mini refrigerator	Mini refrigerator	$215.00	1	$215.00	Home Depot	
	Chair desk	Chair desk	$100.00	1	$100.00	Home Depot	

Item†	Description	Purpose	2021 Unit Cost	Qty	Total Cost	Supplier	Photos
	Chair tall	Chair tall	$100.00	1	$100.00	Home Depot	
	Wooden stairs	Wooden stairs	$133.42	1	$133.42	Home Depot	
	Miscellaneous (wood, screws, brackets, paint, etc.)	Miscellaneous	$1,000.00	1	$1,000.00		
				Total	**$26,922.41**		

†Items numbers are not provided for generic parts.

Appendix C Trailer Vendor Quotes

2021	RETAIL QUOTE				Plant #18
Dealership:	**Texas Trailers Sales and Service**			**VIN#:**	
Order Date:	**7/14/2021**	**PO#**	**ECT**	**Dealer #**	
Model:	**QF8520TA4**		**Request Ship Date:**		**Terms:**
Base Price:	**$10,643**	**Sales Rep:**	**B Waller**		**Rep #** 462
Exterior Color	**White**				

Standard Features:

• 102" Wide Body Design• Ramp Door with Spring Assist• No-Show Beavertail• 48" Side Door with Steel Step• Flushlock on Side Door
• Semi-Style Camlock Door Latches• Safety-Spring Chains on Side Door•White Vinyl Lined ceiling
• Door Hold-Backs on All Doors• Torsion Wide-Track Axle• All-Wheel Electric Brakes with Breakaway• 12-Volt Breakaway Switch with Battery
• E-Z Lube Hubs with Grease Caps• Aluminum Wheels• Chrome Center Caps• Radial Tires• Steel Sealed Sidewalls• 4 – Round Dome Lights
• 2 – 12 Volt Switches• 2 – Roof Vents & 4 – 5,000lb. D-Rings• Aluminum Roof• .080 Mill-Finish Aluminum Top Wrap• 3/8" Plywood Wall Liner with Lauan Trim• Exterior ATP Fenders• TPO Radius Front Cap• DOT Approved Lighting• Clear Lens LED Clearance Lights• Clear Lens LED Strip Tail Lights• Molded ABS Lic. Plate Holderw/ Built-In Light• .030 Aluminum Exterior (Avail. in 14 Colors)• Screwless Exterior Metal• Anodized Rear Hoop• 3/4" Plywood Floor• Urethane Coating on Tongue and Rear Member• Z-Tech Undercoated Frame• Tougne Jack w/ Sand Pad
• Welded Safety Chains• Full-Color Decals• Grease Zerks on Rear Ramp Hinges• 24" ATP Stoneguard•Sand pad for Tongue Jack

Additional options and Upgrades are Listed below

Option #	Qty	Description	Price	Ext.
210	20	Additional Height 18"	33.75	$ 675.00
266	1	30"x15" Horizontal Radius Window w/ Slider & Screen	202.5	$ 202.50
267	2	30"x30" Radius Window w/ Slider & Screen	391.25	$ 782.50
2269	20	Alpha Rubber Tread Plate Flooring	33.75	$ 675.00
2285	20	R7 Insulation On Side Walls	33.75	$ 675.00
1703	20	Kem-Lite Wall Liner	60	$ 1,200.00
286	20	Insulated Ceiling w/ 3/16" White Alum Liner	53.75	$ 1,075.00
48	1	100-Amp Breaker Panel w/ Cable Hatch (Must Be Wired Direct)	498.75	$ 498.75
50	24	GFI Wall Recept (Interior/Exterior; 2 Gang)	107.5	$ 2,580.00
79	2	13,500 BTU Roof-Mt Air Cond w/ Heat Strip	1413.75	$ 2,827.50
1478	1	Add Cambar To Side Door		$ -
	1	Delete Dove Tail		$ -
	1	Double Rear Doors In Place Of Ramp Door		$ -
132	1	60" Extended Triple Tube Tongue	184	$ 184.00
				$ -
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(35) Options:	**$**	**11,375.25**
Base:	**$**	**10,642.50**
Freight	**$**	**250.00**
Factory Surcharge	**$**	**1,234.73**
Total:	**$**	**23,502.48**

Salesperson: Rick Croft

TEXAS TRAILERS SALES & SERVICE
5601 NW 13th Street
GAINESVILLE, FL 32653
Fax: 352-377-8933
Phone: 352-378-4756
Email:
FOB: GAINESVILLE, FL

Quote #: 1626125046
Quote Title: ECT
Quote Date: 7/12/2021
Modified Date: 7/14/2021
Quote For:

Phone:
Email:

Qty	UOM	Description	MSRP	Quote Price
1	EA	WAGON HD-ACG - Model# WHD8520T4	$11,515.00	$11,515.00
20	FT	UPG-8'0" Approximate Inside Height	$960.00	$960.00
20	FT	UPG-98-3/4in Tube Posts	$0.00	$0.00
1	EA	30in x 15in Horizontal Radius Slider Window Notes: Curb Side Wall See Drawing	$204.00	$204.00
2	EA	30in x 26in Horizontal Radius Slider Window Notes: One Each Side Wall - See Drawing	$566.00	$566.00
20	FT	Black Coin Rubber Floor Covering	$1,120.00	$1,120.00
20	FT	Insulated Sidewalls	$400.00	$400.00
20	FT	1/4in White Textured FRP Sidewall Liner	$1,200.00	$1,200.00
20	FT	Insulated Ceiling (requires ceiling liner)	$200.00	$200.00
20	FT	1/4in White Textured FRP Ceiling Liner	$740.00	$740.00
1	EA	120/240V 100APanel w/100A Main-No Motorbase Avail Notes: Curb Side Wall See Drawing	$271.00	$271.00
20	EA	120v 15a Duplex 1g Interior GFI Recept (2 Outlet) Notes: 10 are for customer installed lights post manufacturing. These are to be installed horizontally. See Drawing	$940.00	$940.00
4	EA	120v 20a Duplex 1g Interior GFI Recept (2 Outlet) Notes: Locate C/S wall See Drawing	$236.00	$236.00
2	EA	13.5Mach3 A/C+HT-ceiling panel controls-White Notes: See Drawing	$2,162.00	$2,162.00
1	EA	--- SEE PRINT ---	$0.00	$0.00
1	EA	Wagon HD	$0.00	$0.00
1	EA	Steel Frame	$0.00	$0.00
1	EA	Flat Front	$0.00	$0.00
1	EA	Tag	$0.00	$0.00
1	EA	20ft Long	$0.00	$0.00
1	EA	Round Roof	$0.00	$0.00
1	EA	8-1/2ft Wide	$0.00	$0.00
1	EA	Dust-Resistant Frame Design	$0.00	$0.00
1	EA	2-5/16" 20,000lb Adjustable Coupler - 3 Position	$0.00	$0.00

*Note: Make to Order items with costing older than 90 days will be rejected.

Qty	UOM	Description	MSRP	Quote Price
20	FT	Full Height C Crossmembers 16in OC	$0.00	$0.00
20	FT	2in x 8in Tube Main Rails	$0.00	$0.00
20	FT	Tube Radius Roof Bows 16in On Center	$0.00	$0.00
1	PR	5/16" x 30" G7 Safety Chains w/ Clevis Safety Hook	$0.00	$0.00
20	FT	6'6" Approximate Inside Height	$0.00	$0.00
20	FT	74-3/4in Tube Posts	$0.00	$0.00
20	FT	Vertical Posts 16in On Center	$0.00	$0.00
1	EA	8,000lb Side Wind Drop Leg Jack	$0.00	$0.00
1	EA	48in A-Frame with Center Drawbar	$0.00	$0.00
1	EA	ArmorTech on A-Frame and Rear Hoop	$0.00	$0.00
1	EA	Breakaway Kit Assembly w/Charger	$0.00	$0.00
2	EA	6K Torflex Ele Brake Axle, 10Up,8b,EZ Lube	$0.00	$0.00
1	EA	Tandem Axle	$0.00	$0.00
4	EA	ST235/80R16E GY Rad 8B Silver Spoke Steel Wheel	$0.00	$0.00
4	EA	Chrome Center Caps on Wheels	$0.00	$0.00
1	EA	Max Width x Max Height Rear Double Doors (No Bvtl)	$0.00	$0.00
1	EA	36 x 66 Side Premium Heavy Duty Door - RH Hinge	$0.00	$0.00
20	FT	3/4in PlexCore Decking	$0.00	$0.00
20	FT	3/8in PlexCore Sidewall Liner	$0.00	$0.00
4	EA	5,000lb Square D-Ring with Welded Plate	$0.00	$0.00
2	EA	12 Volt LED Dome Light (Requires 12v Wall Switch)	$0.00	$0.00
1	EA	License Plate Holder w/ Separate Light	$0.00	$0.00
2	EA	LED Clear Lens Amber Clearance Lights	$0.00	$0.00
2	EA	LED Clear Lens Red Clearance Lights	$0.00	$0.00
1	EA	LED Rear ID/Loading Light Bar Combo	$0.00	$0.00
1	PR	LED Wraparound Clear Lens Tail Lights	$0.00	$0.00
2	EA	12v Surface-Mount Switch	$0.00	$0.00
20	FT	DOT Tape	$0.00	$0.00
1	EA	1-Piece Aluminum Roof	$0.00	$0.00
20	FT	Polar White .030 Aluminum Exterior	$0.00	$0.00
20	FT	Bonded Exterior Sidewalls	$0.00	$0.00
1	PR	Smooth Aluminum Fenderettes	$0.00	$0.00
1	EA	24in ATP Stoneguard	$0.00	$0.00
		Subtotal	**$20,514.00**	**$20,514.00**

*Note: Make to Order items with costing older than 90 days will be rejected.

Misc Charges

	Dealer Surcharge	$3595.82	$3595.82
	Freight		$1,300.00
	Total	**$24,109.82**	**$25,409.82**

Pickup Location:

WAGON HD-ACG - Model# WHD8520T4
Quotation is good for 30 days..

*Note: Make to Order items with costing older than 90 days will be rejected.

APPENDIX F:
SCOPING FOR THE COMPLETION OF THE REVISED AQUIFER STORAGE AND RECOVERY QUANTITATIVE ECOLOGICAL RISK ASSESSMENT

FINAL

Scoping for the Completion of the Revised Aquifer Storage and Recovery Quantitative Ecological Risk Assessment

June 2021

Prepared for:

South Florida Water Management District
P.O. Box 24682
West Palm Beach, Florida 33416

Prepared by:

Formation Environmental, LLC
2500 55th Street, Suite 200
Boulder, Colorado 80301

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

APPZ	Avon Park Permeable Zone
ASR	Aquifer Storage and Recovery
ATR	Agency Technical Review
BZ	Boulder Zone
CERP	Comprehensive Everglades Restoration Plan
ECSM	Ecological Conceptual Site Model
ERA	Ecological Risk Assessment
ESOPC	Ecological Stressor of Potential Concern
FDEP	Florida Department of Environmental Protection
FFWCC	Florida Fish and Wildlife Conservation Commission
HASR	Hillsboro Aquifer Storage and Recovery
HQ	Hazard Quotient
KRASR	Kissimmee River Aquifer Storage and Recovery
MGD	Million Gallons per Day
NGO	Non-Governmental Organization
NRC	National Research Council
SFWMD	South Florida Water Management District
TRV	Toxicity Reference Value
UF	University of Florida
UFA	Upper Floridan Aquifer
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

The South Florida Water Management District (the District) and the United States Army Corps of Engineers (USACE) are continually examining opportunities and strategies for water management. In 2004, the District undertook a series of studies for ground water storage and retrieval to assess potential risks of such a process to the aquatic environment resulting in the Aquatic Storage and Recovery (ASR) Regional Study Final Technical Data Report (Regional Study; USACE and SFWMD 2015). The District and USACE are currently in the process of completing the 2021 Science Plan (SFWMD 2021) to address uncertainties identified in the National Research Council's (NRC's) review of the Aquifer Storage and Recovery (ASR) Regional Study Final Technical Data Report (NRC 2015)

Several of the NRC comments relate to uncertainties in the Ecological Risk Assessment (ERA) for the ASR project which was presented as an appendix to the Regional Study. Based on the comments and the information contained in the Science Plan, it was determined that the ERA for the ASR project must be updated and expanded to better describe the potential risk to ecological receptors and communities following completion of the planned ASR construction projects north of Lake Okeechobee. This document provides a scope for the completion of a revised ERA to meet the uncertainties identified in the original ERA and provide a quantitative assessment of the potential ecological risks from the implementation of the ASR plans provided in the Science Plan.

The scope includes the development of a Working Group consisting of District and USACE representatives along with representatives for a range of stakeholders with an interest in the results of the ERA. The Working Group will be tasked with the cooperative development of a comprehensive ERA Workplan (to be prepared by the District). The Workplan will follow United States Environmental Protection Agency (USEPA) ERA guidance and will provide a detailed plan to complete the ERA process (i.e. problem formulation, risk analysis and risk characterization).

The problem formulation step is expected to incorporate much of the data collected in support of the original ERA by including more quantitative analyses of the data. The Workplan will also include a data gaps analysis and study plans for new data collection to fill the data gaps identified by the Working Group.

A flow chart (Figure 3) designed provide District managers with a tool to communicate the ASR ERA process is also provided.

1.0 INTRODUCTION

The South Florida Water Management District (the District) and the United States Army Corps of Engineers (USACE) are continually examining opportunities and strategies for water management. In 2004, the District undertook a series of studies for ground water storage and retrieval to assess potential risks of such a process to the aquatic environment resulting in the Aquatic Storage and Recovery (ASR) Regional Study Final Technical Data Report (Regional Study; USACE and SFWMD 2015). The District and USACE are currently in the process of completing the 2021 Science Plan (SFWMD 2021) to address uncertainties identified in the National Research Council's (NRC's) review of the Aquifer Storage and Recovery (ASR) Regional Study Final Technical Data Report (NRC 2015).

Several of the NRC comments relate to uncertainties in the Ecological Risk Assessment (ERA) for the ASR project which was presented as an appendix to the Regional Study. Based on the comments and the information contained in the Final Draft 2021 ASR Science Plan, it was determined that the ERA for the ASR project must be updated and expanded to better describe the potential risk to ecological receptors and communities following completion of the planned ASR construction projects north of Lake Okeechobee.

The ASR ERA was presented as Appendix F of the Regional Study and was completed in 2015 as a partnership between the District and the USACE as part of the Comprehensive Everglades Restoration Plan (CERP). Stakeholders for the ERA team included representatives from the USACE, the District, United States Fish and Wildlife Service (USFWS), Florida Department of Environmental Protection (FDEP), Florida Fish and Wildlife Conservation Commission (FFWCC), University of Florida (UF), and contractors to USACE and the District.

A study plan was developed to identify stressors and receptors and developed an ecotoxicology program for water quality assessment and ecological monitoring. A Surface Water Modeling Sub-Team took the leadership in identifying the available regional water quality models and scoping the exposure modeling needed for the ERA. The District conducted ongoing aquatic baseline studies at all the pilot projects as well as other regional ecological studies. The USFWS conducted the ecosystem level risk assessment on fisheries and West Indian manatees. The FFWCC conducted fishery studies in the Lake Okeechobee basin. The USGS and University of Florida performed modeling and analysis to evaluate the potential for changes in mercury methylation in Lake Okeechobee and the Greater Everglades.

Prior to the initiation of the ERA, the ERA team developed a list of stressors based on their professional knowledge of south Florida freshwater and estuarine habitats, surface water and groundwater quality, site specific hydrogeology, and operational water quality data collected at utility-owned ASR sites located in Florida. The preliminary water quality stressors were organized into five groups: 1) general water quality constituents; 2) nutrients 3) dissolved solids; 4) metals; and 5) radionuclides.

The team also identified and evaluated physical stressors such as temperature effects, and impingement and entrainment of larval fish. Based on the ERA team's understanding of ASR stressors modes of action, fate and effects in south Florida ecosystems, along with water quality, the following assessment endpoints were selected: 1) Reproducing populations of native fish; 2) Survival of fish and aquatic invertebrates; 3) Periphyton diversity and abundance;4) Submerged aquatic vegetation (SAV); and Human health and wildlife protection.

Ecological effects of five plausible ASR implementation scenarios were developed for the Lake Okeechobee basin. The alternatives considered were: 1) no ASR wells; 2) 200 ASR wells in Upper Floridan Aquifer (UFA); 3) 100 ASR wells in UFA; 4) 32 UFA wells, 48 Avon Park Permeable Zone (APPZ) wells, and 120 Boulder Zone (BZ) wells; and 5) the same number of wells and placement as alternative #4 but included operational restrictions on the rate of recovery.

The overall finding of the ERA was that implementation of the CERP ASR project, as envisioned in the Regional Study, will not result in irreversible ecological or water quality impacts to the Kissimmee River, Lake Okeechobee, or the Greater Everglades. The key findings of the Regional Study and original ERA were summarized in the Science Plan as follows:

- Large capacity ASR systems can be built and operated in South Florida. To date, no "fatal flaws" have been uncovered that might hinder the implementation of CERP ASR.

- Variability in aquifer characteristics will result in varying well performances, making it prudent to conduct an exploratory program before constructing surface facilities.

- Groundwater modeling indicated the overall number of wells should be less than 333. The model indicated approximately 130 wells in the upper and middle portions of the aquifer would meet the performance criteria. Of those, 80 ASR could be constructed around Lake Okeechobee.

- Water recovered from the ASR pilot projects did not have any persistent acute or chronic toxicologic effects on test species. However, there were a few instances where reproduction was inhibited, warranting further investigation.

- Arsenic mobilization occurred during early cycle testing but attenuated over time as the storage zone was conditioned.

- Reduction in phosphorus concentrations was observed during ASR storage. This process was postulated to result from microbial uptake, adsorption, dilution, or mineral precipitation.

- Further implementation of CERP ASR should proceed as a phased approach, including expansion and continued construction and testing of pilot facilities.

Although the ERA did not identify substantial ecological effects from a water quality perspective, there was an acknowledgement that water quality conditions would need to be monitored under ASR implementation primarily to satisfy permit requirements also in addition to reduce the uncertainties identified in the report. In areas where ASR is proposed that have significant fisheries or high-quality aquatic habitat, additional monitoring such as fishery surveys and stream condition index monitoring was also recommended.

CERP ASR implementation was recommended to be completed in an incremental and geographically dispersed manner to minimize the possibility of unforeseen ecological impacts. Implementation of ASR well cluster facilities with maximum capacity of 25 million gallons per day (MGD) at one or more locations within the Lake Okeechobee Basin was estimated to present only limited ecological risk. The Regional Study also indicated that implementation of similar ASR well clusters in other basins would present slightly higher risk but these likely could be mitigated.

Following their review, the NRC provided several comments related to the ASR ERA and its conclusions. These were categorized based on general uncertainties in the Science Plan as follows:

- Develop operations to maximize recovery and reduce water quality impacts
- Conduct longer-term ecotoxicological studies and develop an updated quantitative ERA
- Understand the mechanisms of phosphorus reduction
- Evaluate treatment technologies for optimal water quality during recharge, storage, and recovery
- Compare costs with other water storage alternatives

The Final Draft 2021 ASR Science Plan (SFWMD 2021) outlines a long-term plan (2021 – 2030) for a revised and updated ASR project design, construction, testing and reporting. The plan calls for the phased construction of new ASR wells and the reactivation of two existing ASR wells in the northern areas of Lake Okeechobee. Early phases of the plan indicate that the Kissimmee River Aquifer Storage and Recovery (KRASR) well will be repaired and refurbished along with the permitting of the L-63N ASR system. The construction of two new ASR well clusters (C-38N and C-38S) are planned in the next phase of the project.

The Science Plan also provides information regarding a proposed data management plan and a quality assurance plan. It is recommended that both are implemented and followed for all ERA data collection and data management activities.

The District and USACE have agreed to conduct a revised ERA that will address the uncertainties identified by the NRC, the USACE Agency Technical Review (ATR) team and the public. This document provides a scope and a path forward for planning and implementation of the revised ASR ERA as requested in the NRC comments (NRC 2015) and discussed in the Final Draft 2021 ASR Science Plan (SFWMD 2021). This memorandum contains the following primary elements needed for scoping the completion of the ERA:

- Past experience from the previous ERA and comments from the NRC should be used to identify preliminary aspects of a revised ERA (risk questions, endpoints, etc.);
- A preliminary identification of expected expertise needed to complete the ERA and a preliminary identification of stakeholders to invite to participate in the ASR ERA development process;
- Development of an ERA Working Group with structure and goals;
- Identification of expected data needs; and
- Identification of strategies to communicate the risk assessment process with the public.

2.0 ECOLOGICAL RISK ASSESSMENT PROCESS

The first step toward the completion of the revised ERA will be the formation of a Working Group comprised of stakeholders with an interest in the completion of the ASR ERA and expertise essential to the completion of the ERA. The Working Group will be tasked with determining the elements needed for the District to complete a comprehensive ERA Workplan. The overall goal of the Working Group will be to address the uncertainties in the ASR ERA raised by the NRC and from the public review of the Science Plan. The ERA Workplan will provide all of the necessary information required to complete the ERA and will be developed in cooperation between the group of stakeholders to allow for concurrence with the ERA in terms of how the assessment is completed, the data required to complete it, and the steps taken to interpret the results of the assessment. Details of the steps needed to for the ERA Working Group to prepare the comprehensive ASR ERA Workplan and complete the ASR ERA are provided in the following sub-sections.

2.1 Ecological Risk Assessment Working Group Development

Engaging stakeholders in the ASR ERA in the planning stages of the process is an important step toward completing a risk assessment with a high probability of gaining concurrence with the conclusions of the report. To do this, a Working Group should be convened with the primary goal of identifying the goals, endpoints, techniques, data needs, and decision-making processes needed to revise the ERA using the results, data, and reviews of the original ERA to guide the revisions. The Working Group will be lead by District staff, including those on the ASR ERA team, and the District ASR ERA team representatives would have the responsibilities of scheduling the meetings, creating the agenda, leading the discussion, and managing the progress of the Working Group.

The Working Group should be made of up subject matter experts from the District and other state and federal regulatory agencies who are stakeholders in the ASR ERA process. In addition, subject matter experts from academia and/or non-governmental organizations (NGOs) who can add significant value to the ASR ERA process should also be identified and invited to participate in the Working Group. Table 1 provides a preliminary list of stakeholders who could be included in the Working Group and Table 2 provides a preliminary meeting plan for the Working Group.

The first task of the Working Group will be the preparation of a comprehensive Workplan for the completion of the ASR ERA. The Workplan will serve as a guide for the ASR ERA team to identify potential risk issues, document data gaps, collect data to fill data gaps, analyze exposure to stressors and to characterize the potential for risk.

Once assembled, the Working Group should be convened on a regular basis (Table 2). Early in the process it is expected that the Working Group would meet at least monthly until the ASR ERA Workplan is completed and approved. After completion of the Workplan, Working Group

meetings would be expected to be less frequent. Meetings after the completion of the Work Plan would likely be held to provide project updates, discuss results of studies being completed as part of the ASR ERA process, and consider any changes necessary to improve the ERA Workplan and ASR ERA process. Finally, the Working Group will be tasked with review of the ASR ERA upon completion.

2.2 Ecological Risk Assessment Workplan Components

USEPA (1997, 1998) developed an process for completing a technically defensible ERA based on the *Framework for Ecological Risk Assessment* (EPA, 1992). The eight steps are as follows:

- Step 1: Screening Level Problem Formulation
- Step 2: Screening-Level Exposure Estimate and Risk Calculation
- Step 3: Baseline Risk Assessment Problem Formulation
- Step 4: Study Design and Data Quality Objectives Process
- Step 5: Field Verification of Sampling Design
- Step 6: Site Investigation and Analysis Phase
- Step 7: Risk Characterization
- Step 8: Risk Management

A flow chart depicting the ERA process is shown in Figure 1. The original ERA conducted in early 2000s provided the information required to support the problem formulation for the current ASR ERA. However, the currently available data will be reviewed as necessary and will be used to further refine the baseline problem formulation (Step 3).

2.2.1 Risk Management Goals and Decisions

Two of the main elements required in an ERA are the statement of the risk management goal(s) and the definition of the risk decisions that are required to be made using the conclusions of the ERA. These will both be defined in the Work Plan.

Based on the conclusions reached and comments received on the original ERA, an example of a risk management goal for the ASR ERA could be:

"Site conditions due to operation of the planned ASR Wells should not cause significant risk of adverse ecological effects to receptors from exposure to stressors directly related to the operation of the ASR Wells."

The Working Group will be tasked with determining the final list of risk decisions that the ASR ERA will be designed to support. The following bullet points provide examples of some risk decisions that may be considered by the Working Group.

- Determine whether stressors directly related to the ASR Well operations are likely to result in adverse effects to assessment endpoints
- If adverse effects are likely to occur, determine which stressors, exposure pathways, and fate and transport mechanisms are most important in causing the effects
- Determine whether adverse impacts or risk of adverse effects warrant changes to the ASR w well implementation as presented in the Science Plan

The ERA will be designed to answer the fundamental risk questions to meet the risk management goal(s) identified by the Working Group.

2.2.2 Ecological Conceptual Site Model

An Ecological Conceptual Site Model (ECSM) developed as part of the original ERA is shown in Figure 2. In the baseline problem formulation to be developed in the Work Plan, available site-specific information will be reviewed to identify an updated ECSM. The updated ECSM will identify stressors known to be present or possibly present, fate and transport mechanisms, and ecotoxicity mechanisms to be considered in the ERA. From that information, potentially complete exposure pathways will be identified and used to select refined assessment endpoints to be used in later steps in the ERA. The ECSM, therefore, forms the basis for all further assessment and analysis in the ERA.

The ECSM identifies the means by which ecological receptors may be exposed to site stressors and includes:

- Identification of stressors and stressor sources
- Mechanisms of stressor releases from these sources
- Identification of receptor groups, exposure scenarios and assessment endpoints
- Identification of complete exposure pathways

The primary source of stressors in the ASR process is the release of stored water into the freshwater ecosystem. Examples of a secondary source would be the potential methylation of mercury due to water quality changes following release of the stored water into the freshwater ecosystem. These will both be more fully defined and any other sources and/or release mechanisms will be identified and documented in the ECSM in the Work Plan.

Ultimately, the ASR ERA will determine whether the combination of site-specific exposure scenarios and ecological stressors of potential concern (ESOPC) pose current or future potential risks. The ESOPCs will be selected in the Work Plan from the list of stressors considered in the original ERA and from comments received on that document and the Science Plan. A list of potential stressors discussed in the original ERA was provided in Section 1 of this document and will form the basis for the identification of the updated list of ESOPCs.

Potentially complete exposure pathways will also be identified in the Work Plan and included in the ECSM.

Examples of potentially complete exposure pathways include:

- Exposure of fish and other aquatic organisms to stressors in ASR water released into freshwater ecosystems
- Dietary uptake of bioaccumulative chemicals in or mobilized by ASR waters through contaminated forage and prey items
- Exposure of fish and other aquatic-dependent organisms to altered water temperatures from ASR water released into freshwater ecosystems
- Impingement and entrainment of larval fish at water intake sites

Only exposure pathways that contain or potentially contain the four primary elements identified in EPA's paradigm (Figure 1) – source or sources, release and transport mechanisms, exposure media, and routes of receptor exposure – will be evaluated in the ASR ERA. Incomplete exposure pathways identified in the ECSM will not be evaluated in the ASR ERA but will be discussed in the ASR Workplan and ERA. The Work Plan will provide a complete list of all potentially complete exposure pathways.

There are several examples of potentially exposed ecological receptor groups and representative receptors for the riparian/aquatic ecosystems. These represent the ecological receptors that may be exposed to the ESOPCs through the completed exposure pathways. The list of potentially exposed receptor groups should represent a combination of trophic level (i.e., primary producer, secondary consumer, tertiary consumer) and feeding guilds (i.e., herbivorous, omnivorous, carnivorous).

Representative receptors for each of the trophic levels, feeding guilds, and occupied habitats will be selected for assessment in the ASR ERA. The list of receptors to be considered in the ASR ERA will be completed by the Working Group, but will likely be composed of a range of birds and mammals from multiple trophic levels (e.g. mottled duck, wood stork, crested caracara, raccoon, etc.), fish (e.g. Black crappie and largemouth bass), and secondary consumers (aquatic invertebrates), and primary producers (periphyton and submerged aquatic vegetation).

2.2.3 Assessment and Measurement Endpoints

As part of problem formulation, EPA's paradigm (EPA 1997 and 1998, Figure 1) recommends assessment/measurement endpoints on which the analysis of risk should focus. Assessment endpoints are explicit descriptions of the ecological values to be protected because of management actions at a site. Measurement endpoints are specific data collected to address the assessment endpoints to answer the risk questions as they relate to the risk management goals at the site. These will be defined in the Work Plan with the original ERA forming the initial basis for the endpoints.

In general, common species and/or communities assessment endpoints are defined to predict the potential for significant adverse ecological effects from exposure to toxic conditions or stressors that result in reductions in survivorship or reproductive capability, threatening populations or community function. For species that are afforded additional regulatory protection due to their rare or threatened status, significant adverse effects to their populations can occur even if individuals are affected. If there are threatened and/or endangered species potentially exposed, then the assessment endpoint for special-status species would address the potential for individuals (as opposed to populations) to be adversely affected by ESOPCs. For other species with stable or healthy populations, the assessment should focus on community-level or population-level effects where some individuals may suffer adverse effects, but the effects are not ecologically meaningful because the overall regional population is not significantly affected.

While the assessment endpoints are used to identify the types of measures needed to perform an ERA the measurement endpoints identify the types of data needed to assess risk to the assessment endpoints. Three general categories of measurement endpoints are typically used in an ERA (EPA, 1998):

- **Measures of exposure**—measures that describe the location and concentrations of ESOPCs in abiotic and biotic media that can be used to estimate exposure of receptors. Examples include surface water data, bioconcentration data, modeled water temperature, etc.

- **Measures of effects**—measurement of changes in an attribute of the assessment endpoint in response to exposure. Examples include results of toxicity testing, toxicity reference values (TRVs) for estimates of effects to birds and mammals, tissue-based toxicity benchmarks, measures of thermal tolerance, etc.

- **Measures of ecosystem and receptor characteristics**—measures of factors such as receptor behavior, life history characteristics, and transport of ESOPCs that may affect intensity of exposure or manifestation of effects. Examples may include studies of the potential effects of ESOPCs to fish populations near the ASR wells measured before and after well completion.

Detailed discussions of all three types of measures will be developed by the Working Group and included in the Work Plan.

2.3 Available Data, Data Usability, and Anticipated Data Gaps

In general, ERAs require considerable site-specific data to provide a quantitative evaluation of the potential risks of the project stressors to the ecological receptors being considered in the ERA. As such, a large quantity of data was collected between 2009 and 2013 and incorporated into the original ASR ERA. These data included:

- Surface water and groundwater data at the two ASR pilot testing locations at the KRASR and the Hillsboro ASR (HASR).

- Recovered water data collected from the KRASR and HASR locations. Water data were collected during several recharge and discharge cycles.

- At least six (6) simulation models were used to generate regional projections of hydrologic and water quality impacts associated with ASR well development across the five (5) scenarios presented above.

- Baseline community data from several ecosystems:

    - Fish community data from the Kissimmee Rover

    - Fish community data from Lake Okeechobee

    - Aquatic invertebrate community data from the Kissimmee River

- Laboratory acute and chronic toxicity testing using KRASR water.

    - 96-hr green algae (*Selanastrum capricornutum*)

    - 7-day water flea (*Ceriodaphnia dubia)*

    - 7-day fathead minnow (*Pimephales promelas*)

  - 21-day water flea (*Daphnia magna*)
  - FETAX frog bioassay (*Xenopus sp.*)
  - 96-hr water flea (*C. dubia*)
  - 96-hr bannerfin shiner (*Cyrpinella leedsi*)

- Bioconcentration studies in fish and mussels using KRASR water and *in-situ* in the Kissimmee River.
  - 28-day flow through bluegill (*Lepomis machrochirus*)
  - 28-day flow through freshwater mussel (*Ellipto buckleyi*)
  - 35-day *in situ* freshwater mussel (*E. buckleyi*)
  - 69-day *in situ* freshwater mussel (*E. buckleyi*)
- Periphyton community composition data at KRASR

All of these data collected are provided and summarized in the ASR ERA and represent a valuable tool for the completion of the revised ERA. The existing data can and should be used extensively in both the planning and analysis phases of the revised ERA. A summary of the available data and a range of potential data uses in the revised ERA are presented in Table 3. These should be considered as part of the planning phase for the revised ERA.

It is anticipated that the ERA Working Group will identify data gaps which will require additional data collection to complete the revised ASR ERA. In general, it is likely that those data gaps will fall into one of several categories as shown in Table 4. It should be noted that the data gaps provided in Table 4 are preliminary in nature and are based on best professional judgement. The ERA Working Group will be tasked with identifying the final data gaps and providing/approving data collection plans for filling the gaps and providing data valuable to the completion of the ASR ERA.

The identification of data gaps and the development of study plans to fill those data gaps will represent Steps 4 and 5 of the EPA's ERA paradigm (Figure 1). The completed Problem Formulation, data gaps analysis, and data collection plans will be documented and provided in the completed ASR ERA Workplan.

2.4 Risk Analysis

The risk analysis phase of the ASR ERA is the second part of the sixth step in the ERA process and will be completed using all available data, including those data collected following the data gaps analysis (also part of Step 6 of the eight-step process). Risk analysis includes two steps: exposure analysis and effects analysis. Exposure analysis is used to quantify the degree to which receptors are exposed to ESOPCs. Effects analysis attempts to determine the relationship between exposure to ESOPCs and observed or potential effects to the assessment endpoints.

Exposures to ecological receptors will be calculated based on conditions within exposure units that will be defined based on the planned operations of the ASR Wells. It is anticipated that localized exposure units will be defined near each existing and new well clusters to define exposure in the areas immediately adjacent to each well. In addition, it is expected that larger regional exposure units will also be defined to determine the potential exposure to receptors throughout the regional ecosystems that may receive ASR discharge water. The goal is to estimate exposure that a receptor, receptor population, or community would be expected to encounter across their exposure domain. Exposures for wide-ranging species that generally utilize large areas will likely be evaluated using regional data. The exposure units associated with individual ASR well clusters will likely be used to assess ecological risk to species with smaller home ranges.

The effects analysis will include a hierarchy of effects-based toxicity benchmarks for water, tissues, and diet-based exposure to birds and mammals. Exposures estimated in the exposure analysis will be compared to these benchmarks to provide a quantitative estimation of effects from the ESOPCs. In addition, direct measures of effects such from site-specific toxicity test or bioconcentration study results will be utilized in place of generic TRVs for the effects analysis.

The ASR ERA Workplan will include a detailed plan for the completion of both the exposure and effects analyses.

2.5 Risk Characterization

The ASR ERA Workplan will include a detailed plan for the completion of risk characterization, which integrates the exposure and effects assessments and will be summarized and discussed in the risk characterization. Risk characterization incorporates the exposure and effects data from all ESOPC/receptor pairs in all exposure units as well as the information provided in an uncertainty analysis to form a tiered, weight-of-evidence assessment. The assessment will include results from the effects analysis as well as the results from all other studies completed for the ASR ERA and any additional pertinent data that are identified by the Working Group. The initial tiers of the risk characterization will be more conservative and screening-level with the goal of focusing the assessment into more detailed analysis of those stressors and receptors with the greatest likelihood of being affected by the release of ASR waters in the later tiers of the characterization.

Risks from both chemical and non-chemical stressors will be characterized spatially and temporally to help determine if effects are likely in either critical habitat areas or during critical time periods (e.g. fish spawning). The ultimate goal of the risk characterization is, therefore, to define the probability of risks from exposure to ESOPCs to each of the assessment endpoints that will allow for developing defensible conclusions about potential risks.

Exposure-based risks will be characterized using a standard hazard quotient (HQ) approach. The HQ is the ratio between the estimated exposure and the toxicity reference value (TRV) which could be a simple screening benchmark, dietary based exposure rate, or other effects-based benchmark. The HQ equation is:

$$HQ^{1} = \text{exposure estimate/TRV}$$

The effects assessment will provide HQs calculated for each ECOPC/receptor pair at each location and within exposure domain. These will be interpreted in the risk characterization. The interpretation of HQs calculated in the ASR ERA will be consistent with standard approaches toward interpretation of HQ results. An HQ less than 1.0 using no or low -effect TRVs indicates that no adverse effects are expected (*de minimus* risk) and no further risk analysis is necessary to support risk management decisions. HQs that exceed 1.0 do not necessarily correspond to unacceptable risk but indicate the need for further evaluation to determine whether risks are unacceptable, and/or risk management action is needed to reduce risks (EPA 1997 and 1998).

Additionally, the risk characterization may also include more advanced risk assessment techniques as requested in the NRC comments. These may include probabilistic risk modelling, Baysian statistics, and/or landscape scale risk assessment approaches. It is expected that these more advanced risk assessment approaches will be considered on a case-by-case basis by the Working Group. In those cases where advanced statistical techniques for risk characterization can provide a better estimate of potential risk from ASR well discharges either for certain stressors, receptors, or ecosystems, than traditional risk characterization approaches, they will be considered by the Working Group and may be used in the ASR ERA accordingly.

[1] HQs are unitless and the units for exposure estimate and TRV must be the same but vary from simple comparisons of water concentration (ug/L) and water quality criteria (ug/L) to rates such as mg of a chemical per kg of receptor body weight per day (mg/kg BW/day) for bird and mammal exposure.

3.0 RISK ASSESSMENT COMMUNICATION TOOLS

Communication of the risk assessment process is an important step in the completion of the ASR process. The risk assessment scope presented in this memorandum is presented graphically in Figure 3 and is intended to provide a simple yet detailed explanation of the expected ERA process. In the flow chart, blue shaded shapes represent project milestones and/or anticipated deliverables. Grey shaded shapes represent major elements of the risk assessment that will require definition in the Workplan and green shaded shapes represent the detailed components of the risk assessment elements.

This flow chart is intended only to communicate the process of completing the ASR ERA. Additional risk communication tools will be developed throughout the ERA process to aid in the communication of the results of the ASR ERA to interested parties and the public. Such tools may include public meetings, forums, or webinars that convey risk analysis findings, development of an educational website explaining the benefits of the ASR process, and/or maintenance of a publicly accessible website for project reports, data, and project direction.

4.0 REFERENCES

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SFWMD. 2021. Final Draft 2021 Aquifer Storage and Recovery Science Plan. June. 2021.

USACE and SFWMD. 2015. Final Technical Report: Aquifer Storage and Recovery Regional Study. May 2015. Central and Southern Florida Project. Comprehensive Everglades Restoration Plan.

USEPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. EPA 540-R-97-006. Environmental Response Team, Edison, NJ.

USEPA. 1998. Guidelines for Ecological Risk Assessment. Final. Risk Assessment Forum. EPA/630/R-95/002F.

TABLES

Table 1
Preliminary List of External Subject Matter Experts for Inclusion in the ASR ERA Working Group
ASR Ecological Risk Assessment Scoping Memorandum

Agency/Organization	Representative(s)	Role/Expertise
South Florida Water Management District Contractors	Mike Rothenburg - PSI Intertek	District ERA Contract Manager
	Ashley Douthirt - PSI Intertek	District ERA Coordinator
	Joe Allen - Formation Environmental	District Risk Assessment Manager
	Mark Dunn Lewis, Ph.D - Formation Environmental	Risk Assessment Specialist
	Sean Covington - Formation Environmental	Aquatic Risk Assessor
	Isabel Johnson - ECT Inc.	District Risk Assessment Technical Support
	Jen Mathia - ECT Inc	District Risk Assessment Technical Support
U.S. Army Corps of Engineers	Andrew McQueen, Ph.D	Toxicologist
U.S. Fish and Wildlife Service	John Galvez	Fisheries
	Tammy Ash	Contaminants Specialist
Florida Department of Environmental Protection	Leah D. Stuchal, Ph.D	Toxicologist
	Stephen M. Roberts, Ph.D	Toxicologist
	Dave Whitning	Water Quality
	Leah Smith	Toxicologist
United States Geological Service	Dave Krabenhoff	Mercury Specialist
Academia	Evelyn Gaiser, Ph.D - FIU	Periphyton Specialist
NGOs	Paul Gray - Audubon Society	Ecologist

Note: The list of Working Group participants is preliminary in nature and may change.

Table 2
Preliminary Meeting Plan for the ASR ERA Working Group
ASR Ecological Risk Assessment Scoping Memorandum

Working Group Task	Meeting Frequency	Expected Task Duration	Working Group Output
Introduction	Once	N/A	Group introductions and outline of group goals and expectations.
Work Plan Development	Monthly	1 year	ERA Risk Questions
			Receptors to be addressed by the ERA
			Ecological Conceptual Site Model
			Assessment Endpoints
			Compehensive Review of Available Data
			Food Web Modelling Using Exisiting Data
			Selection of ESOPCs
			Measurement Endpoints
			Data Gaps Analysis
			Identification of Studies Needed to Fill Data Gaps
			Completed Problem Formulation
			Risk Analysis Plan
			Risk Characterization Plan
			Comprehensive Workplan
Project Monitoring and Updates	Quarterly	3 years	Review project updates
			Review data collection activities and study results
			Review and recommend changes to the Workplan as needed
Risk Assessment Review/Approval	Monthly	2 - 3 months	Review and comment on the ASR ERA

Table 3
Potential Uses for Historical Data in the Revised Ecological Risk Assessment
ASR Ecological Risk Assessment Scoping Memorandum

Data Category	Data Description	Potential Data Uses in Revised ERA
Surface Water	Surface water data from the KRASR and HASR locations.	1. Baseline historical surface water data to compare temporal trends in data. 2. Data from mixing zones and downgradient can be used to screen contaminants of concern.
Ground Water	Groundwater data from the KRASR and HASR locations.	Baseline historical groundwater data to compare temporal trends in data.
Recovered Water	Water data collected from the KRASR and HASR locations following recharge and discharge cycles.	1. Baseline historical recovery water data to compare temporal trends. 2. Data can be used in screening to help identify contaminants of concern.
Simulation Models	Hydrologic and water quality models.	Historical modelling data can be used to streamline model selection and improve models for modelling water quality based on the revised project scope.
Baseline Community Data	Baseline fisheries, periphyton, and aquatic invertebrate community data from the Kissimmee River and Lake Okeechobee.	Temporal comparisons in areas where new baseline data may be collected. Historical reference data in areas where new data are not collected.
Laboratory Toxicity Data	Acute and chronic toxicity data to fish, invertebrates, and amphibians from the KRASR location.	1. Temporal comparisons of recovered water toxicity following reopening of the KRASR well. 2. Data can be used as a screening step to identifiy which contaminants have the greatest potential for effects which will streamline and focus toxicity data collection in the revised assessment. 3. Aid in defining site-specific TRVs.
Bioconcentration Data	Laboratory and in situ bioaccumulation data from the KRASR site.	1. Comparisons of fish and mussel tissue data to screening-level toxicity benchmarks to identify contaminants of concern that require additional testing in the revised assessment. 2. Utilize the available data to provide screening-level food web exposure and risk modelling for upper trophic level receptors in order to focus the revised assessment on those species and contaminants of concern that may have risk-based issues. 3. Comparisons in temportal trends between data sets. 4. Aid in defining site-specific TRVs.

Table 4
Preliminary Identification of ASR ERA Data Gaps
ASR Ecological Risk Assessment Scoping Memorandum

Data Category	Expected Data Needs	Expected Locations Requiring Data	Approximate Time Frame of Data Collection
Baseline Community Data	Fish	In the vicinity of wells to be reactivated and planned new well construction areas.	2022 - 2023
	Benthic Invertebrates		
	Periphyton		
Toxicity Testing	Invertebrates	In the vicinity of wells to be reactivated and planned new well construction areas.	2022 - 2025
	Fish		
	Periphyton		
	Amphibians		
Lab-Based Bioconcentration Studies	Fish	In the vicinity of wells to be reactivated and planned new well construction areas.	2022 - 2025
	Invertebrates		
	Periphyton		
Mesocosm-Based Bioaccumulation Studies	Fish	In the vicinity of wells to be reactivated and planned new well construction areas.	2022 - 2025
	Invertebrates		
	Periphyton		
Surface Water and Mixing Zone Modelling	Modelled temperature and water quality data.	In the vicinity of wells to be reactivated and planned new well construction areas.	2022- 2025
		Regional	
Food Web Modelling	Estimated bioaccumulation of contaminants of concern.	Based on currently available data and bioconcentration studies to be completed.	Using existing data; 2021 - 2022 New new data; 2025

FIGURES

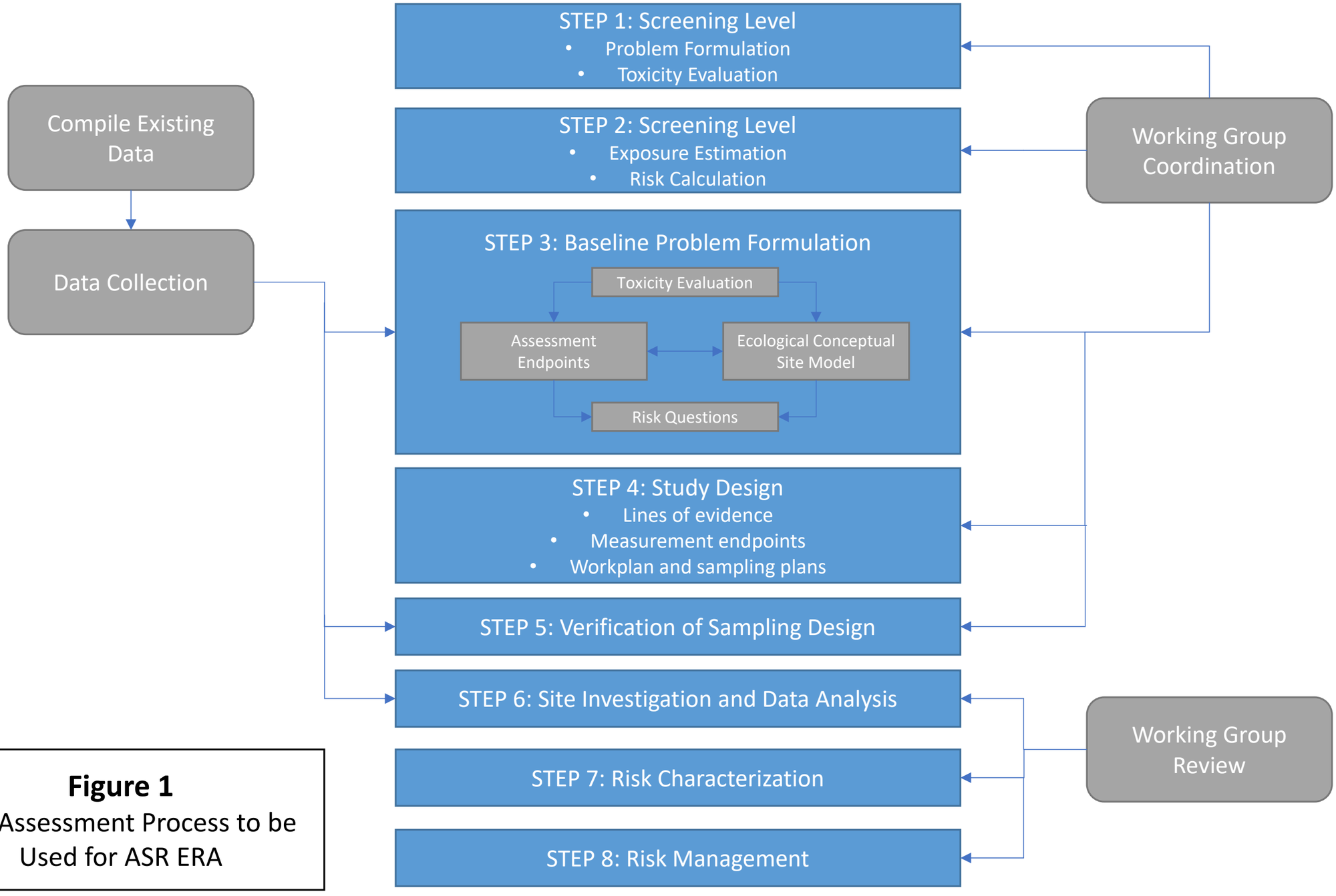

Figure 1
Risk Assessment Process to be Used for ASR ERA

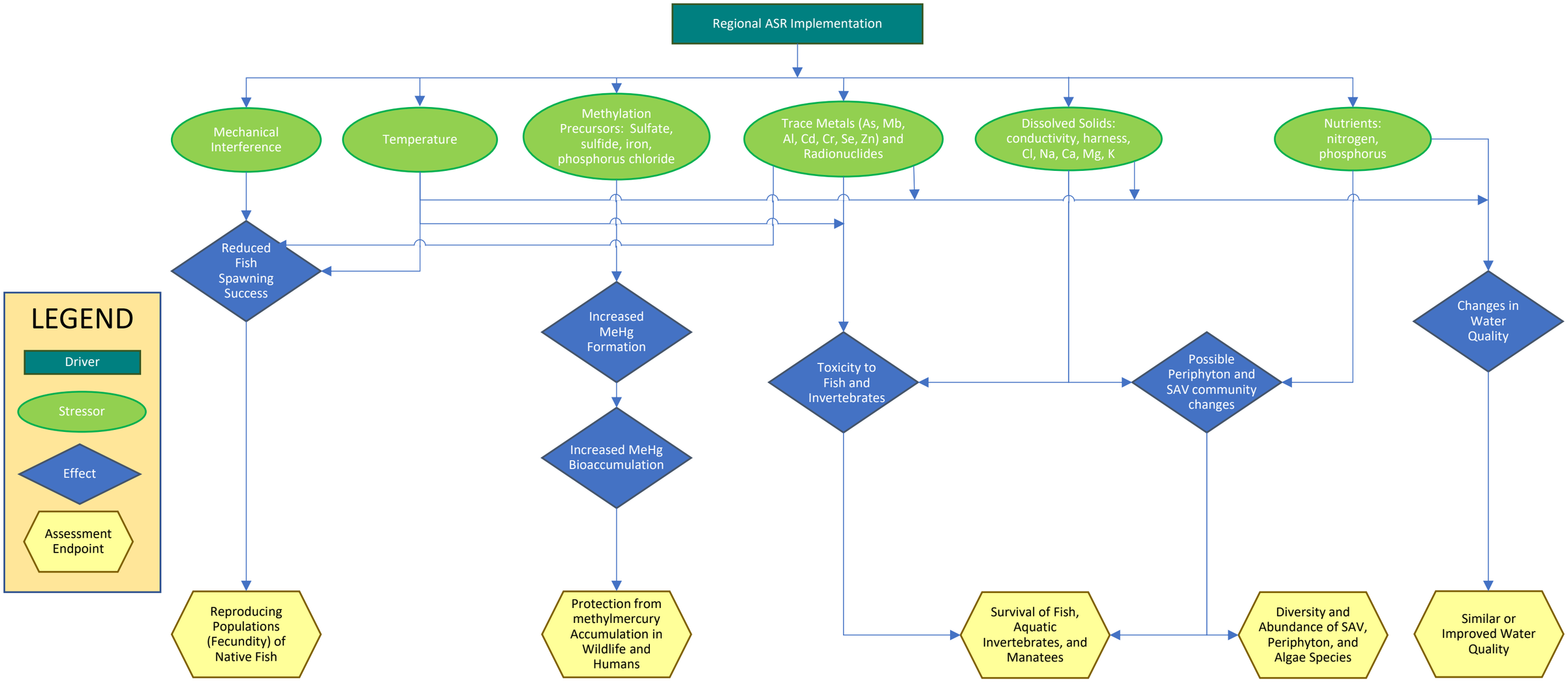

Figure 2
Conceptual Ecological Model
Presented in the 2015 ASR ERA

ASR Scoping Memo
Planning memo for ERA completion (2021)

Form ERA Working Group
Stakeholder group tasked with development of a comprehensive risk assessment process and project review (2021- 2022)

ERA Workplan
Comprehensive plan for completing the ERA (2022)

Data Collection
Collect data identified in the workplan (2022 – 2024)

Risk Assessment Report
Complete the risk assessment describing potential risks per the workplan (2025)

Risk Management and Communication
Management of risk and public communication of the results of the risk assessment (2025+)

Problem Formulation

- ID Risk Management Goals and Risk Decisions
- Refine Ecological Conceptual Site Model
  - Stressor Sources
  - Describe release mechanisms
  - ID complete exposure pathways
  - ID receptors of concern
- Define Risk Assessment Endpoints
  - Assessment Endpoints
  - Measurement Endpoints
- Refine list of Ecological Stressors of Potential Concern
  - Evaluate existing water quality and toxicity data to refine list of stressors
  - Use existing bioconcentration data to model risk of food web risk to refine list of stressors
- Evaluate data gaps and prepare data collection plans

Risk Analysis Plan

- Exposure analysis plan
  - Identify exposure units
  - Plan for quantitative analyses of exposure
- Effects analysis plan
  - Create hierarchy of effects benchmarks
  - Incorporate direct measures of effects (e.g. toxicity tests)

Risk Characterization Plan

- Plan for hazard quotient calculation for exposure-based risks
- Plan for the interpretation of advanced risk assessment techniques

Figure 3
ASR Ecological Risk Assessment Completion Process Flowchart

APPENDIX G:
ECOLOGICAL RISK-BASED ANALYSIS OF HISTORICAL BIOCONCENTRATION AND TOXICITY DATA FOR THE AQUIFER STORAGE AND RECOVERY QUANTITATIVE ECOLOGICAL RISK ASSESSMENT

Ecological Risk-Based Analysis of Historical Bioconcentration and Toxicity Data for the Aquifer Storage and Recovery Quantitative Ecological Risk Assessment

Prepared for:
South Florida Water Management District
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FORMATION
ENVIRONMENTAL

DECEMBER 2021

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LIST OF ABBREVIATIONS

APPZ	Avon Park Permeable Zone
ASR	Aquifer Storage and Recovery
ATR	Agency Technical Review
BCG	Biota Concentration Guideline
BW	Body Weight
BZ	Boulder Zone
CERP	Comprehensive Everglades Restoration Plan
District	South Florida Water Management District
DO	Dissolved Oxygen
dw	Dry Weight
ERA	Ecological Risk Assessment
ERED	Environmental Residue Effects Database
FCM	Foodchain Multiplier
FDEP	Florida Department of Environmental Protection
FETAX	Frog Embryo Teratogenesis Assay Xenopus
FFWCC	Florida Fish and Wildlife Conservation Commission
HQ	Hazard Quotient
IC25	Inhibition Concentration 25%
kg	Kilogram
KRASR	Kissimmee River Aquifer Storage and Recovery
l (L)	Liter
LC50	Lethal Concentration 50%
mg	Milligram
MGD	Million Gallons per Day
NOAEL	No Observed Adverse Effect Level
NOEC	No Observed Effect Concentration
NRC	National Research Council
NTU	Nephelometric Turbidity Unit
ORP	Oxidation-Reduction Potential

pCi/L	picocurie/Liter
pH	Hydrogen Ion Activity
POD	Point of Discharge
Ra-226	Radium-226
Ra-228	Radium-228
SAV	Submerged Aquatic Vegetation
SFWMD	South Florida Water Management District
TDS	Total Dissolved Solids
TIR	Total Ionizing Radiation
TL3	Trophic Level 3
TL4	Trophic Level 4
TRV	Toxicity Reference Value
UF	University of Florida
USACE	U.S. Army Corps of Engineers
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Society
ww	Wet Weight

EXECUTIVE SUMMARY

The South Florida Water Management District (SFWMD or the District) and the United States Army Corps of Engineers (USACE) are continually examining opportunities and strategies for water management. In 2004, the District undertook a series of studies for groundwater storage and retrieval to assess potential risks of such a process to the aquatic environment resulting in the Aquifer Storage and Recovery (ASR) Regional Study Final Technical Data Report (Regional Study; USACE and SFWMD 2015). The District and USACE are currently in the process of completing the 2021 Science Plan (SFWMD 2021) to address uncertainties identified in the National Research Council's (NRC's) review of the ASR Regional Study Final Technical Data Report (NRC 2015).

Several of the NRC comments relate to uncertainties in the Ecological Risk Assessment (ERA) for the ASR project, which was presented as an appendix to the Regional Study. Based on the comments and the information contained in the Science Plan, it was determined that the ERA for the ASR project must be updated and expanded to better describe the potential risk to ecological receptors and communities following completion of the planned ASR construction projects north of Lake Okeechobee. This document provides the results of a screening-level assessment of the potential risk using the bioconcentration data and toxicity testing data collected in the original ERA presented in the Regional Study.

To assess the risk of bioconcentrating chemicals to upper-trophic-level birds, mammals, and reptiles that may feed in the vicinity of the ASR wells, a conservative, screening-level exposure and risk model was used to estimate exposure to a wide range of receptors at maximum analyte concentrations measured in the bioconcentration study. The screening-level approach was used to minimize the potential for false negative conclusions regarding risk. Overall, risks to all upper-trophic-level receptors from all analytes measured in the bioconcentration studies were low. Risks from selenium exposure could not be entirely ruled out, but they were similar using data from downstream and in the mixing zone of the ASR well and in the upstream or background samples. This result matched what was observed in the original ASR ERA, which did not indicate statistically significant bioconcentration of selenium in samples exposed to recovered ASR well water. It is recommended that the Working Group consider using the results of the original ASR ERA and the expanded analysis presented here to focus the bioaccumulation risk assessment in the updated ASR ERA on a narrow set of chemicals and receptors. While the updated ASR ERA should assess risk to birds, mammals, and reptiles that may be exposed to recovered ASR water, future data collection in support of the upper-trophic-level receptor assessment endpoints should be focused on further understanding whether longer cycles resulting in longer storage times may result in higher concentrations of the potentially bioaccumulative analytes (e.g., mercury and methylmercury) in the recovered waters.

Fish and mussel tissues were evaluated relative to risk-based benchmarks to conservatively determine if the concentrations observed in the bioconcentration studies conducted in the original ERA are indicative of potential adverse effects to local fish or benthic invertebrate populations. Although some of the chemicals evaluated can biomagnify (i.e., a progressive buildup of a chemical through the food chain that can cause risk to upper-trophic-level receptors as discussed in Section 2.1), the primary focus of assessing

fish and mussel tissues was to evaluate the potential risk from chemicals that bioaccumulate and bioconcentrate. Bioaccumulation refers to the net accumulation over time of metals (or other persistent substances) within an organism from both biotic (other organisms) and abiotic (soil, air, and water) sources.

Fish tissue metal residues measured during different exposure scenarios were equal to or did not exceed tissue-based Toxicity Reference Values (TRVs) at the no-effect level. Based on these results, risk of metals bioaccumulation in fish based on the currently available data is considered *de minimis*.

It is recommended that while the updated ASR ERA should assess risk to fish and benthic invertebrates that may be exposed to recovered ASR water, the assessment should again be limited to confirming the low levels of risk. Extensive studies to address the potential for risk to fish and benthic invertebrates from bioconcentration of metals and radionuclides may not be warranted based on the results of this SLERA. Future data collection in support of the fish and benthic invertebrate assessment endpoints should be focused on further understanding whether longer cycles resulting in longer storage times may result in higher concentrations of the potentially bioaccumulative analytes in the recovered waters.

Mussel tissue residues did not exceed their no-effect level TRVs for 8 of 12 metals. Aluminum bioaccumulation in mussel tissues occurred during Cycles 1 and 2 exposures but appeared to be largely a function of background surface water and not ASR recovery. Similarly, manganese bioaccumulation during Cycle 4 exposures appeared to be a function of background surface water exposures and not ASR recovery. Molybdenum bioaccumulation was observed to concentrations equal to the no-effect level TRV, and similar to manganese, these Cycle 4 bioaccumulation exposures were a function of background surface waters and not ASR recovery. Likewise, two samples had zinc concentrations approximately equal to the no-effect TRVs during Cycle 2 at a downstream site during the ASR recovery phase. Overall, the bioconcentration data from the original ERA show that the potential for bioaccumulation risk to benthic invertebrates from exposure to recovered ASR water is also very low.

Finally, the original ASR ERA conducted over 80 acute and chronic multi-species toxicity tests at the Kissimmee River Aquifer Storage and Recovery (KRASR) Site during Cycles 1 through 4 to evaluate the potential for toxicity of ASR recharge and recovery water. The report concluded the following:

> "Overall, the recovered water from KRASR did not show quantifiable acute or chronic effects on any species tested with the exception of the sensitive cladoceran *Ceriodaphnia dubia*. The effect observed was on reproduction of this sensitive cladoceran species, showing that at times during mid- to late- cycle the recovered water at concentrations greater than 50 percent had an inhibitory effect on the reproduction of this species. The cause for this chronic effect is not known."

The screening-level assessment presented in this report was intended to attempt to find potentially causative factors of the effects observed by combining the results of the toxicity tests with water quality samples collected from the same locations at the same times as the toxicity tests.

Of the over 80 toxicity tests using different organisms, observed toxicity, when measured, was almost exclusively for tests using *C. dubia* survival and/or reproduction, which only occurred in seven tests. One of those seven tests was for *Selenastrum* growth effects while the remaining six tests were for *C. dubia*. Compiling available corresponding water quality data with those tests led to discovery of a few instances where individual sample parameter concentrations exceeded their respective TRVs. However, in those few instances, further assessment of the water quality data, toxicity data, and sample conditions and timing found that none of those parameters were causal factors for toxicity.

Except for a single nitrate-N and a single gross alpha water quality sample, no nutrients or organics, radionuclides, or physico-chemical parameters had concentrations that exceeded their respective TRVs. No sample toxicity was observed in corresponding water samples linked to any toxicity tests. Likewise, all metals, except arsenic, had concentrations less than their respective TRVs, and concentrations of all major and minor ions, except chloride, were less than their respective TRVs.

The number of times where observed toxicity and corresponding water quality with any Hazard Quotients (HQs) > 1 is low (4 out of over 80 tests). When these overlaps occurred, the available data did not support conclusions of toxicity based on parameter concentrations alone (i.e., concentrations of arsenic or chloride). However, there were times when measured water quality data were not available to match all toxicity tests. This data gap is the primary uncertainty factor for this screening-level ERA. This is the primary uncertainty factor for this screening-level ERA. Fortunately, for arsenic and chloride, water quality data were available for all time periods through all cycles; however, for many parameters, this was not the case. To address this uncertainty, it is recommended that any future toxicity testing conducted in support of the updated ASR ERA have specific paired initial water quality sample results so that if toxicity is observed, potential causal factors can be better understood.

1 INTRODUCTION

The District and the USACE are continually examining opportunities and strategies for water management. In 2004, the District and USACE undertook a series of studies for groundwater storage and retrieval to assess potential risks of such a process to the aquatic environment, resulting in the ASR Regional Study Final Technical Data Report (Regional Study; USACE and SFWMD 2015).

The original ASR ERA was completed in 2015 as a partnership between the District and the USACE as part of the Comprehensive Everglades Restoration Plan (CERP). Stakeholders for the ERA team included representatives from the USACE, the District, United States Fish and Wildlife Service (USFWS), Florida Department of Environmental Protection (FDEP), Florida Fish and Wildlife Conservation Commission (FFWCC), University of Florida (UF), and contractors to USACE and the District.

As part of the ERA process, a study plan was developed to identify stressors and receptors and developed an ecotoxicology testing program for water quality assessment and ecological monitoring. A Surface Water Modeling Sub-Team took the leadership in identifying the available regional water quality models and scoping the exposure modeling needed for the ERA. The District conducted ongoing aquatic baseline studies at all the pilot projects as well as other regional ecological studies. The USFWS conducted the

ecosystem-level risk assessment on fisheries and West Indian manatees. The FFWCC conducted fishery studies in the Lake Okeechobee basin. The United States Geological Survey (USGS) and UF performed modeling and analysis to evaluate the potential for changes in mercury methylation in Lake Okeechobee and the Greater Everglades.

Prior to the initiation of the original ASR ERA, the ERA team developed a list of stressors based on their professional knowledge of south Florida freshwater and estuarine habitats, surface water and groundwater quality, site-specific hydrogeology, and operational water quality data collected at utility-owned ASR sites located in Florida. The preliminary water quality stressors were organized into five groups: 1) general water quality constituents, 2) nutrients, 3) dissolved solids, 4) metals, and 5) radionuclides.

The team also identified and evaluated physical stressors such as temperature effects and impingement and entrainment of larval fish. Based on the ERA team's understanding of ASR stressors modes of action, fate and effects in south Florida ecosystems, along with water quality, the following assessment endpoints were selected: 1) reproducing populations of native fish; 2) survival of fish and aquatic invertebrates; 3) Periphyton diversity and abundance; 4) submerged aquatic vegetation (SAV); and 5) human health and wildlife protection.

Ecological risk analysis was conducted for five plausible ASR implementation scenarios that were developed for the Lake Okeechobee basin. The alternatives considered were as follows: 1) no ASR wells; 2) 200 ASR wells in Upper Floridan Aquifer (UFA); 3) 100 ASR wells in UFA; 4) 32 UFA wells, 48 Avon Park Permeable Zone (APPZ) wells, and 120 Boulder Zone (BZ) wells; and 5) the same number of wells and placement as alternative #4 but included operational restrictions on the rate of recovery.

The overall finding of the ERA was that implementation of the CERP ASR project, as envisioned in the Regional Study, will not result in irreversible ecological or water quality impacts to the Kissimmee River, Lake Okeechobee, or the Greater Everglades. The key findings of the Regional Study and original ERA were summarized in the Science Plan as follows:

- Large capacity ASR systems can be built and operated in South Florida. To date, no "fatal flaws" have been uncovered that might hinder the implementation of the CERP ASR project.
- Variability in aquifer characteristics will result in varying well performances, making it prudent to conduct an exploratory program before constructing surface facilities.
- Groundwater modeling indicated that the overall number of wells should be less than 333. The model indicated that approximately 130 wells in the upper and middle portions of the aquifer would meet the performance criteria. Of those, 80 ASR could be constructed around Lake Okeechobee.
- Water recovered from the ASR pilot projects did not have any persistent acute or chronic toxicologic effects on test species. However, there were a few instances where reproduction was inhibited, warranting further investigation.

- Arsenic mobilization occurred during early cycle testing but attenuated over time as the storage zone was conditioned.
- Reduction in phosphorus concentrations was observed during ASR storage. This process was postulated to result from microbial uptake, adsorption, dilution, or mineral precipitation.
- Further implementation of CERP ASR should proceed as a phased approach, including expansion and continued construction and testing of pilot facilities.

Although the ERA did not identify substantial ecological effects from a water quality perspective, there was an acknowledgement that water quality conditions would need to be monitored under ASR implementation primarily to satisfy permit requirements. Additional monitoring would also be required to reduce the uncertainties identified in the report. In areas where ASR is proposed that have significant fisheries or high-quality aquatic habitat, additional monitoring such as fishery surveys and stream condition index monitoring was also recommended.

CERP ASR implementation was recommended to be completed in an incremental and geographically dispersed manner to minimize the possibility of unforeseen ecological impacts. Implementation of ASR well cluster facilities with maximum capacity of 25 Million Gallons per Day (MGD) at one or more locations within the Lake Okeechobee Basin was estimated to present only limited ecological risk. The Regional Study also indicated that implementation of similar ASR well clusters in other basins would present slightly higher risk, but these likely could be mitigated.

The NRC reviewed and provided comments on the Regional Study (NRC 2015), including the original ASR ERA. Based on those comments, the District completed a Science Plan (SFWMD 2021) that included actions meant to address the uncertainties identified by the NRC in the Regional Study.

Several of the comments from the NRC related directly to uncertainties in the original ASR ERA were categorized based on general uncertainties in the Science Plan as follows:

- Develop operations to maximize recovery and reduce water quality impacts.
- Conduct longer-term ecotoxicological studies, including *in situ* monitoring, and develop an updated quantitative ERA.
- Understand the mechanisms of phosphorus reduction.
- Evaluate treatment technologies for optimal water quality during recharge, storage, and recovery.
- Compare costs with other water storage alternatives.

Based on the comments received and the information contained in the Science Plan, it was determined that the ERA for the ASR project must be updated and expanded to describe the potential risk better and more quantitatively to ecological receptors and communities following completion of the planned ASR construction projects in proximity to Lake Okeechobee.

The Science Plan calls for the phased construction of new ASR wells and the reactivation of two existing ASR wells in the northern areas of Lake Okeechobee. Early phases of the plan indicate that the KRASR well will be repaired and refurbished along with the permitting of the L-63N ASR system. The construction of two new ASR well clusters (C-38N and C-38S) are planned in the next phase of the project.

The Science Plan also provides information regarding a proposed data management plan and a quality assurance plan which will be implemented and followed for all ERA data collection and data management activities.

The District and USACE have agreed to conduct a revised ERA that will address the uncertainties identified by the NRC, the USACE Agency Technical Review (ATR) team and the public. In July 2021, the District completed a scoping document that provided a scope and a path forward for planning and completion of the revised ASR ERA as requested in the NRC comments and discussed in the Science Plan. This scoping document contained the following primary elements needed for the completion of the ERA:

- Past experience from the previous ERA and comments from the NRC should be used to identify preliminary aspects of a revised ERA (risk questions, endpoints, etc.).
- The scoping document contained a preliminary identification of expected expertise needed to complete the ERA and a preliminary identification of stakeholders to invite to participate in the ASR ERA development process.
- Development of an ERA Working Group was described, including structure and goals.
- Expected data needs were identified.
- Strategies to communicate the risk assessment process with the public were identified.

The second and third elements provided in the scoping document, related to the formation of a Working Group, have been completed, and the Working Group held its first meeting in October 2021 with the goal of developing a comprehensive ERA Work Plan that provides the guidance needed to complete the revised ERA. Additional Working Group meetings have been held in November 2021 and are planned in December 2021 and in 2022 to further discuss the development of the ERA Work Plan.

The analyses presented in this document address a portion of the first element presented in the scoping memorandum. Under the original ERA, many data were collected to represent the potential bioconcentration of metals and radionuclides in water recovered from the ASR well in the Kissimmee River. The original ERA concluded that several trace metals had significantly higher concentrations after being exposed to the recovered water than those exposed to laboratory water and/or water collected from upstream of the ASR well. The original ERA did not, however, provide a quantitative assessment of the potential risks of the observed bioconcentration in fish and mussel tissues to either upper-trophic level receptors or to the fish and mussels. A conservative screening-level assessment of the potential risks due to the observed bioconcentration to wildlife (i.e., birds, mammals, and reptiles) and to the fish and mussels via elevated body burdens is provided in this document. This assessment is designed to aid in the

development of the comprehensive Work Plan by providing information upon which future bioconcentration studies may be focused.

Similarly, the toxicity of the water recovered from the ASR wells was tested extensively in the original ASR ERA. These data were collected along with water quality data from the same location and times as the toxicity samples. While the toxicity test data showed only limited toxicity, the data were not extensively evaluated in relation to the spatially and temporally collocated water quality data. To the extent possible, the available toxicity data from the original ERA were evaluated in this document along with the water quality data to attempt to determine any causative links between the water quality and the observed toxicity in the samples. The results of this causative analysis can be used by the Working Group to focus data collection plans for the upcoming ERA during the ongoing Work Plan development process.

2 FOODCHAIN BIOACCUMULATION ASSESSMENT

The bioconcentration and bioaccumulation of trace metals and radionuclides into fish and mussels were measured in the original ERA at the KRASR in 2009. During the first cycle of stored water recovery, the analyses measured bioconcentration in both fish and mussels. During the second cycle of recovery, caged mussels were placed in the Kissimmee River both upstream and downstream of the ASR well to assess the potential of *in situ* bioaccumulation. During the fourth cycle of recovery, native mussels were collected from upstream and downstream of the discharge site.

The analytes measured in the bioconcentration tests were as follows:

- Aluminum
- Antimony
- Arsenic
- Cadmium
- Chromium
- Total Mercury
- Methyl Mercury
- Molybdenum
- Nickel
- Selenium
- Zinc
- Radium-226 (Radium-226)
- Radium-228 (Radium-228)

During the discharge period of the first well cycle, both fish and mussels were housed within a mobile bioconcentration lab and exposed to recovered ASR water. Metal and radionuclide concentrations were measured at the beginning of the test (Day 0) and after 28 days of exposure (Day 28). Animals were exposed via a flow-through system to recovered water as follows:

- Laboratory control water prepared using reverse osmosis
- Background surface water collected from the Kissimmee River upstream of the ASR well
- 100% recovered water from the ASR discharge
- A 50/50 mix of recovered water and Kissimmee River background water

During the discharge period of the second cycle, caged mussels were placed at one location upstream of the ASR well, two locations in the mixing zone adjacent to the well discharge point, and one location downstream of the ASR well. The caged mussels were sampled at Day 0 as a control, after 35 days of exposure, and after 69 days of exposure.

The tissue data collected in both bioconcentration tests are provided in Table 2-1 and all associated water sampling corresponding to the bioconcentration tests are provided in Table 2-2.

The following observations were made in the original ERA.

In Cycle 1 recharge water, (i.e., background surface water collected from the Kissimmee River upstream of the ASR Well):

- Mussels
    - The only statistically significant change over the 28-day study period was depuration of Ra-226 ($p=0.015$).
- Fish
    - Arsenic significantly ($p<0.001$) increased in fish tissues from laboratory control tissue concentrations.

In Cycle 1 recovered water (i.e., water collected from the ASR discharge point):

- Mussels
    - Arsenic increased in all three treatment groups versus the laboratory control ($p<0.001$ for all treatments) and was significantly higher in the 100% recovered water treatment than the background surface water treatment ($p=0.005$) and 50/50 mixture treatment ($p=0.04$).
    - Nickel was significantly higher ($p<0.05$) in all three treatment groups versus the laboratory control. The ending concentration for the 100% recovered water treatment was significantly higher than that for background surface water ($p=0.002$) and 50/50 mixture ($p=0.011$).

  - Mercury accumulated in mussels in both the background surface water and 50/50 mixture treatments (p=0.011 and p=0.037 respectively) versus the laboratory control. There was no significant increase in the 100% recovered water treatment versus the laboratory control, indicating some uncertainty in the results.

- Fish
  - Molybdenum increased in the 50/50 mixture (p=0.016) and in the 100% recovered water treatments (p=0.002) relative to the laboratory control, but not relative to the upstream background treatment.

The results of the caged mussel study completed during the second recharge/discharge cycle were as follows:

- Mercury was found to be significantly higher at the stations in the mixing zone of ASR discharge versus those collected from the laboratory control samples (p=0.004), while the pooled data from the upstream and downstream stations were not significantly different from either laboratory control samples or those collected from the pooled locations adjacent to the ASR discharge.
- Methylmercury concentrations were found to be significantly lower at the mixing zone stations than the laboratory control, while concentrations from the pooled upstream and downstream locations were significantly higher than those from the laboratory background stations (p<0.001). The results indicated that the bioconcentration of mercury may have been decreased via dilution at the discharge point relative to concentrations within the Kissimmee River upstream and downstream of the ASR discharge.
- Molybdenum concentrations were higher at the discharge point than either the laboratory control or in the mussels placed upstream and downstream of the discharge point (p<0.001).
- Arsenic concentrations were higher in mussels caged in the mixing zone stations versus those from upstream and downstream locations and versus the laboratory control. However, the elevated concentrations in the mixing zone were only observed at Day 35 of the exposure (p<0.001) and not on Day 69, indicating that long-term bioconcentration is uncertain.

Native mussels were collected in the vicinity of the KRASR during recharge and near completion of the KRASR cycle 4 recovery period (Table 2-1). Two sample collection locations were located in the mixing zone adjacent to the discharge area and at a background sampling location across the river and slightly upstream from the ASR discharge area. Statistical analysis was not conducted in the original ASR ERA on the native mussel samples due to insufficient replication. However, the field-collected samples appeared to show that radiation and mercury tissue concentrations in native river mussels were lower in the Kissimmee River near the end of the recovery period as compared to the recharge period. This was an unexpected result for radiation; however, the lower mercury tissue concentrations were consistent with reduced mercury concentration in the recovered water. There were insufficient data to be sure if these observations were related to the ASR discharges.

Overall, significant bioconcentration was noted for mussel and fish tissues due to exposure to stored and recovered water from the ASR discharge. In one or more treatments, concentrations of arsenic, mercury, molybdenum, and nickel were elevated versus one or more control or background treatments when the animals were exposed to recovered ASR water.

While statistically significant bioconcentration was noted in the original ERA, no analysis of the biological significance or risk-based relevance of those effects to either the exposed animals or to other ecological receptors at higher trophic levels that could prey on the exposed animals was provided in the original ERA. As noted by the NRC reviewers, the revised ERA should include quantitative analyses of risks to the ecological receptors potentially exposed to ASR discharge waters.

As a screening step for the planning phase of the revised ASR ERA, the potential for risks to upper-trophic-level receptors due to bioconcentration in fish and aquatic invertebrate tissues is provided in Section 2.1. A screening-level risk-based evaluation of the potential risk to fish and mussels based on the accumulated body burden of bioconcentrated metals and radionuclides is provided in Section 2.2.

2.1 SCREENING-LEVEL EXPOSURE TO AQUATIC FEEDING WILDLIFE

The potential for risk to aquatic-feeding wildlife from bioaccumulating contaminants in the recovered ASR water was not evaluated in the original ASR ERA. However, since several metals bioconcentrated in prey items following exposure to recovery water, a quantitative assessment of risks from that bioconcentration is needed.

Screening-level [1] (i.e., conservative) exposure and risks were calculated for aquatic-feeding birds, mammals, and reptiles using a model developed for the District specifically for the purposes of assessing risk due to the bioconcentration of metals in aquatic food chains (Goodrich 2002, NewFields 2006). The District model provides conservative (i.e., protective) exposure estimates for key species of wildlife that occur in central and southern Florida. The model has been extensively used by the District and its results have been approved by the USFWS and FDEP in decision making regarding property acquisition and in identifying potential corrective action issues prior to project construction. The simplified conceptual model used in the food chain exposure assessment is provided in Figure 2-1.

For the District model to be useful in assessing screening-level risks due to exposure to recovered ASR water, several modifications were required. Since these data are available from the original ASR ERA, no estimation is required, and the measured concentrations were used in the model in preference to the model-predicted values. Since actual mussel and fish data are available, the estimation of concentrations in upper-trophic-level fish was estimated from the existing tissue data using trophic transfer factors (TTFs)

[1] A screening-level ERA is used to help determine when more comprehensive data collection or risk analysis may be needed to support management decisions. Conservative assumptions about exposure and toxicity are used to minimize the chance of underestimating risk of adverse effects. In reality, these assumptions are not accurate indicators of exposure and risk but help determine which stressors or receptors are not a risk and can be left out of a more comprehensive approach, thus helping to maximize the efficiency of the baseline risk assessment (USEPA 2001).

and/or Foodchain Multipliers (FCMs) instead of bioconcentration factors from surface water as done in the District model.

The generic equation used to calculate exposure was:

$$Exposure_{Total} = (SUF) * \frac{[(C_{water} * IR_{water}) + \sum(C_{prey} * IR_{prey})]}{BW}$$

Where:

$Exposure_{Total}$= Daily exposure rate resulting from ingestion of water and all prey items (milligrams chemical per kilogram body weight per day [mg chemical/kg BW/day]).

C_{water} = Maximum Concentration of chemical in surface water (milligrams per liter [mg/L]).

C_{prey} = Maximum Concentration of chemical in each prey type (mg/kg dry weight [DW]) ingested.

IR_{water} = Daily ingestion rate of water (kg/day).

IR_{prey} = Daily ingestion rate of each prey item (kg/day DW).

BW = Body Weight of receptor species (kg).

SUF = Site Use Factor to account for the amount of time that the organism spends using the Site. Assumed to be equal to 1 in this screening-level assessment.

Exposure was estimated on a species-by-species basis, which requires species-specific exposure parameters for each species. The following sections describe the variables used in the screening-level model and the results of the exposure modeling:

- Species evaluated in the screening-level assessment along with their ingestion rates, body weight, and assumed prey consumption (Section 2.1.1)
- Exposure concentration estimation (Section 2.1.2)
- Exposure estimation (Section 2.1.3)

2.1.1 SPECIES EVALUATED

Exposure was estimated for the list of avian receptors commonly used by the District in their screening-level ERAs (SLERAs) to determine the need for potential remediation at acquired properties that may be inundated in the future. This list includes several state and federal trust species as representative target species in exposure and risk calculations:

- White Pelican (*Pelecanus erythrorhynchos*)
- Everglade snail kite (*Rostrhamus sociabilis*)

- Osprey (*Pandion haliaetus*)
- Clapper rail (*Rallus longirostris*)
- Great Blue Heron (*Ardea herodias*)
- Wood Stork (*Mycteria americana*)
- White Ibis (*Eudocimus albus*)
- Little Blue Heron (*Egretta caerulea*)
- Tri-Colored Heron (*Egretta tricolor*)
- Mottled Duck (*Anas fulvigula*)

In addition, the District's food web model also includes several mammals dependent on aquatic habitats. Two of those—the raccoon (*Procyon lotor*) and the river otter (*Lontra canadensis*)—were also selected for use in this assessment. Finally, the American alligator (*Alligator mississippiensis*) was selected to represent aquatic reptiles that may be exposed to recovered ASR waters.

The District's food web model includes the parameters needed to estimate exposure for each of these receptors. The parameters are as follows:

- Body weight (kg/animal)
- Food ingestion rate (kg of food ingested daily in DW)
- Water ingestion rate (L of water ingested daily)
- Dietary contents (percent of diet):
    - Aquatic invertebrates
    - Forage fish
    - Trophic Level 3 (TL3) fish
    - Trophic Level 4 (TL4) fish

The receptor parameters used in the screening-level risk evaluation are provided in Table 2-3.

2.1.2 EXPOSURE CONCENTRATIONS

To estimate exposure, concentrations of analytes must either be measured or estimated in each of the media to which the receptors are exposed. For several media, exposure concentrations are available from laboratory analyses. As discussed in Section 2, laboratory data were available for surface water, mussels, and forage fish from the bioconcentrations studies completed for the original ASR. Those data are presented in Tables 2.1 and 2.2.

Consistent with the screening-level approach, the maximum concentrations detected for each analyte in each medium from samples exposed to recovered ASR water were used as the exposure point concentrations for surface water, aquatic invertebrates (as measured in mussels), and forage fish (as measured in juvenile bluegill).

Analyte concentrations in upper-trophic-level fish were estimated using FCMs from several sources (Sample et al. 1996, and USEPA 1995). An FCM is a simple ratio of analyte concentrations in the higher trophic level tissues to concentrations in lower trophic level tissues which can be multiplied by the concentration in the lower trophic level tissues to provide an estimate of the concentration in the upper-trophic-level tissue. Analyte concentrations in TL3 fish (e.g., black crappie and bluegill) were estimated as:

$$C_{TL3} = C_{foragefish} * FCM_{TL2-3}$$

Where:

C_{TL3} = Concentration in TL3 fish (mg/kg DW)

$C_{foragefish}$ = Maximum measured fish concentrations in the bioconcentration studies (mg/kg DW)

FCM_{TL2-3} = Foodchain Multiplier from forage fish to TL3 fish (unitless)

Analyte concentrations in TL4 fish (e.g., largemouth bass) were estimated as:

$$C_{TL4} = C_{TL3} * FCM_{TL3-4}$$

Where:

C_{TL4} = Concentration in TL4 fish (mg/kg DW)

C_{TL3} = Maximum estimated concentrations in TL3 fish (mg/kg DW)

FCM_{TL3-4} = Foodchain Multiplier from TL3 to TL4 fish (unitless)

The exposure concentrations for benthic invertebrates and forage fish are provided in Table 2-1. Exposure concentrations for surface water are provided in Table 2-2, and estimated exposure concentrations for TL3 and TL4 fish are provided in Table 2-4.

2.1.3 EXPOSURE ESTIMATION

The total exposure for each receptor to each analyte was estimated using the receptor parameters provided in Section 2.1.1 and the exposure concentrations estimated in Section 2.1.2 using the following equation:

$$Exposure_{Food} = \frac{\left(P_{BI} * IR_{food} * C_{BI}\right) + \left(P_{foragefish} * IR_{food} * C_{foragefish}\right) + \left(P_{TL3} * IR_{food} * C_{TL3}\right) + \left(P_{TL4} * IR_{food} * C_{TL4}\right)}{BW}$$

Where:

$Exposure_{Food}$= Daily exposure rate resulting from ingestion all prey items (mg chemical/kg BW/day)

C_{water} = Maximum Concentration of chemical in surface water (mg/L)

IR_{water} = Daily ingestion rate of water (kg/day)

IR_{food} = Daily ingestion rate of food (kg/day DW)

BW = Body Weight of receptor species (kg)

SUF = Site Use Factor to account for the amount of time that the organism spends using the Site; assumed to be equal to 1 in this screening-level assessment

P_{BI} = Proportion of diet as benthic invertebrates (unitless)

$P_{forgagefish}$ = Proportion of diet as forage fish (unitless)

P_{TL3} = Proportion of diet as TL3 fish (unitless)

P_{TL4} = Proportion of diet as TL4 fish (unitless)

C_{BI} = Measured concentration of benthic invertebrates (mg/kg DW)

$C_{forgagefish}$ = Measured concentrations of forage fish (mg/kg DW)

C_{TL3} = Estimated concentration of TL3 fish (mg/kg DW)

C_{TL4} = Estimated concentration of TL4 fish (mg/kg DW)

The exposure from surface water ingestion was calculated as:

$$Exposure_{water} = \frac{IR_{water} * C_{water}}{BW}$$

Where:

$Exposure_{water}$ = Daily exposure rate resulting from ingestion of water (mg/kg BW/day)

C_{water} = Maximum Concentration of chemical in surface water (mg/L)

IR_{water} = Daily ingestion rate of water (kg/day)

BW = Body Weight of receptor species (kg)

Total exposure was calculated as:

$$Exposure_{total} = SUF * (Exposure_{food} + Exposure_{water})$$

Where:

$Exposure_{total}$ = Daily exposure rate resulting from ingestion of food and water (mg/kg BW/day)

SUF = Site use factor or the proportion of the total home range of the receptor encompassed by the Site; an SUF equal to 1 was used for conservative purposes

The estimated maximum exposures (mg/kg BW/day) for each receptor/analyte pair are provided in Table 2-5.

2.1.4 SCREENING-LEVEL TOXICITY REFERENCE VALUES

The exposure estimates generated by the exposure model were compared to TRVs, which represent estimated levels of toxicity based on specific toxicological endpoints for test organisms. For this screening-level assessment, No Observed Adverse Effect Levels (NOAELs)—which represent exposure rates at or below which no adverse effects to growth, reproduction, or mortality are expected—were used to estimate the potential for risk due to exposure to recovered ASR water. The NOAEL TRVs are class-specific and are provided for both birds and mammals. Toxicity data for reptiles are limited, and the TRVs identified for birds were used as surrogate TRVs for the alligator receptor.

The NOAEL TRVs used in the District's model were obtained from the United States Environmental Protection Agency's (USEPA's) extensive literature-based review of the toxicity of many trace metals to birds and mammals as part of their development of soil screening levels (USEPA 2007). While the goal of that assessment was the development of terrestrial screening-levels, the toxicity data reviewed and assembled has wide utility in identifying NOAEL TRVs for use in screening-level aquatic ERAs as well. These TRVs represent the best available NOAEL TRVs for the analytes for which they are available. For several analytes (mercury, methylmercury, and molybdenum), no TRVs were developed by USEPA. In those cases, several standard and widely used ecotoxicity databases were consulted and used to identify conservative NOAEL TRVs for bird and mammal receptors. The TRVs selected for used in this assessment are provided in Table 2-6.

2.1.5 HAZARD QUOTIENT CALCULATION

The calculation of hazard quotients (HQs) is a standard approach identified in USEPA guidance (1997) used to compare estimated exposure to TRVs where HQ is a ratio of the estimated exposure concentration to the TRV:

$$\mathrm{HQ} = Exposure_{total}/\mathrm{TRV}$$

The HQs calculated using maximum detected concentrations in prey items collected from the ASR mixing zone and/or downstream of the ASR and those in recovered ASR water are provided in Table 2-7.

Due to the highly conservative nature of the assessment, an HQ greater than 1 is not, by default, indicative of a risk to the receptor but rather that the risk cannot conclusively be determined to be low. In such a case, it is recommended that the analyte/receptor pair should be considered in more detail in the revised ASR ERA. This is a conservative assumption because the assessment assumes that the receptors spend 100 percent of their time feeding and drinking within the mixing zone of the ASR discharge and that all food and water ingested contain the maximum detected concentration of each analyte. Since all of the wildlife receptors are mobile species and can move freely throughout their home ranges, it is unlikely that more than one or two individuals whose home ranges may be focused in the vicinity of the ASR well would be exposed to food from the ASR well mixing zone for more than a fraction of the time. In addition, not prey and water concentrations would be expected to be more closely aligned with the average concentrations of each analyte than the maximum detected concentration. Given these built-in conservatisms in the screening-level model, it is unlikely that the potential for risk would be significant with HQs greater than 1.

If the HQ is less than 1 for the NOAEL TRV, then no adverse effects are predicted, and risks from that analyte/receptor pair can be considered to be trivial or *de minimis* and of low priority for additional assessment in the revised ASR ERA. Despite the conservatism built into the screening model, out of an abundance of caution, if the intake exceeds the NOAEL TRV (i.e., HQ > 1), the risk of adverse effects cannot be considered to be low, and the analyte/receptor pair should be evaluated further in the ASR ERA process.

Of the 11 analytes evaluated, selenium was the only analyte with HQs equal to 1 using NOAEL TRVs. . As a result, risks to all analytes except selenium can be considered to be *de minimis*.

The potential for risk cannot be conclusively ruled out for receptors with selenium HQs equal to 1 (clapper rail, everglade snail kite, mottled duck, and raccoon) but as discussed above, since the HQs are not greater than 1, there is a high likelihood that selenium risks to those receptors are also *de minimis*.

Selenium was also detected in background samples collected from upstream of the ASR discharge or was present in laboratory background samples and the maximum detected concentrations from those samples (tissue and surface water) were also used to calculate HQs (Table 2-8). As observed using the downstream data, multiple receptors also had HQs equal to 1 using the NOAEL TRV in the background samples (raccoon and river otter), indicating a similar level of potential risk in the background samples. This corresponds with the conclusions from the original ASR ERA because concentrations in neither fish nor mussel tissues were higher in any of the tests where they were exposed to ASR recovery water. Because the risk did not increase in the exposures estimated downstream versus upstream of the ASR discharge, the storage of water within the ASR well did not appear to increase selenium concentrations and/or the potential for risk to wildlife receptors downstream of the ASR well. While the potential for risk to wildlife receptors from selenium cannot be entirely ruled out based on the available data, the likelihood of risk is very low given the conservative nature of the assessment and the lack of increase in exposure media concentrations and estimated exposure between the background and post-storage ASR water.

2.1.6 RADIOLOGICAL EXPOSURES

For radionuclides, total ionizing radiation (TIR) risks to aquatic and riparian receptors were evaluated following guidance for general screening provided in the U.S. Department of Energy (USDOE) Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota (USDOE 2002), using the methodology available in the RESRAD-Biota software (USDOE 2016). The maximum measured concentrations of radium (Ra-226 and Ra-228) were compared to default Level I Biota Concentration Guides (BCGs), which are screening values considered safe to exposed biota, for each type of ecosystem (aquatic, terrestrial, or riparian). BCGs represent the concentration of a radionuclide in an environmental media that would not result in adverse effects to sensitive receptors. The BCG for Ra-226 and Ra-228 were equal to 10.2 and 8.49 pCi/L for aquatic animals and 4.08 and 3.40 pCi/L for riparian animals. As shown in Table 2-2, the maximum measured concentrations of Ra-226 and Ra-228 in recovered water were equal to 2.4 and 0.65 pCi/L, respectively. This indicates that the Ra-226 and Ra-228 concentrations observed in recovered water are highly unlikely to pose a risk to aquatic or riparian ecological receptors.

2.2 RISK-BASED EVALUATION OF TISSUE CONCENTRATIONS FOR AQUATIC LIFE

Fish and mussel tissues were evaluated relative to risk-based benchmarks to conservatively determine if the concentrations observed in the bioconcentration studies conducted in the original ERA are indicative of potential effects to local fish or benthic invertebrate populations. Although some of the chemicals evaluated can biomagnify (i.e., a progressive buildup of a chemical through the food chain that can cause risk to upper-trophic-level receptors as discussed in Section 2.1), the primary focus of assessing fish and mussel tissues was to evaluate the potential risk from chemicals that bioaccumulate and bioconcentrate. Bioaccumulation refers to the net accumulation over time of metals (or other persistent substances) within an organism from both biotic (other organisms) and abiotic (soil, air, and water) sources. Bioconcentration is the accumulation of a chemical in tissues of a fish or other organism to levels greater than are found in the surrounding environment.

Estimating dietary exposure and risk for fish for some chemicals, such as selenium, can be much more important, in terms of toxicity, than evaluating exposure through water. However, estimating doses of chemicals in fish by exposure route is poorly understood. In addition, adequate models to describe these relationships, such as those that have been developed for wildlife, are largely not available. Thus, measured tissue concentrations from laboratory or field studies were compared to evaluate potential ecological effects to fish and mussels based on measured tissue residues.

The chemical concentrations reported in the fish and mussel tissues from the laboratory-based bioconcentration tests reported in the original ASR ERA were from water. Caged mussels were placed upstream, in the mixing zone, and downstream of the ASR during the second ASR cycle. Wild mussels were also collected from upstream, downstream, and in the mixing zone during the fourth ASR water recovery cycle. These data, summarized in Table 2-1, better represent the potential bioaccumulation from all sources.

Exposure conditions and results for fish and mussels during the bioconcentration studies are described in Section 2 above. The subsections below describe a risk-based screening-level assessment of metals measured in fish and mussel tissues.

2.2.1 TRV SOURCES AND SELECTION CRITERIA

Risks due to chemical concentrations in fish and mussels were screened by comparing measured tissue concentrations to screening-level TRV concentrations where associated effects or no effects were observed. These TRVs were compiled from publicly available database sources and published literature documenting results from various laboratory and field studies. TRVs were identified and compiled from two databases:

- Jarvinen and Ankley (1999) Linkage of Effects to Tissue Residues: Development of a comprehensive database for aquatic organisms exposed to inorganic and organic chemicals
- USACE (2019) Environmental Residue Effects Database (ERED)

In the event that no TRV was found for either fish or mussel tissue, publicly available literature sources were searched to examine availability of suitable TRVs. While many of the TRVs were sourced from the database compilation identified above, the original source of the study was identified if possible.

Both databases compile effects data for aquatic organisms (including fish, invertebrates, and algae) exposed to a variety of chemicals, durations, exposure pathways, life stages, and for different tissues. A hierarchy of tissue effects data was established in the criteria definition process to narrow possible risk screening effects thresholds:

1. Whole body fish tissue or soft tissue for mussels were preferential when available; otherwise, tissue data from other organs (e.g., gill, liver, or muscle tissue) were used.
2. Response data from freshwater studies were used preferentially over those from marine studies. However, if no freshwater studies were available, then saltwater studies were utilized. Tissue residue effects data from marine species were selected only if alternative tissue residue data, as indicated above, were not available.
3. Warm-water species were selected preferentially when available, but if data for warm-water species were unavailable, then tissue residues for salmonid or other freshwater species were used.
4. The preferred endpoints for tissue benchmark data were no observed effects for growth or reproduction (or both); no observed effects data for survival were used if data for growth or reproduction effects were not available.
5. Tests from longer-term exposures were preferentially selected over short-term exposures in developing the assessment benchmarks.

The selected TRVs for both fish and mussel tissues are shown in Table 2-9 together with original study sources referenced from the compiled databases identified above.

2.2.2 TRV APPLICATION AND INTERPRETATION

Comparisons of ASR ERA fish and mussel tissue results to TRVs of tissue residues-effects data allow risk screening to assess if chemical tissue residues in recovery water may pose a risk to aquatic life.

Maximum tissue residue concentrations reported in each of the ASR ERA exposure scenarios were compared with the corresponding chemical benchmarks to assess potential risks (Table 2-10 and 2-11). If maximum tissue concentrations exceeded their respective tissue TRVs, then further analyses of the tissue concentration data were conducted to evaluate tissue concentrations from background exposures versus recovery water, versus recharge/discharge water.

Data for concentrations of chemicals in fish and mussel tissues were reported in the original ASR ERA (2014) for fish (whole body) and mussels (soft tissues) on a wet weight (ww) basis.

As a result, data were first converted to DW using an assumed dry/wet conversion factor of 0.27 (e.g., 27% solids or 73% moisture) for fish (Garber 2009) and 0.15 for soft mussel tissue (e.g., 15% solids or 85% moisture) (Mo and Neilson 1992). As noted in Section 2.1, comparison of TRVs to tissue residue concentrations was conducted through developing ratios for HQs (e.g., tissue concentration/TRV concentration). HQs were rounded to one significant figure, consistent with standard risk assessment protocols (USEPA 2005).

2.2.3 AQUATIC ORGANISM BIOACCUMULATION RISK CHARACTERIZATION

2.2.3.1 FISH TISSUE

Assessment of the tissue data indicates that of the 11 metals screened for bioaccumulation risks in fish tissues, 10 had HQs < 1 for all the exposure scenarios (e.g., control, upstream, discharge, and laboratory mixture) (Table 2-10). Negligible, or *de minimis*, risks are predicted for bioaccumulation risk due to tissue concentrations of antimony, arsenic, cadmium, chromium, mercury, methyl mercury, molybdenum, nickel, selenium, and zinc.

Aluminum concentrations in fish tissues for all exposure scenarios, except the 50/50 simulated discharge, all had HQs <1. The HQ for the 50/50 simulated discharge had an HQ of 1.2, which when rounded to one significant figure is equal to 1. Aluminum concentrations in this mixture ranged from 45 to 64.5 µg/L, with the majority of aluminum in that mixture originating from background surface water, which had aluminum concentrations that ranged from 113 to 151 µg/L. The recovered ASR water had aluminum concentrations of 3.1 to 4.2 µg/L. Given the source of aluminum in the 50/50 simulated mixture discharge water, risks due to aluminum bioaccumulation due to ASR discharge water are considered *de minimis* as the exposure to existing background conditions posed no bioaccumulation risk (e.g., HQ <1).

The original ASR ERA statistical comparisons for the bioaccumulation data indicated a significant increase in fish tissue arsenic concentrations over background for fish exposed to 50/50 mix background/recovery water and full recovery water. Further, molybdenum was shown to be significantly greater in mix water and recovery water exposures compared to background water exposures. Despite these significant

increases, fish bioaccumulation of arsenic or molybdenum did not exceed respective TRVs resulting in HQs<1; therefore, no risks were predicted for arsenic or molybdenum bioaccumulation or any other metals for fish.

2.2.3.2 MUSSEL TISSUE

Of the 12 metals screened for bioaccumulation risks in mussel tissues, eight had HQs <1 for all the exposure scenarios, including antimony, arsenic, cadmium, chromium, mercury, methyl mercury, nickel, and selenium (Table 2-11). Bioaccumulation risk due to these metals is therefore considered *de minimis.*

Aluminum

The maximum aluminum tissue concentrations measured during Cycle 1, 28-day laboratory exposures, had HQs>1 for upstream background (HQ=2), and simulated discharge water (e.g., 50/50 mixtures) (HQ=2), whereas the downstream discharge water had HQs<1. As described above for fish tissues, the aluminum in water originates in the background surface water, where concentrations ranged from 102 to 210 µg/L. Recovered surface water concentrations ranged from 6.8 to 8.9 µg/L.

The maximum aluminum tissue concentrations during Cycle 2, 35- and 69-day field exposures, resulted in HQs>1 for upstream background, discharge, and downstream exposure conditions (HQ range=3 to 4). HQs for background surface waters ranged from 2 to 3, whereas the discharge water HQs ranged from 2 to 3. Downstream exposure conditions resulted in HQs ranging from 2 to 4. Most of the highest tissue concentrations of aluminum observed were for the 69-day upstream background, discharge, and downstream water exposures (Table 2-12). The 35-day exposures generally resulted in lower tissue concentrations. Cycle 4 field exposures resulted in HQs<1 with field-collected mussels showing no signs of significant bioaccumulation at upstream or discharge sample sites. Presence of aluminum in background surface waters during Cycles 1 and 2 (2009) affected mussel tissue bioaccumulation. These same conditions were not likely present during Cycle 4 (2012 and 2013) as all aluminum bioaccumulation HQs were less than 1 during this cycle.

The original ASR ERA did not find any statistical comparisons of background recharge, or recovery exposure conditions where aluminum in mussel tissues was significantly altered. Paired with the above findings, these lines of evidence support that aluminum bioaccumulation in mussel tissue was not significantly affected by ASR activities.

Manganese

Manganese bioaccumulation was only evaluated in field-collected native mussel tissue during Cycle 4. Maximum mussel tissue concentrations of manganese during Cycle 4 resulted in HQs > 1 (range: 8 to 46) for both the upstream and discharge exposure scenarios during both recharge and recovery (Table 2-12). No corresponding water measurements of manganese were found for this time period. All the measured mussel tissue manganese concentrations exceeded the TRV by many times; however, HQs were overall greater during recovery than during recharge, and greater in background exposures versus discharge water exposures.

The ASR ERA did not conduct any statistical comparisons of background, recharge, or recovery exposure conditions for Cycle 4 tests, and manganese was only evaluated for bioaccumulation in Cycle 4 tests. With only two rounds of tests in Cycle 4, there are no quantifiable trends of manganese bioaccumulation because all available data exceeded the bioaccumulation TRVs used in this assessment. However, the data do indicate that manganese is present in background surface waters at sufficiently high concentrations to result in mussel bioaccumulation to a greater concentration than the TRV. Recovery water exposures resulted in highly variable responses that may be site-, time-, cycle-, and operational-phase specific. Further evaluation of manganese is likely warranted to assure that while it may be part of the background condition, ASR activities do not enhance bioaccumulation potential.

Molybdenum

Molybdenum bioaccumulation was evaluated in mussel tissue during all phases of the initial studies (e.g., lab exposures and Cycles 1, 2, and 4). Maximum field-collected native mussel tissue concentrations of manganese during Cycle 4 resulted in HQs equal to 1 for both the upstream and discharge exposure scenarios during both recharge and recovery (Table 2-12). All other HQs during laboratory exposures and Cycles 1 and 2 were less than 1. Tissue concentrations in mussel tissue during Cycle 4 ranged from 0.85 to 0.98 mg/kg ww during recharge and 0.84 to 0.88 mg/kg ww during the recovery phase. Upstream water concentrations of molybdenum appear to be unchanged by recharge or recovery, and bioaccumulation in mussel tissues is similar to the No Observed Effect Concentration (NOEC) values used as a TRV in this assessment. The consistent tissue concentrations during both the recharge and recovery cycles suggest that the ASR does not pose a risk to molybdenum bioaccumulation in mussels, but its higher concentrations during Cycle 4 suggests that molybdenum may be a parameter of interest as the ASR recharge and recovery process continues.

The original ASR ERA did not include any statistical comparisons of background, recharge, or recovery exposure conditions for Cycle 4 tests when molybdenum concentrations in mussel tissues actually exceeded the TRV. Similar to manganese, the data do indicate that molybdenum is present in background surface waters at sufficiently high concentrations to result in mussel bioaccumulation to a greater concentration than the TRV.

For those statistical comparisons conducted in the original ASR ERA, findings indicated that molybdenum significantly increased in mix water during Cycle 1 and that molybdenum concentrations were higher at the discharge than either the background or control mussels during Cycle 2. These findings, however, did not correspond to instances of molybdenum concentrations in mussel tissue exceeding the TRVs. Further, evaluation of molybdenum is likely warranted to assure that while it may be part of the background condition, ASR activities do not enhance bioaccumulation potential.

Zinc

Zinc bioaccumulation was evaluated in mussel tissue during laboratory exposures and Cycles 1 and 2. Maximum mussel tissue concentrations of zinc only exceeded the TRV once during Cycle 2 35-day exposures at the discharge site (station 3B) during ASR recovery, resulting in an HQ of 1 (Table 2-12).

Further evaluation of the data during this cycle shows that at station 3A, an HQ of 1 was derived for tissue concentrations of zinc in mussel tissue. All other exposure scenarios had HQs <1.

The ASR ERA statistical comparison did not identify zinc as a metal that significantly bioaccumulated in recharge or recovery water, indicating that risks are likely to be *de minimis* and associated with background conditions.

Bioaccumulation Summary

Comparison of fish tissue metals residues measured during different exposure scenarios to tissue-based TRVs at the no-effect level found no HQs >1. One aluminum concentration in a simulated discharge (50/50 mix) in laboratory exposures had an HQ of 1. Risk of metals bioaccumulation based on the currently available data is considered *de minimis*.

Similar comparisons of metal concentrations in mussel tissues to respective no-effect TRVs found HQs <1 for 8 of 12 metals. Aluminum bioaccumulation in mussel tissues occurred during Cycles 1 and 2 exposures but appeared to be largely a function of background surface water and not ASR recovery. Similarly, manganese bioaccumulation during Cycle 4 exposures appeared to be a function of background surface water exposures and not ASR recovery. Low HQs for molybdenum bioaccumulation were observed (e.g., HQ = 1), and similar to manganese, these Cycle 4 exposures were a function of background surface waters and not ASR recovery. Likewise, two zinc bioaccumulation HQs=1 during Cycle 2 were observed at a downstream site during the ASR recovery phase. Overall, the bioconcentration data from the original ERA show that the potential for bioaccumulation risk to benthic invertebrates from exposure to recovered ASR water is very low.

3 EVALUATION OF THE ORIGINAL ASR ERA TOXICITY TEST RESULTS

The original ASR ERA conducted over 80 acute and chronic multi-species toxicity tests at the KRASR during Cycles 1 through 4 to evaluate the potential for toxicity of ASR recharge and recovery water. Specific toxicity tests run to characterize the different phases and cycles of the ASR project are summarized in Table 3-1. Tests included acute and short-term and long-term chronic tests using up to five different species, and multiple endpoints (e.g., survival, growth, reproduction, and/or teratogenesis), depending on the test and species being conducted. While the overall effort was quite comprehensive, not all tests were completed during all cycles, but the suite of tests run throughout (including the acute and chronic *Ceriodaphnia dubia,* short-term chronic *Pimphales promelas,* and acute *Cyprinella leedsi*) satisfied necessary permit conditions as well as a range of species sensitivities that would allow for a reasonably thorough evaluation of the potential toxicity of ASR water.

Results of the original ASR ERA toxicity tests are summarized herein in Table 3-2. Results indicate no effects of recharge or recovery water to fish (fathead minnows and bannerfin shiner), amphibians (Frog Embryo Teratogenesis Assay Xenopus [FETAX]), or *Daphnia magna*. A single response was noted for one of the algae tests during Cycle 1 in recharge water (NOEC=25%). For the water flea, *C. dubia*, no effects on survival were noted during the seven-day test, but there was an effect during the short-term 96-hour

test using this species during Cycle 3 in recovery water (LC50 [Lethal Concentration 50%]=83.92%). The following was described for the *C. dubia* reproduction tests in the original ASR ERA:

> "An effect on reproduction of *C. dubia* was observed during Cycle 1 in two of the tests using recovered water. The March 10, 2009, test showed a statistically significant difference between the 12.5 percent recovered water and the controls. This data point is considered a test anomaly since no effects on reproduction were observed at higher recovered water concentrations up to 100 percent. The March 24, 2009, sample of recovered water showed an Inhibition Concentration (IC25) of 95.52 percent, indicating a minor but measurable reduction in reproduction of the water flea in 95.52 percent recovered water. Cycle 2 showed an effect on reproduction on two tests. The November sample showed a decrease in reproduction in 100 percent recovered water and the last sample near the completion of the cycle showed an IC25 of 76.4 percent. Cycle 3 had one sampling event (May 2011) that showed effects on the survival (96-hour LC50 of 83.92 %) and reduced reproduction (IC25 of 7.2%), also near the end of the cycle. Two of the mid-cycle samples during Cycle 4 also showed chronic effects on *C. dubia* reproduction with IC25 of 83.9 and 76.2 percent. But the following three-monthly tests did not show this effect."

The original ASR ERA concluded that:

> "Overall, the recovered water from KRASR did not show quantifiable acute or chronic effects on any species tested with the exception of the sensitive cladoceran *C. dubia.* The effect observed was on reproduction of this sensitive cladoceran species, showing that at times during mid- to late- cycle the recovered water at concentrations greater than 50 percent had an inhibitory effect on the reproduction of this species. The cause for this chronic effect is not known."

3.1 RISK SCREENING APPROACH FOR ORIGINAL TOXICITY TEST DATA

To screen potential ecological risks based on the toxicity data generated as part of the original ASR ERA, the toxicity test data were compiled with corresponding water quality sample data collected from the same dates as the toxicity test samples. The surface water data from the same location as the toxicity tests at point of discharge (POD) sampling location (located at the bottom of the discharge aeration cascade) was used. If no data corresponding to the test date were available for that date at the POD, the data collected at the well head (location EXKR-1) were used to estimate the water quality in the toxicity test samples. Results of tests were matched to water quality parameters by groups, including metals, major and minor ions, nutrients and organics, radionuclides, and remaining field measured parameters.

Once toxicity test data were grouped with water quality parameters, toxicity test results were identified as toxic or not toxic. TRVs were identified for water quality parameters to assess exceedance/non-exceedance of corresponding applicable thresholds. TRVs were sourced from parameter-specific chronic water quality standards, criteria, or literature-based effects thresholds (Table 3-3). The hierarchy for selection of TRVs was as follows:

- Florida Water Quality Standards – Primary source

- National Criteria, Great Lakes Water Quality Initiative Tier 1 or Tier 2 criteria, Region 4 Screening Criteria for water – Secondary sources where the most recently updated values were used.

When a water quality standard value was not available from the state standards, then the most current values from sources listed in the second bullet point above were utilized. For all the metals water quality data, TRVs were identified for screening risks. For major and minor ions, silica was the only parameter for which no TRVs were identified. TRVs for radionuclides were found only for gross alpha and Ra-226 and Ra-228. For nutrients, TRVs were identified only for ammonia, nitrite-N, and total phosphorus. For *in-situ* field parameters, TRVs were identified for dissolved oxygen (DO), pH (Hydrogen Ion Activity), temperature, and turbidity.

HQs were calculated for measured water quality data corresponding to the toxicity test samples by dividing the measured concentration(s) by the TRVs. The data reported for the surface water samples did not have all analytes measured in all samples.

Using the HQ approach where HQ≤1 indicates *de minimis* risk and HQ>1[2] indicates that the potential for risk cannot be dismissed as low, the paired toxicity data and risk quotients were used to assess overall potential risk of sample conditions using the following decision matrix.

- Toxicity test is toxic, water quality concentration(s) yield HQ>1 – Conclude that sample conditions may pose a risk to aquatic life, identify possible causal factors.
- Toxicity test is toxic, water quality concentration(s) = HQ≤1 – Conclude that sample conditions may pose a risk to aquatic life, evaluate further for additive toxicity.
- Toxicity test is not toxic, water quality concentration(s) = HQ>1 – Conclude that sample conditions do not likely pose a risk to aquatic life.
- Toxicity test is not toxic, water quality concentration(s) = HQ≤1 – Conclude that sample conditions do not pose a risk to aquatic life.

Tables 3-4 to 3-13 summarize the findings of this analysis with a complete parameter-by-parameter assessment provided in Appendix B.

Metals

Metals screened as part of the analysis included aluminum, antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, methyl mercury, molybdenum, nickel, selenium, strontium, uranium, and zinc (Tables 3-4 and 3-5). Of these, only arsenic (n=25), iron (n=25), manganese (n=15), mercury and methyl mercury (n=22), and molybdenum (n= 15) had associated water quality data spanning the majority of the cycles when toxicity tests were conducted. The remainder of the parameters were only measured during Cycle 1 resulting in 8 samples available for pairing from each parameter with Cycle 2 toxicity tests.

[2] Final HQs are rounded to the nearest whole number where >1 to ≤1.5 = 1 and >1.5 to ≤2 = 2.

Except for arsenic, all the metals screened against their respective TRVs had HQs < 1. Arsenic exceeded its respective TRV (50 ug/L) in 3 of 25 samples on March 11, 17, and 24, 2009, during Cycle 1. The March 24 sample data had corresponding toxicity test data that showed a small but measurable level of effects for *C. dubia* reproduction (IC25=95.5%) from recovery water during Cycle 1, and the corresponding water concentration had an HQ of 1. The March 11 and 17 samples showed no toxicity, although arsenic equaled or exceeded its TRV with HQs of 1 each, respectively. Based on these data, it does not appear that arsenic is a causal factor for the observed toxicity in the March 24 sample, particularly since the chronic National Criteria for arsenic is three times higher (150 ug/L) than the Florida aquatic life standard for arsenic, which is expected to be based more on human health than aquatic life effects.

The observations of toxicity to test organisms do not appear to be caused by individual concentrations of metals in recovery water, although there is a possibility of cumulative effects from metals or other parameters. While a small but measurable effect on *C. dubia* reproduction was observed that corresponded with a water quality sample for arsenic that had an HQ of 1, prior toxicity tests were found to be not toxic with arsenic concentrations that were higher.

Major and Minor Ions

Ions (cations and anions) screened as part of the analysis included bromide, calcium, chloride, fluoride, magnesium, potassium, silica, sodium, sulfate, sulfide, alkalinity, and cyanide. TRVs were identified for all ions with the exception of silica (Tables 3-6 and 3-7). With the exception of chloride, none of the major or minor ions exceeded their respective TRVs (e.g., all HQs<1). Total cyanide concentrations were all less than detectable (<0.005 mg/L), and the criteria for cyanide was 0.0052 mg/L. HQs of 1 in this case would not accurately portray potential risks because all measured concentrations were less than the detection limit, which was essentially equal to the screening criteria.

For chloride, of the 25 time periods when toxicity test samples corresponded with water quality samples, 12 of those time period samples had HQs≥1. Of those 12 time periods, only seven tests indicated potential toxicity in the sample. For the seven tests where toxicity was identified, only three toxicity tests matched those water quality samples yielded results, indicating some level of toxicity. For the three samples where chloride concentrations yielded HQs≥1 and corresponding toxicity was observed, chloride concentrations were 150 mg/L (Cycle 1), 180 mg/L (Cycle 2), and 160 mg/L (Cycle 3) during recovery, each resulting in HQs of 1. For the remaining nine samples, no toxicity was observed, and chloride concentrations ranged from 160 to 300 mg/L.

Based on the decision matrix, test conditions that result in toxicity with corresponding water quality samples that result in HQs>1 indicate that the risk for those sample conditions that are not *de minimis* may pose a risk to aquatic receptors, and causal factors should be identified. However, examination of the larger suite of chloride water quality concentration data and toxicity data indicates that there are several instances of higher chloride concentrations present across Cycles 2, 3, and 4, where no toxicity was observed.

Chloride by itself does not appear to be a causal factor for the toxicity identified in the tests conducted. As a major anion that often combines with other cations, the potential for a chloride complex (e.g., sodium or potassium chloride) to cause toxicity is possible; however, at the concentrations of these parameters individually, it is not likely that cation complexes with chloride are causal factors for observed toxicity.

Nutrients/Organics

Nutrient and organic parameters evaluated included total and dissolved organic carbon (TOC and DOC), total ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, organic nitrogen, Kjeldahl nitrogen, and ortho and total phosphorus. Of these, TRVs were available for ammonia, nitrite, and total phosphorus (Tables 3-8 and 3-9). For nitrates and total phosphorus, water samples paired with toxicity test data yielded HQs ≤1 for all samples. A single nitrate-N sample had a concentration of <0.025 mg/L during Cycle 4 (June 2013), resulting in an HQ equal to 1. At less than the detection limit, the actual nitrate-N concentration will be lower; therefore, the HQ will be less than 1 (based on a non-detectable sample concentration). All toxicity test results for this cycle resulted in no toxicity to test organisms.

Ammonia criteria have a complicated TRV based on temperature and pH and are derived as a 30-day average requiring a minimum of four independent samples. No single sample should exceed 2.5 times the value derived from the equation. Using this approach, the TRVs were derived for ammonia for single sample criteria. Available ammonia water quality data yielded HQs <1 based on the single sample criteria. All the nutrients or organics for which TRVs could be identified had HQs ≤1 and do not appear to be causal factors for observed toxicity. Toxicity due to nutrients or organics is not expected, and risks due to water concentrations of nutrients or organics are *de minimis*.

Radionuclides

Radionuclide water quality data available for pairing with toxicity test data included gross alpha, Ra-226, Ra-228, uranium 234, uranium 235, and uranium 238. Of the parameters, no data were available during the toxicity test timeframes for uranium 234, 235, or 238. Individual sample data for Ra-226 and Ra-228 were summed so that the combined TRV for Ra-226 and Ra-228 could be used. Comparison of the gross alpha water quality data found all samples to be less than the respective TRV, except for the January 2011 Cycle 3 test period where the gross alpha water concentrations were 18.2 picocurie/Liter (pCi/L), resulting in an HQ=1. All toxicity test results for this cycle resulted in no toxicity to test organisms.

For Ra-226 and Ra-228, water concentrations were all less than applicable TRVs yielding HQs<1 for all samples (Tables 3-10 and 3-11). Toxicity due to radionuclides is not expected, and risks due to water concentrations of radionuclides are *de minimis*.

Physicochemical

Physicochemical parameters measured in the field at the time of sample collection for other water quality parameters included water color, DO, oxidation-reduction potential (ORP), pH, specific conductance, water temperature, total dissolved solids (TDS), Total suspended solids, and turbidity. Of these, numeric

or narrative TRVs were available for DO, pH, temperature, and turbidity (Tables 3-12 and 3-13). Use of instantaneous measurements such as these to inform causal factors for toxicity in toxicity tests is problematic. DO, pH, and temperature are parameters specifically adjusted for during or at commencement of toxicity tests to achieve standardized test conditions; therefore, the field measurement data are only applicable to inform the conditions observed at the time of sampling.

Nonetheless, it is still important to understand those conditions and how or if they may have some indirect bearing on potential sample toxicity. Florida DO standards are based on percent saturation, not the actual measured DO in mg/L. Florida's DO percent saturation calculator was used to derive the appropriate values in percent saturation, based on measured DO in mg/L, time of day, and temperature. All DO percent saturation values achieved the applicable criteria with percent saturation, ranging from 75 to 99 percent. In particular, recovery water from Cycles 1 through 4 ranged from 82 to 99 percent saturation.

For pH, the criteria range is to be between 6.5 and 8.5 pH units. All pH data matched to toxicity test data fell within this range. For temperature, discharges should not exceed 92°F (33.3°C). All the measured temperature data were less than 33°C. Turbidity criteria measurements should be less than or equal to 29 Nephelometric Turbidity Units (NTUs) above natural background. In this case, the turbidity in the Kissimmee River during recharge ranged from 2 to 3.3 NTUs while during recovery cycles turbidity ranged from 0.13 to 7.2 NTUs. Turbidity in surface water during these recovery cycles is well below the criteria.

Summary

Over 80 acute and chronic toxicity tests were completed at the KRASR during Cycles 1 through 4 during recharge and recovery. Of the over 80 toxicity tests using different organisms, observed toxicity was almost exclusively for tests using *C. dubia* survival and/or reproduction, which only occurred in seven tests. One of those seven tests was for *Selenastrum* growth effects, while the remaining six tests were for *C. dubia*. Compiling available corresponding water quality data with those tests, a few instances were found where individual sample parameter concentrations exceeded their respective TRVs and resulted in HQs≥1. However, in those few instances, further assessment of the water quality data, toxicity data, and sample conditions and timing found that none of those parameters were likely causal factors for toxicity.

Except for a single nitrate-N and a single gross alpha water quality sample, no nutrients or organics, radionuclides, or physico-chemical parameters exceeded their respective TRVs. No sample toxicity was observed in corresponding water samples linked to toxicity tests. Likewise, all metals except arsenic were less than their respective TRVs and all ions, excepting chloride, were less than their respective TRVs (i.e., HQ<1). The number of times observed toxicity and corresponding water quality exceeding respective TRVs overlapped is low (4 out of over 80 tests). When these overlaps occurred, the available data did not support conclusions of toxicity based on parameter concentrations alone (i.e., concentrations of arsenic or chloride). However, there were times when measured water quality data were not available to match all toxicity tests. This is the primary uncertainty factor for this screening-level ERA. Fortunately, for arsenic and chloride, water quality data were available for all time periods through all cycles; however, for many parameters, this was not the case. It is recommended that any future toxicity testing have specific paired initial water quality sample results so that if toxicity is observed, potential causal factors can be identified.

While intermittent toxicity to *C. dubia* reproduction was observed, toxicity testing for other species (acute and chronic) conducted at the same time as the *C. dubia* reproduction tests did not identify any evidence of sample toxicity. *C. dubia* reproduction is a particularly sensitive test, and while some limited effects were observed, the lack of observed effects for other species suggests that other representative organisms of the larger aquatic community would not experience any effects.

4 CONCLUSIONS

The screening-level risk analyses presented in this report were intended to provide a more quantitative risk analysis of the original ASR ERA data to reduce uncertainty in risk characterization and conclusions and to address the potential risks associated with the ASR discharge into the Kissimmee River. In addition, the results of this assessment are also intended to be used to further focus the planning steps for the updated ASR ERA Work Plan, which will be completed in 2022.

In general, based on the data collected in support of the original ASR ERA, risks to benthic invertebrates, fish, and upper-trophic-level receptors within the mixing zones and downstream of the ASR discharge from exposure to metals and radionuclides in the discharge water appear to be low. Overall, it is recommended that the results of this analysis be considered by the Working Group in the development of the Work Plan to complete the updated ASR ERA. The conclusions and recommendations for each of the analyses presented in this assessment are summarized as follows.

Bioaccumulation Risk to Upper-Trophic-Level Receptors

Based on the results of the screening-level risk analysis of the KRASR recovered and discharged water, risks to upper-trophic-level birds, mammals, and reptiles due to exposure to ASR water following recovery and discharge into Florida waterways is expected to be low. Using a conservative screening-level assessment, HQs calculated for all receptor/analyte pairs were less than or equal to 1. Only selenium had HQs equal to 1 for several receptors, but those HQs were the same both upstream and downstream of the discharge. This finding is consistent with the conclusions of the bioconcentration tests in the original ASR ERA, which did not show significant bioconcentration of selenium in the downstream or mixing zone samples versus background or laboratory concentrations.

It is recommended that the Working Group consider using the results of the original ASR ERA and the expanded analysis presented here to focus the bioaccumulation risk assessment in the updated ASR ERA on a narrow set of chemicals and receptors. While the updated ASR ERA should assess risk to birds, mammals, and reptiles that may be exposed to recovered ASR water, future data collection in support of the upper-trophic-level receptor assessment endpoints should be focused on further understanding whether longer cycles resulting in longer storage times may result in higher concentrations of the potentially bioaccumulative analytes (e.g., mercury and methylmercury) in the recovered waters.

Bioconcentration and Bioaccumulation Risk to Fish and Benthic Invertebrates

Potential risks to fish and benthic invertebrates were assessed using a screening-level approach where the concentrations of the detected analytes in tissues were compared to TRVs representative of no-effect concentrations in fish or invertebrate tissues.

Comparison of fish tissue metals residues measured during different exposure scenarios to tissue-based TRVs at the no-effect level found no HQs>1. One aluminum concentration in a simulated discharge (50/50 mix) in laboratory exposures had an HQ of 1. The risk of effects to fish exposed to metals in discharged ASR water via bioaccumulation is considered to be very low or *de minimis* based on the screening-level assessment of the tissue data presented in the original ASR ERA.

Similar comparisons of metal concentrations in mussel tissues to no-effect TRVs found HQs<1 for 8 of 12 metals. Aluminum bioaccumulation in mussel tissues occurred during Cycles 1 and 2 exposures but appeared to be largely a function of background surface water and not ASR recovery. Similarly, manganese bioaccumulation during Cycle 4 exposures appeared to be a function of background surface water exposures and not ASR recovery. Low HQs for molybdenum bioaccumulation were observed (e.g., HQ=1) and similar to manganese, these Cycle 4 exposures were a function of background surface waters and not ASR recovery. Likewise, two zinc bioaccumulation HQs=1 during Cycle 2 were observed at a downstream site during the ASR recovery phase. Overall, the bioconcentration data from the original ERA show that the potential for bioaccumulation risk to benthic invertebrates from exposure to recovered ASR water is also very low.

Based on this very low potential for risk, it is recommended that while the updated ASR ERA should assess risk to fish and benthic invertebrates that may be exposed to recovered ASR water, the assessment should again be limited to confirming the low levels of risk. Extensive studies to address the potential for risk to fish and benthic invertebrates from bioconcentration of metals and radionuclides may not be warranted based on the results of this SLERA. Future data collection in support of the fish and benthic invertebrate assessment endpoints should be focused on further understanding whether longer cycles resulting in longer storage times may result in higher concentrations of the potentially bioaccumulative analytes in the recovered waters.

Toxicity of Recovered ASR Waters

The original ASR ERA conducted over 80 acute and chronic multi-species toxicity tests at the KRASR during Cycles 1 through 4 to evaluate the potential for toxicity of ASR recharge and recovery water. The report concluded the following:

> "Overall, the recovered water from KRASR did not show quantifiable acute or chronic effects on any species tested with the exception of the sensitive cladoceran *C. dubia*. The effect observed was on reproduction of this sensitive cladoceran species, showing that at times during mid- to late- cycle the recovered water at concentrations greater than 50 percent had an inhibitory effect on the reproduction of this species. The cause for this chronic effect is not known."

The screening-level assessment presented in this report was intended to attempt to find potentially causative factors of the effects observed by combining the results of the toxicity tests with water quality samples collected from the same locations at the same times as the toxicity tests.

Of the over 80 toxicity tests using different organisms, observed toxicity, when measured, was almost exclusively for tests using *C. dubia* survival and/or reproduction, which only occurred in seven tests. One of those seven tests was for *Selenastrum* growth effects while the remaining six tests were for *C. dubia*. Compiling available corresponding water quality data with those tests, found a few instances where individual sample parameter concentrations exceeded their respective TRVs and resulted in HQs≥1. However, in those few instances, further assessment of the water quality data, toxicity data, and sample conditions and timing found that none of those parameters were causal factors for toxicity.

Except for a single nitrate-N and a single gross alpha water quality sample, no nutrients or organics, radionuclides, or physico-chemical parameters had concentrations that exceeded their respective TRVs. No sample toxicity was observed in corresponding water samples linked to any toxicity tests. Likewise, all metals except arsenic had concentrations less than their respective TRVs, and concentrations of all major and minor ions, excepting chloride, were less than their respective TRVs (i.e., HQ<1).

The number of times where observed toxicity and corresponding water quality with any HQs>1 is low (4 out of over 80 tests). When these overlaps occurred, the available data did not support conclusions of toxicity based on parameter concentrations alone (i.e., concentrations of arsenic or chloride). However, there were times when measured water quality data were not available to match all toxicity tests. This is the primary uncertainty factor for this screening-level ERA. Fortunately, for arsenic and chloride, water quality data were available for all time periods through all cycles; however, for many parameters, this was not the case. To address this uncertainty, it is recommended that any future toxicity testing conducted in support of the updated ASR ERA have specific paired initial water quality sample results so that if toxicity is observed, potential causal factors can be better understood.

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Figure 1
Simplified Conceptual Exposure Model for Screening Level Bioaccumulation Risk Estimates in Upper Trophic Level Receptors

Risk-Based Analysis of Historical Data for the ASR ERA

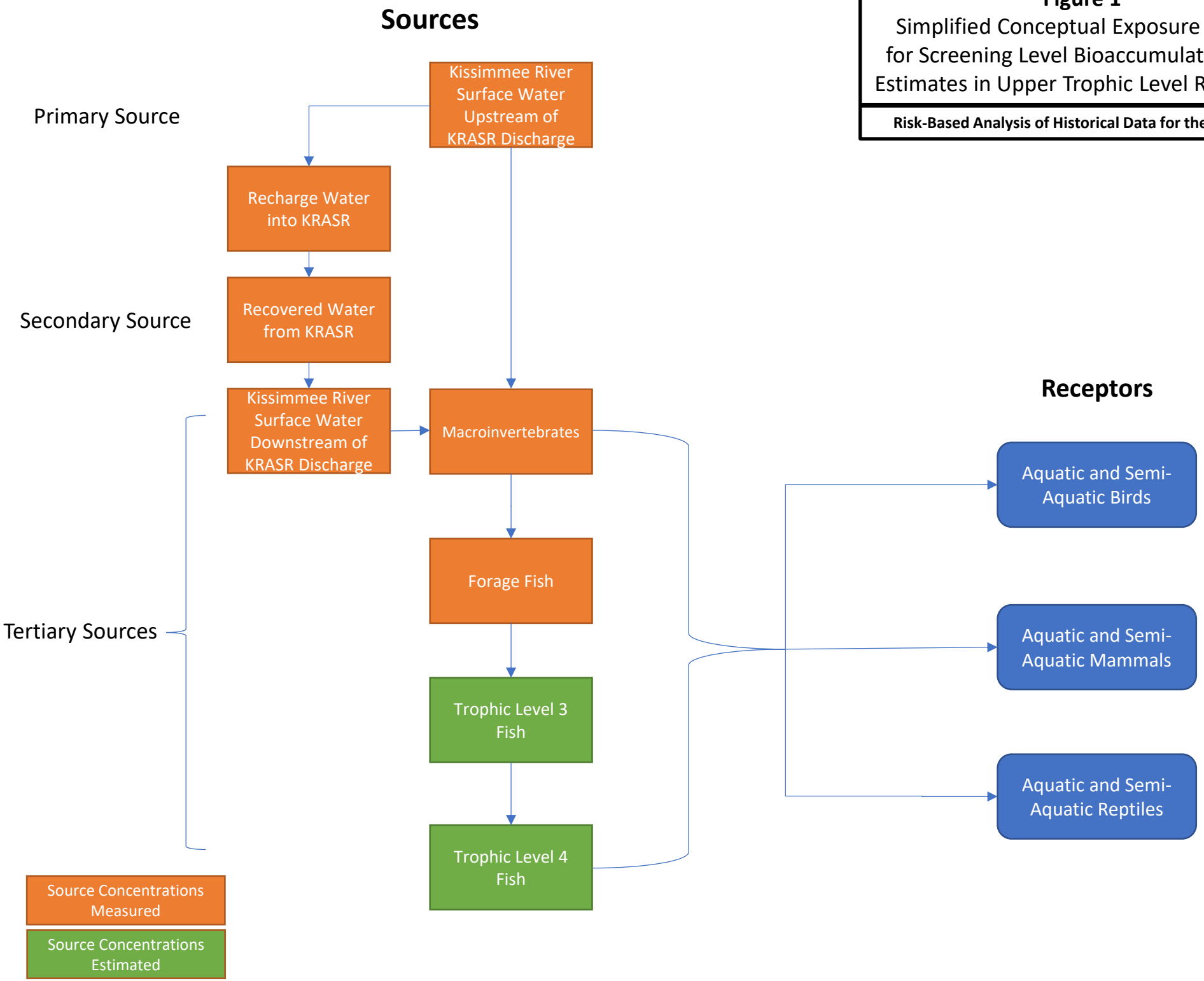

Table 2-1
Trace Metal and Radionuclide Concentrations in Fish and Mussel Tissue from KRASR
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	Phase	Exposure Length	Tissue Type	Treatment	Aluminum (mg/Kg)	Antimony (mg/Kg)	Arsenic (mg/Kg)	Cadmium (mg/Kg)	Chromium (mg/Kg)	Mercury (ng/g)	Methyl Mercury (ng/g)	Molybdenum (mg/Kg)	Nickel (mg/Kg)	Ra-226 (pCi/L)	Ra-228 (pCi/L)	Selenium (mg/Kg)	Zinc (mg/Kg)
Cycle 1	Cycled Water (Laboratory Exposure)	28-Days	Mussel	Laboratory Control	7.2	<0.026	0.66	0.27	0.28	42.3	8.47	<0.06	0.17	3.09	1.25	<0.65	21.1
				Background Recharge (100%)	32.4	<0.026	0.65	0.24	0.17	36.9	5.70	0.05	0.20	1.36	0.92	<0.66	27.9
			Fish	Laboratory Control	<2.6	<0.026	<0.32	<0.013	0.70	20.67	21.77	0.11	0.44	--	--	<0.64	26.4
				Background Recharge (100%)	1.67	<0.025	0.46	<0.013	0.36	13.13	16.32	0.05	0.25	--	--	<0.64	21.0
	Recovered Water (Mobile Lab Exposure)	28-Days	Mussel	Laboratory Control	5.11	<0.024	0.52	0.23	<0.24	38.3	8.05	0.04	0.05	1.47	0.98	<0.60	9.9
				Upstream Background	55.50	<0.025	1.07	0.38	0.39	60.3	9.03	0.07	0.19	1.08	1.11	0.36	43.0
				Recovered Water Mix (50/50)	51.1	<0.025	1.40	0.33	0.31	57.3	9.35	0.09	0.25	1.64	0.70	<0.62	37.3
				Recovered Water (100%)	15.1	<0.025	2.18	0.29	0.25	50.0	8.20	0.12	0.4	1.57	1.00	<0.63	31.7
		28-Days	Fish	Laboratory Control	<2.5	<0.025	0.21	<0.012	<0.24	18.8	21.55	0.07	0.11	--	--	0.41	33.9
				Upstream Background	1.9	0.019	0.44	0.01	0.34	16.7	10.72	0.04	0.23	--	--	<0.62	19.3
				Recovered Water Mix (50/50)	15.2	<0.025	0.46	<0.012	0.17	16.1	10.63	0.10	0.19	--	--	<0.62	31.4
				Recovered Water (100%)	<2.5	<0.025	0.41	0.01	0.18	17.6	21.93	0.13	0.10	--	--	0.36	26.6
Cycle 2	Recovery Phase (Field Exposures)	35-Days	Mussel	Laboratory Control	7.10	0.026	0.53	0.21	0.14	39.2	7.13	0.04	0.06	2.02	0.62	0.28	16.77
			Mussel	Upstream Background	56.70	<0.012	0.86	0.25	0.53	69.7	11.67	0.07	0.17	0.76	0.45	<0.14	38.73
				Mixing Zone	50.80	<0.011	1.01	0.30	0.27	105.4	<0.80	0.09	0.16	0.86	0.58	0.48	46.00
				Mixing Zone	92.10	<0.012	1.03	0.21	0.49	74.3	<0.80	0.08	0.19	1.17	0.50	0.66	66.77
				Downstream	50.80	<0.011	0.93	0.16	0.28	57.7	9.00	0.06	0.15	0.73	0.54	<0.13	38.67
		69-Days	Mussel	Upstream Background	96.47	0.017	0.70	0.15	0.13	64.5	10.33	0.06	0.06	0.86	1.03	0.19	18.70
				Mixing Zone	81.57	<0.012	0.72	0.16	0.18	85.1	0.60	0.07	0.09	1.36	1.06	0.40	23.20
				Mixing Zone	56.93	<0.012	0.83	0.20	0.21	73.8	0.93	0.07	0.12	0.81	0.71	0.37	24.63
				Downstream	112.70	<0.012	0.61	0.20	0.18	79.8	11.60	0.05	0.14	1.08	0.94	0.20	9.99
Cycle 4	Recharge (Field Exposure)	N/A Collected 12/2012	Mussel	Upstream Background	8.50	--	0.49	--	--	--	--	<0.85	--	--	2.68	--	--
				Mixing Zone	11.00	--	0.41	--	--	--	--	<0.98	--	--	3.65	--	--
				Mixing Zone	<9.8	--	0.49	--	--	--	--	<0.98	--	--	4.11	--	--
	Recovery Phase (Field Exposures)	N/A Collected 5/2013	Mussel	Upstream Background	24.00	--	0.81	--	--	--	--	<0.88	--	--	0.76	--	--
				Mixing Zone	<9.7	--	0.70	--	--	--	--	<0.93	--	--	0.64	--	--
				Mixing Zone	22.00	--	0.78	--	--	--	--	<0.84	--	--	0.92	--	--

Notes:

Adapted from Tables 5.18 and 5.20 of the Original ASR ERA. Appendix F of USACE 2015.
-- = Not reported.
< Indicates that the concentration was below the detection limit shown.
All concentrations reported in fresh weight.
Maximum Downstream Fish Concentration
Maximum Downstream Mussel Concentration

Table 2-2
Trace Metal and Radionuclide Concentrations in Surface Water Used in Bioconcentration Tests
Risk-Based Assessment of Historical ASR Bioassay Data

Treatment	Analyte	Day 0							Day 28						
		Fish Vessels			Mussel Vessels			Average	Fish Vessels			Mussel Vessels			Average
		A	B	C	A	B	C		A	B	C	A	B	C	
Upstream Background Surface Water	Aluminum (µg/L)	151	121	113	111	102	210	134.7	52	158	130	265	221	533	226.5
	Antimony (µg/L)	0.098	0.099	0.099	0.109	0.102	0.102	0.102	0.087	0.086	0.094	0.093	0.085	0.090	0.0892
	Arsenic (µg/L)	1.47	1.47	1.44	1.36	1.46	1.39	1.43	1.54	1.63	1.64	1.72	1.73	2.06	1.72
	Cadmium (µg/L)	0.008	0.007	0.01	0.008	0.008	0.009	<0.020	<0.004	0.004	0.006	0.008	0.008	0.017	0.0075
	Chromium (µg/L)	0.21	0.21	0.18	0.19	0.14	0.17	0.18	0.20	0.36	0.31	0.54	0.45	1.10	0.493
	Mercury (ng/L)	1.77	1.79	1.76	1.76	1.80	2.07	1.83	1.44	1.38	1.52	1.62	1.57	1.31	1.473
	Methyl Mercury (ng/L)														
	Molybdenum (µg/L)	3.05	3.10	3.01	3.10	3.09	3.16	3.085	2.84	2.76	2.86	2.82	2.93	3.5	2.952
	Nickel (µg/L)	0.83	0.92	0.90	0.94	0.88	0.88	0.892	0.69	0.77	0.74	0.84	0.82	1.14	0.833
	Ra-226 (pCi/L)	-	-	-	0.41	-0.05	1.04	0.467	-	-	-	0.34	0.48	0.1	0.307
	Ra-228 (pCi/L)	-	-	-	0.46	0.4	0.83	0.5637	-	-	-	0.01	-0.09	0.48	0.133
	Selenium (µg/L)	1.04	1.11	1.16	1.11	1.19	1.06	1.112	0.73	0.69	0.68	0.75	0.70	0.79	0.723
	Zinc (µg/L)	2.85	1.66	1.91	1.99	1.30	1.67	1.897	0.66	1.49	1.23	2.46	2.55	4.68	2.178
50/50 Mixture of Background Surface Water and Recovered ASR Water	Aluminum (µg/L)	64.5	45.0	63.9	76.3	161	71.5	80.37	13.9	22.0	25.2	22.2	18.5	15.5	19.55
	Antimony (µg/L)	0.271	0.273	0.279	0.232	0.276	0.270	0.2668	0.089	0.083	0.086	0.091	0.091	0.092	0.08867
	Arsenic (µg/L)	36.5	36.7	36.4	29.3	38.6	36.2	35.62	25.3	19.7	16.2	16.9	18.0	20.9	19.5
	Cadmium (µg/L)	0.019	0.027	0.025	0.005	0.017	0.022	0.0192	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Chromium (µg/L)	0.06	0.06	0.09	0.11	0.08	0.07	0.078	0.09	0.11	0.13	0.11	0.12	0.1	0.11
	Mercury (ng/L)	0.94	0.98	1.01	1.28	0.91	1.38	1.083	0.63	0.86	0.91	0.77	0.71	0.59	0.745
	Methyl Mercury (ng/L)	0.037	0.034	0.055	0.062	0.054	0.067	0.0515	0.077	0.067	0.079	0.106	0.09	0.066	0.0808
	Molybdenum (µg/L)	159	154	153	130	169	158	153.8	72.2	55.2	45.1	46.3	51.4	59.1	54.88
	Nickel (µg/L)	2.5	2.37	2.57	2.18	2.71	2.5	2.472	1.92	1.7	1.55	1.5	1.55	1.55	1.628
	Ra-226 (pCi/L)	-	-	-	0.5	0.43	0.44	0.457	-	-	-	1.17	0.91	0.94	1.007
	Ra-228 (pCi/L)	-	-	-	0.64	0.45	0.36	0.483	-	-	-	0.13	0.45	0.58	0.387
	Selenium (µg/L)	1.51	1.36	1.43	1.41	1.43	1.37	1.4183	1.93	1.68	1.47	1.32	1.56	1.63	1.598
	Zinc (µg/L)	1.53	1.46	1.12	2.03	1.71	1.26	1.518	0.75	0.90	0.87	0.70	0.59	0.72	0.755
Recovered ASR Water (100%)	Aluminum (µg/L)	3.8	3.1	4.2	8.9	6.8	7.5	5.7	4.2	2.7	3.1	2.6	2.4	2.4	2.9
	Antimony (µg/L)	0.442	0.444	0.440	0.447	0.460	0.454	0.4478	0.096	0.117	0.096	0.091	0.099	0.101	0.100
	Arsenic (µg/L)	69.5	70.0	68.5	69.0	68.8	68.8	69.1	41.9	39.9	37.4	37.2	38.6	37.7	38.78
	Cadmium (µg/L)	0.058	0.063	0.052	0.040	0.072	0.062	0.0578	0.174	0.177	0.178	0.182	0.186	0.194	0.1818
	Chromium (µg/L)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	0.05	0.04	0.05	0.04	0.04	0.045
	Mercury (ng/L)	0.15	0.17	0.17	0.4	0.2	0.21	0.217	0.1	0.29	0.15	0.15	0.19	0.13	0.168
	Methyl Mercury (ng/L)	<0.019	<0.019	<0.019	0.021	<0.019	<0.019	0.0114	0.021	0.021	<0.019	<0.019	<0.019	0.023	0.0156
	Molybdenum (µg/L)	296	306	316	287	302	269	296	101	99	100	101	95.9	98.9	99.3
	Nickel (µg/L)	4.02	3.96	3.86	3.99	4	4.06	3.982	2.37	2.33	2.19	2.34	2.25	2.18	2.277
	Ra-226 (pCi/L)	-	-	-	0.36	1.57	2.26	1.397	-	-	-	2.4	2.12	2.01	2.18
	Ra-228 (pCi/L)	-	-	-	0.16	0.17	0.33	0.22	-	-	-	0.65	-0.2	0.45	0.3
	Selenium (µg/L)	1.8	1.87	1.75	1.92	1.78	1.76	1.813	2.34	2.28	2.29	2.59	2.36	2.21	2.345
	Zinc (µg/L)	0.69	1.13	1.29	1.03	1.05	1.06	1.042	0.63	0.67	0.6	0.54	0.66	0.56	0.61

Notes:

Adapted from Table 5.19 of the Original ASR ERA. Appendix F of USACE 2015.
-- = Not reported
< Indicates that the concentration was below the detection limit shown.
Used as the Surface Water Exposure Point Concentration

Table 2-3
Receptor-Specific Exposure Parameters Used in the Screening Level Bioaccumulation Assessment
Risk-Based Assessment of Historical ASR Bioassay Data

Receptor	Body Weight (kg)[2]	Food Ingestion Rate (kg/day dry weight)[2]	Water Ingestion Rate (L/day)[2]	Proportion of Diet by Prey Type[1]			
				Benthic Invertebrates	Forage Fish	Trophic Level 3 Fish	Trophic Level 4 Fish
Birds							
Clapper Rail	0.297	0.022	0.026	75%	13%	13%	0%
Everglade Snail Kite	0.378	0.031	0.031	100%	0%	0%	0%
Great Blue Heron	2.2	0.1	0.1	5%	5%	30%	60%
Little Blue Heron	0.34	0.03	0.03	30%	60%	10%	0%
Mottled Duck	1.04	0.056	0.061	90%	10%	0%	0%
Osprey	1.5	0.07	0.08	0%	30%	40%	30%
Tri-Colored Heron	0.75	0.048	0.049	10%	55%	15%	20%
White Ibis	1	0.05	0.05	90%	10%	0%	0%
Wood Stork	2.4	0.1	0.1	20%	60%	10%	0%
Mammals							
Raccoon	3.9	0.21	0.34	25%	25%	25%	25%
River Otter	7.4	0.36	0.6	20%	40%	20%	20%
Reptile							
American Alligator	10	0.36	0.36	0%	10%	20%	70%

Notes
1 - Dietary proportion percentages are generalized based in primarily on the District SLERA Model and adjusted by professional judgement to match the generalized food web used in this assessment.
2 - Body weight and ingestion rates used in the District SLERA model. References for the values are provided in Appendix A. Values for the alligator from Southern Regional Aquaculture Center (1993).

Table 2-4
Maximum Exposure Point Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Analyte	Maximum Fish Concentration (mg/kg wet weight)[1]	Maximum Mussel Concentration (mg/kg wet weight)[1]	Food Chain Multipliers		Estimated Trophic Level 3 Fish Concentration (mg/kg wet weight)	Estimated Trophic Level 4 Fish Concentration (mg/kg wet weight)	Dry Weight Prey Concentrations				Maximum Measured Surface Water (mg/L)[4]
			Trophic Level 2 - Trophic Level 3[2]	Trophic Level 3 - Trophic Level 4[2]			Maximum Forage Fish Concentration (mg/kg dry weight)[3]	Maximum Benthic Invertebrate Concentration (mg/kg dry weight)[3]	Estimated Trophic Level 3 Fish Concentration (mg/kg dry weight)[3]	Estimated Trophic Level 4 Fish Concentration (mg/kg dry weight)[3]	
Aluminum	15.2	112.7	1	1	15.20	15.20	56.30	1024.55	56.30	56.30	0.003
Antimony	0.0125	0.0125	1	1	0.01	0.01	0.05	0.11	0.05	0.05	0.0001
Arsenic	0.46	2.18	1	1	0.46	0.46	1.70	19.82	1.70	1.70	0.039
Cadmium	0.01	0.33	1	1	0.01	0.01	0.04	3.00	0.04	0.04	0.00018
Chromium	0.18	0.49	1	1	0.18	0.18	0.67	4.45	0.67	0.67	0.000045
Mercury	0.0176	0.1054	1.26	5	0.02	0.11	0.07	0.96	0.08	0.41	0.00017
Methyl Mercury	0.02193	0.0116	1.26	5	0.03	0.14	0.08	0.11	0.10	0.51	0.000016
Molybdenum	0.13	0.12	1	1	0.13	0.13	0.48	1.09	0.48	0.48	0.0993
Nickel	0.19	0.4	1	1	0.19	0.19	0.70	3.64	0.70	0.70	0.0028
Selenium	0.36	0.66	1.5	1.5	0.54	0.81	1.33	6.00	2.00	3.00	0.0023
Zinc	31.4	66.77	1	1	31.40	31.40	116.30	607.00	116.30	116.30	0.0206

Notes:

[1] - Maximum fish and mussel concentrations identified in Table 2-1.

[2] - FCMs for Al, Sb, As, Cd, Cr, Ni, and Zn from Sample et al. (1996). FCMs for Hg and Methyl Hg from USPEA 1995. FCMs for Se based on a conservative estimate using best professional judgement. Mo is not a known bioaccumulator, so an FCM equal to 1 was used based on best professional judgement.

[3] - Dry weight concentrations estimated from wet weight concentrations as: Cdry weight = Cwet weight/(1 - fmoisture). Forage fish assumed to be 73% water and mussels assumed to be 89% water.

[4] - Maximum surface water concentrations identified in Table 2-2.

Table 2-5
Maximum Exposure Estimated in ASR Recovery Water
Risk-Based Assessment of Historical ASR Bioassay Data

Receptor	Analyte	Body Weight (kg)	Exposure Rate (mg/kg BW/day)		Proportion of Total Diet				Concentration (mg/kg DW)				Estimated Exposure				Food Exposure (mg/kg BW/day)	Surface Water Concentration (mg/L)	Water Exposure (mg/kg BW/day)	Total Exposure (mg/kg BW/day)
			Food	Water	Benthic Invertebrates	Forage Fish	Trophic Level 3 Fish	Trophic Level 4 Fish	Benthic Invertebrates	Forage Fish	Trophic Level 3 Fish	Trophic Level 4 Fish	Benthic Invertebrates	Forage Fish	Trophic Level 3 Fish	Trophic Level 4 Fish				
Clapper Rail	Aluminum	0.297	0.07	0.09	0.75	0.125	0.125	0	1024.55	56.30	56.30	56.30	56.92	0.52	0.52	0.00	57.96	0.00	0.00	57.96
	Antimony								0.11	0.05	0.05	0.05	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Arsenic								19.82	1.70	1.70	1.70	1.10	0.02	0.02	0.00	1.13	0.04	0.00	1.14
	Cadmium								3.00	0.04	0.04	0.04	0.17	0.00	0.00	0.00	0.17	0.00	0.00	0.17
	Chromium								4.45	0.67	0.67	0.67	0.25	0.01	0.01	0.00	0.26	0.00	0.00	0.26
	Mercury								0.96	0.07	0.08	0.41	0.05	0.00	0.00	0.00	0.05	0.00	0.00	0.05
	Methyl Mercury								0.11	0.08	0.10	0.51	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Molybdenum								1.09	0.48	0.48	0.48	0.06	0.00	0.00	0.00	0.07	0.10	0.01	0.08
	Nickel								3.64	0.70	0.70	0.70	0.20	0.01	0.01	0.00	0.22	0.00	0.00	0.22
	Selenium								6.00	1.33	2.00	3.00	0.33	0.01	0.02	0.00	0.36	0.00	0.00	0.36
	Zinc								607.00	116.30	116.30	116.30	33.72	1.08	1.08	0.00	35.88	0.02	0.00	35.88
Everglade Snail Kite	Aluminum	0.378	0.08	0.08	1	0	0	0	1024.55	56.30	56.30	56.30	84.02	0.00	0.00	0.00	84.02	0.00	0.00	84.02
	Antimony								0.11	0.05	0.05	0.05	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Arsenic								19.82	1.70	1.70	1.70	1.63	0.00	0.00	0.00	1.63	0.04	0.00	1.63
	Cadmium								3.00	0.04	0.04	0.04	0.25	0.00	0.00	0.00	0.25	0.00	0.00	0.25
	Chromium								4.45	0.67	0.67	0.67	0.37	0.00	0.00	0.00	0.37	0.00	0.00	0.37
	Mercury								0.96	0.07	0.08	0.41	0.08	0.00	0.00	0.00	0.08	0.00	0.00	0.08
	Methyl Mercury								0.11	0.08	0.10	0.51	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Molybdenum								1.09	0.48	0.48	0.48	0.09	0.00	0.00	0.00	0.09	0.10	0.01	0.10
	Nickel								3.64	0.70	0.70	0.70	0.30	0.00	0.00	0.00	0.30	0.00	0.00	0.30
	Selenium								6.00	1.33	2.00	3.00	0.49	0.00	0.00	0.00	0.49	0.00	0.00	0.49
	Zinc								607.00	116.30	116.30	116.30	49.78	0.00	0.00	0.00	49.78	0.02	0.00	49.78
Great Blue Heron	Aluminum	2.2	0.05	0.05	0.05	0.05	0.3	0.6	1024.55	56.30	56.30	56.30	2.33	0.13	0.77	1.54	4.76	0.00	0.00	4.76
	Antimony								0.11	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Arsenic								19.82	1.70	1.70	1.70	0.05	0.00	0.02	0.05	0.12	0.04	0.00	0.12
	Cadmium								3.00	0.04	0.04	0.04	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Chromium								4.45	0.67	0.67	0.67	0.01	0.00	0.01	0.02	0.04	0.00	0.00	0.04
	Mercury								0.96	0.07	0.08	0.41	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01
	Methyl Mercury								0.11	0.08	0.10	0.51	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.02
	Molybdenum								1.09	0.48	0.48	0.48	0.00	0.00	0.01	0.01	0.02	0.10	0.00	0.03
	Nickel								3.64	0.70	0.70	0.70	0.01	0.00	0.01	0.02	0.04	0.00	0.00	0.04
	Selenium								6.00	1.33	2.00	3.00	0.01	0.00	0.03	0.08	0.13	0.00	0.00	0.13
	Zinc								607.00	116.30	116.30	116.30	1.38	0.26	1.59	3.17	6.40	0.02	0.00	6.40
Little Blue Heron	Aluminum	0.34	0.09	0.09	0.3	0.6	0.1	0	1024.55	56.30	56.30	56.30	27.12	2.98	0.50	0.00	30.60	0.00	0.00	30.60
	Antimony								0.11	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Arsenic								19.82	1.70	1.70	1.70	0.52	0.09	0.02	0.00	0.63	0.04	0.00	0.63
	Cadmium								3.00	0.04	0.04	0.04	0.08	0.00	0.00	0.00	0.08	0.00	0.00	0.08
	Chromium								4.45	0.67	0.67	0.67	0.12	0.04	0.01	0.00	0.16	0.00	0.00	0.16
	Mercury								0.96	0.07	0.08	0.41	0.03	0.00	0.00	0.00	0.03	0.00	0.00	0.03
	Methyl Mercury								0.11	0.08	0.10	0.51	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Molybdenum								1.09	0.48	0.48	0.48	0.03	0.03	0.00	0.00	0.06	0.10	0.01	0.07
	Nickel								3.64	0.70	0.70	0.70	0.10	0.04	0.01	0.00	0.14	0.00	0.00	0.14
	Selenium								6.00	1.33	2.00	3.00	0.16	0.07	0.02	0.00	0.25	0.00	0.00	0.25
	Zinc								607.00	116.30	116.30	116.30	16.07	6.16	1.03	0.00	23.25	0.02	0.00	23.25
Mottled Duck	Aluminum	1.04	0.05	0.06	0.9	0.1	0	0	1024.55	56.30	56.30	56.30	49.65	0.30	0.00	0.00	49.95	0.00	0.00	49.95
	Antimony								0.11	0.05	0.05	0.05	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Arsenic								19.82	1.70	1.70	1.70	0.96	0.01	0.00	0.00	0.97	0.04	0.00	0.97
	Cadmium								3.00	0.04	0.04	0.04	0.15	0.00	0.00	0.00	0.15	0.00	0.00	0.15
	Chromium								4.45	0.67	0.67	0.67	0.22	0.00	0.00	0.00	0.22	0.00	0.00	0.22
	Mercury								0.96	0.07	0.08	0.41	0.05	0.00	0.00	0.00	0.05	0.00	0.00	0.05
	Methyl Mercury								0.11	0.08	0.10	0.51	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Molybdenum								1.09	0.48	0.48	0.48	0.05	0.00	0.00	0.00	0.06	0.10	0.01	0.06
	Nickel								3.64	0.70	0.70	0.70	0.18	0.00	0.00	0.00	0.18	0.00	0.00	0.18

Table 2-5
Maximum Exposure Estimated in ASR Recovery Water
Risk-Based Assessment of Historical ASR Bioassay Data

Receptor	Analyte	Body Weight (kg)	Exposure Rate (mg/kg BW/day)		Proportion of Total Diet				Concentration (mg/kg DW)				Estimated Exposure				Food Exposure (mg/kg BW/day)	Surface Water Concentration (mg/L)	Water Exposure (mg/kg BW/day)	Total Exposure (mg/kg BW/day)
			Food	Water	Benthic Invertebrates	Forage Fish	Trophic Level 3 Fish	Trophic Level 4 Fish	Benthic Invertebrates	Forage Fish	Trophic Level 3 Fish	Trophic Level 4 Fish	Benthic Invertebrates	Forage Fish	Trophic Level 3 Fish	Trophic Level 4 Fish				
	Selenium								6.00	1.33	2.00	3.00	0.29	0.01	0.00	0.00	0.30	0.00	0.00	0.30
	Zinc								607.00	116.30	116.30	116.30	29.42	0.63	0.00	0.00	30.04	0.02	0.00	30.04
Osprey	Aluminum	1.5	0.05	0.05	0	0.3	0.4	0.3	1024.55	56.30	56.30	56.30	0.00	0.79	1.05	0.79	2.63	0.00	0.00	2.63
	Antimony								0.11	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Arsenic								19.82	1.70	1.70	1.70	0.00	0.02	0.03	0.02	0.08	0.04	0.00	0.08
	Cadmium								3.00	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Chromium								4.45	0.67	0.67	0.67	0.00	0.01	0.01	0.01	0.03	0.00	0.00	0.03
	Mercury								0.96	0.07	0.08	0.41	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01
	Methyl Mercury								0.11	0.08	0.10	0.51	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01
	Molybdenum								1.09	0.48	0.48	0.48	0.00	0.01	0.01	0.01	0.02	0.10	0.01	0.03
	Nickel								3.64	0.70	0.70	0.70	0.00	0.01	0.01	0.01	0.03	0.00	0.00	0.03
	Selenium								6.00	1.33	2.00	3.00	0.00	0.02	0.04	0.04	0.10	0.00	0.00	0.10
	Zinc								607.00	116.30	116.30	116.30	0.00	1.63	2.17	1.63	5.43	0.02	0.00	5.43
Tri-Colored Heron	Aluminum	0.75	0.06	0.07	0.1	0.55	0.15	0.2	1024.55	56.30	56.30	56.30	6.56	1.98	0.54	0.72	9.80	0.00	0.00	9.80
	Antimony								0.11	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Arsenic								19.82	1.70	1.70	1.70	0.13	0.06	0.02	0.02	0.22	0.04	0.00	0.23
	Cadmium								3.00	0.04	0.04	0.04	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.02
	Chromium								4.45	0.67	0.67	0.67	0.03	0.02	0.01	0.01	0.07	0.00	0.00	0.07
	Mercury								0.96	0.07	0.08	0.41	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01
	Methyl Mercury								0.11	0.08	0.10	0.51	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01
	Molybdenum								1.09	0.48	0.48	0.48	0.01	0.02	0.00	0.01	0.03	0.10	0.01	0.04
	Nickel								3.64	0.70	0.70	0.70	0.02	0.02	0.01	0.01	0.06	0.00	0.00	0.06
	Selenium								6.00	1.33	2.00	3.00	0.04	0.05	0.02	0.04	0.14	0.00	0.00	0.14
	Zinc								607.00	116.30	116.30	116.30	3.88	4.09	1.12	1.49	10.58	0.02	0.00	10.58
White Ibis	Aluminum	1	0.05	0.05	0.9	0.1	0	0	1024.55	56.30	56.30	56.30	46.10	0.28	0.00	0.00	46.39	0.00	0.00	46.39
	Antimony								0.11	0.05	0.05	0.05	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Arsenic								19.82	1.70	1.70	1.70	0.89	0.01	0.00	0.00	0.90	0.04	0.00	0.90
	Cadmium								3.00	0.04	0.04	0.04	0.14	0.00	0.00	0.00	0.14	0.00	0.00	0.14
	Chromium								4.45	0.67	0.67	0.67	0.20	0.00	0.00	0.00	0.20	0.00	0.00	0.20
	Mercury								0.96	0.07	0.08	0.41	0.04	0.00	0.00	0.00	0.04	0.00	0.00	0.04
	Methyl Mercury								0.11	0.08	0.10	0.51	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Molybdenum								1.09	0.48	0.48	0.48	0.05	0.00	0.00	0.00	0.05	0.10	0.00	0.06
	Nickel								3.64	0.70	0.70	0.70	0.16	0.00	0.00	0.00	0.17	0.00	0.00	0.17
	Selenium								6.00	1.33	2.00	3.00	0.27	0.01	0.00	0.00	0.28	0.00	0.00	0.28
	Zinc								607.00	116.30	116.30	116.30	27.32	0.58	0.00	0.00	27.90	0.02	0.00	27.90
Wood Stork	Aluminum	2.4	0.04	0.04	0.2	0.6	0.1	0	1024.55	56.30	56.30	56.30	8.54	1.41	0.23	0.00	10.18	0.00	0.00	10.18
	Antimony								0.11	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Arsenic								19.82	1.70	1.70	1.70	0.17	0.04	0.01	0.00	0.21	0.04	0.00	0.22
	Cadmium								3.00	0.04	0.04	0.04	0.03	0.00	0.00	0.00	0.03	0.00	0.00	0.03
	Chromium								4.45	0.67	0.67	0.67	0.04	0.02	0.00	0.00	0.06	0.00	0.00	0.06
	Mercury								0.96	0.07	0.08	0.41	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Methyl Mercury								0.11	0.08	0.10	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Molybdenum								1.09	0.48	0.48	0.48	0.01	0.01	0.00	0.00	0.02	0.10	0.00	0.03
	Nickel								3.64	0.70	0.70	0.70	0.03	0.02	0.00	0.00	0.05	0.00	0.00	0.05
	Selenium								6.00	1.33	2.00	3.00	0.05	0.03	0.01	0.00	0.09	0.00	0.00	0.09
	Zinc								607.00	116.30	116.30	116.30	5.06	2.91	0.48	0.00	8.45	0.02	0.00	8.45
Raccoon	Aluminum	3.9	0.05	0.09	0.25	0.25	0.25	0.25	1024.55	56.30	56.30	56.30	13.79	0.76	0.76	0.76	16.07	0.00	0.00	16.07
	Antimony								0.11	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Arsenic								19.82	1.70	1.70	1.70	0.27	0.02	0.02	0.02	0.34	0.04	0.00	0.34
	Cadmium								3.00	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.04	0.00	0.00	0.04
	Chromium								4.45	0.67	0.67	0.67	0.06	0.01	0.01	0.01	0.09	0.00	0.00	0.09
	Mercury								0.96	0.07	0.08	0.41	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.02
	Methyl Mercury								0.11	0.08	0.10	0.51	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01

Table 2-5
Maximum Exposure Estimated in ASR Recovery Water
Risk-Based Assessment of Historical ASR Bioassay Data

Receptor	Analyte	Body Weight (kg)	Exposure Rate (mg/kg BW/day)		Proportion of Total Diet				Concentration (mg/kg DW)				Estimated Exposure				Food Exposure (mg/kg BW/day)	Surface Water Concentration (mg/L)	Water Exposure (mg/kg BW/day)	Total Exposure (mg/kg BW/day)
			Food	Water	Benthic Invertebrates	Forage Fish	Trophic Level 3 Fish	Trophic Level 4 Fish	Benthic Invertebrates	Forage Fish	Trophic Level 3 Fish	Trophic Level 4 Fish	Benthic Invertebrates	Forage Fish	Trophic Level 3 Fish	Trophic Level 4 Fish				
	Molybdenum								1.09	0.48	0.48	0.48	0.01	0.01	0.01	0.01	0.03	0.10	0.01	0.04
	Nickel								3.64	0.70	0.70	0.70	0.05	0.01	0.01	0.01	0.08	0.00	0.00	0.08
	Selenium								6.00	1.33	2.00	3.00	0.08	0.02	0.03	0.04	0.17	0.00	0.00	0.17
	Zinc								607.00	116.30	116.30	116.30	8.17	1.57	1.57	1.57	12.87	0.02	0.00	12.87
River Otter	Aluminum	7.4	0.05	0.08	0.2	0.4	0.2	0.2	1024.55	56.30	56.30	56.30	9.97	1.10	0.55	0.55	12.16	0.00	0.00	12.16
	Antimony								0.11	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Arsenic								19.82	1.70	1.70	1.70	0.19	0.03	0.02	0.02	0.26	0.04	0.00	0.26
	Cadmium								3.00	0.04	0.04	0.04	0.03	0.00	0.00	0.00	0.03	0.00	0.00	0.03
	Chromium								4.45	0.67	0.67	0.67	0.04	0.01	0.01	0.01	0.07	0.00	0.00	0.07
	Mercury								0.96	0.07	0.08	0.41	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.02
	Methyl Mercury								0.11	0.08	0.10	0.51	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
	Molybdenum								1.09	0.48	0.48	0.48	0.01	0.01	0.00	0.00	0.03	0.10	0.01	0.04
	Nickel								3.64	0.70	0.70	0.70	0.04	0.01	0.01	0.01	0.06	0.00	0.00	0.06
	Selenium								6.00	1.33	2.00	3.00	0.06	0.03	0.02	0.03	0.13	0.00	0.00	0.13
	Zinc								607.00	116.30	116.30	116.30	5.91	2.26	1.13	1.13	10.43	0.02	0.00	10.43
American Alligator	Aluminum	10	0.04	0.04	0	0.1	0.2	0.7	1024.55	56.30	56.30	56.30	0.00	0.20	0.41	1.42	2.03	0.00	0.00	2.03
	Antimony								0.11	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Arsenic								19.82	1.70	1.70	1.70	0.00	0.01	0.01	0.04	0.06	0.04	0.00	0.06
	Cadmium								3.00	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Chromium								4.45	0.67	0.67	0.67	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.02
	Mercury								0.96	0.07	0.08	0.41	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01
	Methyl Mercury								0.11	0.08	0.10	0.51	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01
	Molybdenum								1.09	0.48	0.48	0.48	0.00	0.00	0.00	0.01	0.02	0.10	0.00	0.02
	Nickel								3.64	0.70	0.70	0.70	0.00	0.00	0.01	0.02	0.03	0.00	0.00	0.03
	Selenium								6.00	1.33	2.00	3.00	0.00	0.00	0.01	0.08	0.09	0.00	0.00	0.09
	Zinc								607.00	116.30	116.30	116.30	0.00	0.42	0.84	2.93	4.19	0.02	0.00	4.19

Table 2-6
No-Effect Toxicity Reference Values
Risk-Based Assessment of Historical ASR Bioassay Data

Analyte	NOAEL TRV (mg/kg BW/day)			
	Birds	Source	Mammals	Source
Aluminum	NV		NV	
Antimony	NV		0.059	EcoSSL
Arsenic	2.24	EcoSSL	1.04	EcoSSL
Cadmium	1.47	EcoSSL	0.77	EcoSSL
Chromium	2.66	EcoSSL	9.24	EcoSSL
Manganese	179	EcoSSL	51.5	EcoSSL
Mercury	0.45	Sample et al. 1996	1	Sample et al. 1996
Methyl Mercury	0.064	Sample et al. 1996	0.15	Sample et al. 1996
Molybdenum	3.5	Sample et al. 1996	0.26	Sample et al. 1996
Nickel	6.71	EcoSSL	1.7	EcoSSL
Selenium	0.29	EcoSSL	0.143	EcoSSL
Zinc	66.1	EcoSSL	75.4	EcoSSL

Notes:
NV = No TRV available.
EcoSSL = USEPA Ecological Soil Screening Level Toxicological Reference Value Database (USEPA 2007)

Table 2-7
NOAEL Hazard Quotient Calculations; ASR Recovery Water
Risk-Based Assessment of Historical ASR Bioassay Data

Receptor	Analyte	Exposure (mg/kg BW/day)			NOAEL TRV (mg/kg BW/day)	NOAEL HQ
		Food	Water	Total		
Clapper Rail	Aluminum	5.80E+01	2.54E-04	5.80E+01	NV	NA
	Antimony	7.17E-03	8.75E-06	7.18E-03	NV	NA
	Arsenic	1.13E+00	3.39E-03	1.14E+00	2.24	<1
	Cadmium	1.67E-01	1.59E-05	1.67E-01	1.47	<1
	Chromium	2.60E-01	3.94E-06	2.60E-01	2.66	<1
	Mercury	5.46E-02	1.47E-05	5.46E-02	0.45	<1
	Methyl Mercury	7.56E-03	1.37E-06	7.56E-03	0.064	<1
	Molybdenum	6.95E-02	8.69E-03	7.82E-02	3.5	<1
	Nickel	2.15E-01	2.42E-04	2.15E-01	6.71	<1
	Selenium	3.64E-01	2.05E-04	3.64E-01	0.29	1
	Zinc	3.59E+01	1.80E-03	3.59E+01	66.1	<1
Everglade Snail Kite	Aluminum	8.40E+01	2.38E-04	8.40E+01	NV	NA
	Antimony	9.32E-03	8.20E-06	9.33E-03	NV	NA
	Arsenic	1.63E+00	3.18E-03	1.63E+00	2.24	<1
	Cadmium	2.46E-01	1.49E-05	2.46E-01	1.47	<1
	Chromium	3.65E-01	3.69E-06	3.65E-01	2.66	<1
	Mercury	7.86E-02	1.38E-05	7.86E-02	0.45	<1
	Methyl Mercury	8.65E-03	1.28E-06	8.65E-03	0.064	<1
	Molybdenum	8.95E-02	8.14E-03	9.76E-02	3.5	<1
	Nickel	2.98E-01	2.27E-04	2.98E-01	6.71	<1
	Selenium	4.92E-01	1.92E-04	4.92E-01	0.29	1
	Zinc	4.98E+01	1.69E-03	4.98E+01	66.1	<1
Great Blue Heron	Aluminum	4.76E+00	1.32E-04	4.76E+00	NV	NA
	Antimony	2.26E-03	4.55E-06	2.26E-03	NV	NA
	Arsenic	1.19E-01	1.76E-03	1.20E-01	2.24	<1
	Cadmium	8.42E-03	8.26E-06	8.43E-03	1.47	<1
	Chromium	3.89E-02	2.05E-06	3.89E-02	2.66	<1
	Mercury	1.46E-02	7.64E-06	1.47E-02	0.45	<1
	Methyl Mercury	1.58E-02	7.09E-07	1.58E-02	0.064	<1
	Molybdenum	2.33E-02	4.51E-03	2.78E-02	3.5	<1

Table 2-7
NOAEL Hazard Quotient Calculations; ASR Recovery Water
Risk-Based Assessment of Historical ASR Bioassay Data

Receptor	Analyte	Exposure (mg/kg BW/day)			NOAEL TRV (mg/kg BW/day)	NOAEL HQ
		Food	Water	Total		
	Nickel	3.87E-02	1.26E-04	3.88E-02	6.71	<1
	Selenium	1.26E-01	1.07E-04	1.26E-01	0.29	<1
	Zinc	6.40E+00	9.37E-04	6.40E+00	66.1	<1
Little Blue Heron	Aluminum	3.06E+01	2.56E-04	3.06E+01	NV	NA
	Antimony	5.87E-03	8.82E-06	5.88E-03	NV	NA
	Arsenic	6.30E-01	3.42E-03	6.33E-01	2.24	<1
	Cadmium	8.17E-02	1.60E-05	8.17E-02	1.47	<1
	Chromium	1.59E-01	3.97E-06	1.59E-01	2.66	<1
	Mercury	2.95E-02	1.48E-05	2.96E-02	0.45	<1
	Methyl Mercury	7.99E-03	1.38E-06	8.00E-03	0.064	<1
	Molybdenum	5.86E-02	8.76E-03	6.74E-02	3.5	<1
	Nickel	1.40E-01	2.44E-04	1.40E-01	6.71	<1
	Selenium	2.47E-01	2.07E-04	2.47E-01	0.29	<1
	Zinc	2.33E+01	1.82E-03	2.33E+01	66.1	<1
Mottled Duck	Aluminum	5.00E+01	1.70E-04	5.00E+01	NV	NA
	Antimony	5.76E-03	5.87E-06	5.76E-03	NV	NA
	Arsenic	9.70E-01	2.27E-03	9.72E-01	2.24	<1
	Cadmium	1.46E-01	1.07E-05	1.46E-01	1.47	<1
	Chromium	2.19E-01	2.64E-06	2.19E-01	2.66	<1
	Mercury	4.68E-02	9.85E-06	4.68E-02	0.45	<1
	Methyl Mercury	5.55E-03	9.15E-07	5.55E-03	0.064	<1
	Molybdenum	5.55E-02	5.82E-03	6.13E-02	3.5	<1
	Nickel	1.80E-01	1.62E-04	1.80E-01	6.71	<1
	Selenium	2.98E-01	1.38E-04	2.98E-01	0.29	1
	Zinc	3.00E+01	1.21E-03	3.00E+01	66.1	<1
	Aluminum	2.63E+00	1.55E-04	2.63E+00	NV	NA
	Antimony	2.16E-03	5.33E-06	2.17E-03	NV	NA
	Arsenic	7.95E-02	2.07E-03	8.16E-02	2.24	<1
	Cadmium	1.73E-03	9.70E-06	1.74E-03	1.47	<1
	Chromium	3.11E-02	2.40E-06	3.11E-02	2.66	<1

Table 2-7
NOAEL Hazard Quotient Calculations; ASR Recovery Water
Risk-Based Assessment of Historical ASR Bioassay Data

Receptor	Analyte	Exposure (mg/kg BW/day)			NOAEL TRV (mg/kg BW/day)	NOAEL HQ
		Food	Water	Total		
Osprey	Mercury	8.20E-03	8.96E-06	8.20E-03	0.45	<1
	Methyl Mercury	1.02E-02	8.32E-07	1.02E-02	0.064	<1
	Molybdenum	2.25E-02	5.30E-03	2.78E-02	3.5	<1
	Nickel	3.28E-02	1.48E-04	3.30E-02	6.71	<1
	Selenium	9.80E-02	1.25E-04	9.81E-02	0.29	<1
	Zinc	5.43E+00	1.10E-03	5.43E+00	66.1	<1
Tri-Colored Heron	Aluminum	9.80E+00	1.89E-04	9.80E+00	NV	NA
	Antimony	3.39E-03	6.53E-06	3.40E-03	NV	NA
	Arsenic	2.25E-01	2.53E-03	2.28E-01	2.24	<1
	Cadmium	2.13E-02	1.19E-05	2.13E-02	1.47	<1
	Chromium	6.69E-02	2.94E-06	6.69E-02	2.66	<1
	Mercury	1.45E-02	1.10E-05	1.45E-02	0.45	<1
	Methyl Mercury	1.11E-02	1.02E-06	1.11E-02	0.064	<1
	Molybdenum	3.47E-02	6.49E-03	4.12E-02	3.5	<1
	Nickel	6.38E-02	1.81E-04	6.40E-02	6.71	<1
	Selenium	1.43E-01	1.53E-04	1.43E-01	0.29	<1
	Zinc	1.06E+01	1.35E-03	1.06E+01	66.1	<1
White Ibis	Aluminum	4.64E+01	1.45E-04	4.64E+01	NV	NA
	Antimony	5.35E-03	5.00E-06	5.35E-03	NV	NA
	Arsenic	9.00E-01	1.94E-03	9.02E-01	2.24	<1
	Cadmium	1.35E-01	9.09E-06	1.35E-01	1.47	<1
	Chromium	2.04E-01	2.25E-06	2.04E-01	2.66	<1
	Mercury	4.34E-02	8.40E-06	4.35E-02	0.45	<1
	Methyl Mercury	5.15E-03	7.80E-07	5.15E-03	0.064	<1
	Molybdenum	5.15E-02	4.97E-03	5.65E-02	3.5	<1
	Nickel	1.67E-01	1.39E-04	1.67E-01	6.71	<1
	Selenium	2.77E-01	1.17E-04	2.77E-01	0.29	<1
	Zinc	2.79E+01	1.03E-03	2.79E+01	66.1	<1
	Aluminum	1.02E+01	1.21E-04	1.02E+01	NV	NA
	Antimony	2.30E-03	4.17E-06	2.30E-03	NV	NA

Table 2-7
NOAEL Hazard Quotient Calculations; ASR Recovery Water
Risk-Based Assessment of Historical ASR Bioassay Data

Receptor	Analyte	Exposure (mg/kg BW/day)			NOAEL TRV (mg/kg BW/day)	NOAEL HQ
		Food	Water	Total		
Wood Stork	Arsenic	2.15E-01	1.62E-03	2.16E-01	2.24	<1
	Cadmium	2.61E-02	7.58E-06	2.61E-02	1.47	<1
	Chromium	5.66E-02	1.88E-06	5.66E-02	2.66	<1
	Mercury	9.96E-03	7.00E-06	9.96E-03	0.45	<1
	Methyl Mercury	3.34E-03	6.50E-07	3.34E-03	0.064	<1
	Molybdenum	2.31E-02	4.14E-03	2.73E-02	3.5	<1
	Nickel	5.08E-02	1.15E-04	5.09E-02	6.71	<1
	Selenium	9.17E-02	9.77E-05	9.18E-02	0.29	<1
	Zinc	8.45E+00	8.59E-04	8.45E+00	66.1	<1
Raccoon	Aluminum	1.61E+01	2.53E-04	1.61E+01	NV	NA
	Antimony	3.40E-03	8.72E-06	3.41E-03	0.059	<1
	Arsenic	3.36E-01	3.38E-03	3.39E-01	1.04	<1
	Cadmium	4.19E-02	1.58E-05	4.19E-02	0.77	<1
	Chromium	8.69E-02	3.92E-06	8.69E-02	9.24	<1
	Mercury	2.04E-02	1.46E-05	2.04E-02	1	<1
	Methyl Mercury	1.08E-02	1.36E-06	1.08E-02	0.15	<1
	Molybdenum	3.41E-02	8.66E-03	4.28E-02	0.26	<1
	Nickel	7.74E-02	2.41E-04	7.76E-02	1.7	<1
	Selenium	1.66E-01	2.04E-04	1.66E-01	0.143	1
	Zinc	1.29E+01	1.80E-03	1.29E+01	75.4	<1
River Otter	Aluminum	1.22E+01	2.35E-04	1.22E+01	NV	NA
	Antimony	2.91E-03	8.11E-06	2.92E-03	0.059	<1
	Arsenic	2.59E-01	3.14E-03	2.62E-01	1.04	<1
	Cadmium	3.06E-02	1.47E-05	3.06E-02	0.77	<1
	Chromium	6.93E-02	3.65E-06	6.93E-02	9.24	<1
	Mercury	1.54E-02	1.36E-05	1.54E-02	1	<1
	Methyl Mercury	8.58E-03	1.26E-06	8.58E-03	0.15	<1
	Molybdenum	2.94E-02	8.05E-03	3.74E-02	0.26	<1
	Nickel	6.28E-02	2.25E-04	6.30E-02	1.7	<1
	Selenium	1.33E-01	1.90E-04	1.33E-01	0.143	<1

Table 2-7
NOAEL Hazard Quotient Calculations; ASR Recovery Water
Risk-Based Assessment of Historical ASR Bioassay Data

Receptor	Analyte	Exposure (mg/kg BW/day)			NOAEL TRV (mg/kg BW/day)	NOAEL HQ
		Food	Water	Total		
	Zinc	1.04E+01	1.67E-03	1.04E+01	75.4	<1
American Alligator	Aluminum	2.03E+00	1.04E-04	2.03E+00	NV	NA
	Antimony	1.67E-03	3.60E-06	1.67E-03	NV	NA
	Arsenic	6.13E-02	1.40E-03	6.27E-02	2.24	<1
	Cadmium	1.33E-03	6.54E-06	1.34E-03	1.47	<1
	Chromium	2.40E-02	1.62E-06	2.40E-02	2.66	<1
	Mercury	1.12E-02	6.05E-06	1.12E-02	0.45	<1
	Methyl Mercury	1.39E-02	5.62E-07	1.39E-02	0.064	<1
	Molybdenum	1.73E-02	3.57E-03	2.09E-02	3.5	<1
	Nickel	2.53E-02	9.97E-05	2.54E-02	6.71	<1
	Selenium	9.48E-02	8.44E-05	9.49E-02	0.29	<1
	Zinc	4.19E+00	7.42E-04	4.19E+00	66.1	<1

Notes
NV = No TRV available.
NA = Not applicable since no TRV was available.
HQ is equal to 1.
HQs are rounded to 1 significant figure.

Table 2-8
NOAEL Hazard Quotient Calculations; Background Water
Risk-Based Assessment of Historical ASR Bioassay Data

Receptor	Analyte	Exposure (mg/kg BW/day)			NOAEL TRV (mg/kg BW/day)	NOAEL HQ
		Food	Water	Total		
Clapper Rail	Selenium	0.18	0.06	0.24	0.29	<1
Everglade Snail Kite		0.21	0.06	0.27	0.29	<1
Great Blue Heron		0.13	0.03	0.17	0.29	<1
Little Blue Heron		0.17	0.06	0.23	0.29	<1
Mottled Duck		0.13	0.04	0.17	0.29	<1
Osprey		0.11	0.04	0.15	0.29	<1
Tri-Colored Heron		0.14	0.05	0.18	0.29	<1
White Ibis		0.12	0.04	0.16	0.29	<1
Wood Stork		0.07	0.03	0.10	0.29	<1
Raccoon		0.13	0.06	0.19	0.143	1
River Otter		0.11	0.06	0.17	0.143	1
American Alligator		0.11	0.03	0.13	0.29	<1

Notes
HQ is equal to 1.
HQs are rounded to 1 significant figure.

Table 2-9
Fish and Muscle Tissue TRVs
Risk-Based Assessment of Historical ASR Bioassay Data

ECOPC	Fish and Mussel Tissue TRVs (mg/kg dw)					
Analyte	Fish	Source	Notes	Mussels	Source	Notes
Aluminum	46.30	a	juvenile Brook trout, growth NOEC (12.5 mg/kg ww)	206.67	l	NOEC mortality and growth Mytilus, (31 mg/kg ww), 90 day exp
Antimony	18.52	b	Rainbow trout, NOEC survival, (5.0 mg/kg ww)	33.33		used fish value
Arsenic	6.92	c	Survival and growth - No effect Bluegill (1.8 mg/kg ww)	24	l	NOEC mortality and growth Mytilus, (3.6 mg/kg ww), 90 day exps
Cadmium	0.13	d	NOEC survival and growth, bluegill, 180 days (0.036 mg/kg ww)	26.67	m	NOEC mortality, behavior, biochem in Zebra mussel, (4 mg/kg ww), 28 day exps,
Chromium	8.52	e	Chromium VI, rainbow trout 2.3 mg/kg ww - NOEC mortality	30.67	n	highest NOEC Mytilus digestive tract tissue biochemistry, (4.6 mg/kg ww)
Manganese				122.67	o	highest NOEC survival, Mytilus, (18.4 mg/kg ww)
Mercury	2.96	f	Fathead minnow, growth, NOEC, 60 days, (0.8 mg/kg ww)	1.04	p	Geomean NOECs (various tissues) reproduction endpoint 88 day exposure giant floater mussel (0.156 mg/kg ww) (ERED DB)
Methyl Mercury	6.56	g	Fathead minnow, reproduction, NOEC, (1.77 mg/kg ww)	0.5	p	Geomean NOECs (various tissues) reproduction endpoint 88 day exposure giant floater mussel (0.075 mg/kg ww) (ERED DB)
Molybdenum	2.67	h	Growth corrected NOEC for rainbow trout (0.72 mg/kg ww)	4.80	h	
Nickel	1.78	i	FHM larvae, 21 day exp, NOEC routine metabolic rate (0.48 mg/kg ww)	526.67	q	NOEC mortality, 26 days, whole body, (79 mg/kg ww)
Selenium	8.50	j	National whole body criteria derived from effects concentrations translated from the egg EC10 criterion (8.5 mg/kg dw)	6.67	r	highest WB noec (physiological response), diet exposure, corbicula (1 mg/kg ww)
Zinc	185.19	k	Flagfish growth, no effect growth, mortality, repro, 100 days, larvae to adult (50 mg/kg ww)	306.67	s	NOEC behavior soft tissues) 70 days exp (46 mg/kg ww) Corbicula

Notes:

NOEC = No Observed Effect Concentrations, RBT = Rainbow Trout, LOED = Lowest Observed Adverse Effects Level, TRV = Toxicity Reference Value, FHM = Fathead Minnow
Wet weight concentrations converted to dry weight using an assumed moisture content of 73 % for fish and 85% for mussels
Whole body tissue concentrations used whenever available.
ww = wet weight, dw = dry weight

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Table 2-10
Maximum Metal Concentrations in Fish Tissues for Different Exposure Conditions and Hazard Quotients
Risk-Based Assessment of Historical ASR Bioassay Data

Location	Test Location	Cycle	Duration	Water	Zone	Phase	Tissue	Parameter	Tissue (mg/kg) wet	Tissue (mg/kg) dry	Tissue threshold (mg/kg dw)	HQ
Control	Lab	All	28 Days	Lab	Control	All	Fish	Aluminum	2.6	9.6	46	0.2
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Aluminum	1.7	6.2	46	0.1
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Aluminum	2.5	9.3	46	0.2
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Aluminum	15	56	46	**1**
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Aluminum	1.9	7.0	46	0.2
Control	Lab	All	28 Days	Lab	Control	All	Fish	Antimony	0.03	0.10	19	0.01
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Antimony	0.03	0.09	19	0.01
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Antimony	0.03	0.09	19	0.01
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Antimony	0.03	0.09	19	0.01
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Antimony	0.02	0.07	19	0.00
Control	Lab	All	28 Days	Lab	Control	All	Fish	Arsenic	0.21	0.78	6.9	0.1
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Arsenic	0.46	1.7	6.9	0.2
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Arsenic	0.41	1.5	6.9	0.2
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Arsenic	0.46	1.7	6.9	0.2
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Arsenic	0.44	1.6	6.9	0.2
Control	Lab	All	28 Days	Lab	Control	All	Fish	Cadmium	0.01	0.05	0.13	0.4
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Cadmium	0.01	0.05	0.13	0.4
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Cadmium	0.01	0.04	0.13	0.3
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Cadmium	0.01	0.04	0.13	0.3
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Cadmium	0.01	0.04	0.13	0.3
Control	Lab	All	28 Days	Lab	Control	All	Fish	Chromium	0.7	2.6	8.5	0.3
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Chromium	0.36	1.3	8.5	0.2
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Chromium	0.18	0.67	8.5	0.08
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Chromium	0.17	0.63	8.5	0.07
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Chromium	0.34	1.3	8.5	0.1
Control	Lab	All	28 Days	Lab	Control	All	Fish	Mercury	0.02	0.08	3.0	0.03
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Mercury	0.01	0.05	3.0	0.02
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Mercury	0.02	0.07	3.0	0.02
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Mercury	0.02	0.06	3.0	0.02
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Mercury	0.02	0.06	3.0	0.02
Control	Lab	All	28 Days	Lab	Control	All	Fish	Methylmercury	0.02	0.08	6.6	0.01
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Methylmercury	0.02	0.06	6.6	0.01
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Methylmercury	0.02	0.08	6.6	0.01
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Methylmercury	0.01	0.04	6.6	0.01
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Methylmercury	0.01	0.04	6.6	0.01
Control	Lab	All	28 Days	Lab	Control	All	Fish	Molybdenum	0.11	0.41	2.7	0.2
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Molybdenum	0.05	0.19	2.7	0.07

Table 2-10
Maximum Metal Concentrations in Fish Tissues for Different Exposure Conditions and Hazard Quotients
Risk-Based Assessment of Historical ASR Bioassay Data

Location	Test Location	Cycle	Duration	Water	Zone	Phase	Tissue	Parameter	Tissue (mg/kg) wet	Tissue (mg/kg) dry	Tissue threshold (mg/kg dw)	HQ
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Molybdenum	0.13	0.48	2.7	0.2
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Molybdenum	0.10	0.37	2.7	0.1
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Molybdenum	0.04	0.15	2.7	0.06
Control	Lab	All	28 Days	Lab	Control	All	Fish	Nickel	0.44	1.6	1.8	0.9
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Nickel	0.25	0.93	1.8	0.5
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Nickel	0.10	0.37	1.8	0.2
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Nickel	0.19	0.70	1.8	0.4
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Nickel	0.23	0.85	1.8	0.5
Control	Lab	All	28 Days	Lab	Control	All	Fish	Selenium	0.41	1.5	8.5	0.2
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Selenium	0.64	2.4	8.5	0.3
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Selenium	0.36	1.3	8.5	0.2
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Selenium	0.62	2.3	8.5	0.3
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Selenium	0.62	2.3	8.5	0.3
Control	Lab	All	28 Days	Lab	Control	All	Fish	Zinc	34	126	185	0.7
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Fish	Zinc	21	78	185	0.4
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Fish	Zinc	27	99	185	0.5
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Fish	Zinc	31	116	185	0.6
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Fish	Zinc	19	71	185	0.4

Notes:
Assume 73% moisture for fish tissues
HQ = Hazard Quotient
dw = dry weight

Table 2-11
Maximum Metal Concentrations in Mussel Tissues for Different Exposure Conditions and Hazard Quotients
Risk-Based Assessment of Historical ASR Bioassay Data

Location	Test Location	Cycle	Duration	Water	Zone	Phase	Tissue	Parameter	Tissue (mg/kg) wet	Tissue (mg/kg) dry	Tissue threshold (mg/kg	HQ
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Aluminum	7.2	48	207	0.2
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Aluminum	32	216	207	**1**
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Aluminum	56	370	207	**2**
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Aluminum	15	101	207	0.5
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Aluminum	51	341	207	**2**
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Aluminum	96	643	207	**3**
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Aluminum	92	614	207	**3**
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Aluminum	113	751	207	**4**
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Aluminum	8.5	57	207	0.3
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Aluminum	24	160	207	0.8
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Aluminum	11	73	207	0.4
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Aluminum	22	147	207	0.7
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Antimony	0.03	0.17	33	0.01
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Antimony	0.03	0.17	33	0.01
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Antimony	0.03	0.17	33	0.01
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Antimony	0.02	0.11	33	0.003
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Antimony	0.03	0.17	33	0.01
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Antimony	0.01	0.08	33	0.002
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Antimony	0.01	0.08	33	0.002
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Antimony	0.03	0.17	33	0.01
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Antimony	--	--	NA	NA
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Antimony	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Antimony	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Antimony	--	--	NA	NA
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Arsenic	0.66	4.4	24	0.2
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Arsenic	0.65	4.3	24	0.2
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Arsenic	1.1	7.1	24	0.3
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Arsenic	0.86	5.7	24	0.2
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Arsenic	2.2	15	24	0.6
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Arsenic	1.0	6.9	24	0.3
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Arsenic	0.93	6.2	24	0.3
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Arsenic	1.4	9.3	24	0.4
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Arsenic	0.49	3.3	24	0.1
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Arsenic	0.81	5.4	24	0.2
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Arsenic	0.49	3.3	24	0.1
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Arsenic	0.78	5.2	24	0.2
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Cadmium	0.27	1.8	27	0.1
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Cadmium	0.24	1.6	27	0.1

Table 2-11
Maximum Metal Concentrations in Mussel Tissues for Different Exposure Conditions and Hazard Quotients
Risk-Based Assessment of Historical ASR Bioassay Data

Location	Test Location	Cycle	Duration	Water	Zone	Phase	Tissue	Parameter	Tissue (mg/kg) wet	Tissue (mg/kg) dry	Tissue threshold (mg/kg	HQ
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Cadmium	0.38	2.5	27	0.1
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Cadmium	0.25	1.7	27	0.1
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Cadmium	0.29	1.9	27	0.1
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Cadmium	0.3	2	27	0.1
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Cadmium	0.20	1.3	27	0.1
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Cadmium	0.33	2.2	27	0.1
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Cadmium	--	--	NA	NA
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Cadmium	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Cadmium	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Cadmium	--	--	NA	NA
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Chromium	0.28	1.9	31	0.1
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Chromium	0.17	1.1	31	0.04
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Chromium	0	2.6	31	0.1
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Chromium	0.53	3.5	31	0.1
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Chromium	0	1.7	31	0.1
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Chromium	0	3.3	31	0.1
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Chromium	0	1.9	31	0.1
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Chromium	0.31	2.1	31	0.1
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Chromium	--	--	NA	NA
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Chromium	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Chromium	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Chromium	--	--	NA	**NA**
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Manganese	--	--	NA	NA
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Manganese	--	--	NA	NA
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Manganese	--	--	NA	NA
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Manganese	--	--	NA	NA
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Manganese	--	--	NA	NA
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Manganese	--	--	NA	NA
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Manganese	--	--	NA	NA
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Manganese	--	--	NA	NA
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Manganese	140	933	123	**8**
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Manganese	840	5600	123	**46**
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Manganese	340	2267	123	**18**
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Manganese	450	3000	123	**24**
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Mercury	0.04	0.28	1.0	0.3
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Mercury	0.04	0.25	1.0	0.2
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Mercury	0.06	0.40	1.0	0.4
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Mercury	0.07	0.46	1.0	0.4

Table 2-11
Maximum Metal Concentrations in Mussel Tissues for Different Exposure Conditions and Hazard Quotients
Risk-Based Assessment of Historical ASR Bioassay Data

Location	Test Location	Cycle	Duration	Water	Zone	Phase	Tissue	Parameter	Tissue (mg/kg) wet	Tissue (mg/kg) dry	Tissue threshold (mg/kg	HQ
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Mercury	0.05	0.33	1.0	0.3
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Mercury	0.11	0.70	1.0	0.7
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Mercury	0.08	0.53	1.0	0.5
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Mercury	0.06	0.38	1.0	0.4
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Mercury	0.10	0.65	1.0	0.6
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Mercury	0.05	0.30	1.0	0.3
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Mercury	0.06	0.39	1.0	0.4
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Mercury	0.06	0.37	1.0	0.4
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Methylmercur	0.01	0.06	0.5	0.1
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Methylmercur	0.01	0.04	0.5	0.1
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Methylmercur	0.01	0.06	0.5	0.1
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Methylmercur	0.01	0.08	0.5	0.2
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Methylmercur	0.01	0.05	0.5	0.1
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Methylmercur	0.00	0.01	0.5	0.01
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Methylmercur	0.01	0.08	0.5	0.2
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Methylmercur	0.009	0.06	0.5	0.1
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Methylmercur	--	--	NA	NA
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Methylmercur	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Methylmercur	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Methylmercur	--	--	NA	NA
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Molybdenum	0.04	0.27	4.8	0.1
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Molybdenum	0.05	0.33	4.8	0.1
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Molybdenum	0.07	0.47	4.8	0.1
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Molybdenum	0.07	0.47	4.8	0.1
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Molybdenum	0.12	0.80	4.8	0.2
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Molybdenum	0.09	0.60	4.8	0.1
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Molybdenum	0.06	0.40	4.8	0.1
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Molybdenum	0.09	0.60	4.8	0.1
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Molybdenum	0.85	5.7	4.8	**1**
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Molybdenum	0.88	5.9	4.8	**1**
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Molybdenum	1	6.5	5	**1**
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Molybdenum	0.84	5.6	5	**1**
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Nickel	0	1.1	527	0.002
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Nickel	0	1.3	527	0.003
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Nickel	0	1.3	527	0.002
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Nickel	0.17	1.1	527	0.002
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Nickel	0.4	2.7	527	0.01
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Nickel	0.2	1.3	527	0.002

Table 2-11
Maximum Metal Concentrations in Mussel Tissues for Different Exposure Conditions and Hazard Quotients
Risk-Based Assessment of Historical ASR Bioassay Data

Location	Test Location	Cycle	Duration	Water	Zone	Phase	Tissue	Parameter	Tissue (mg/kg) wet	Tissue (mg/kg) dry	Tissue threshold (mg/kg	HQ
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Nickel	0.15	1.0	527	0.002
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Nickel	0	1.7	527	0.003
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Nickel	--	--	NA	NA
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Nickel	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Nickel	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Nickel	--	--	NA	NA
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Selenium	0.28	1.9	7	0.3
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Selenium	0.66	4.4	7	0.7
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Selenium	0.36	2.4	6.7	0.4
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Selenium	0.19	1.3	6.7	0.2
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Selenium	0.63	4.2	6.7	0.6
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Selenium	0.66	4.4	6.7	0.7
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Selenium	0.2	1.3	6.7	0.2
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Selenium	0.62	4.1	6.7	0.6
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Selenium	--	--	NA	NA
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Selenium	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Selenium	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Selenium	--	--	NA	NA
Control	Lab	All	28 Days	Lab	Control	All	Mussel	Zinc	21	141	307	0.5
Well	Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	Zinc	28	186	307	0.6
Background	Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	Zinc	43	287	307	0.9
Background	Field	Cycle 2	35 or 69 Days	Station 1	Upstream	Recovery	Mussel	Zinc	39	258	307	0.8
Downstream	Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	Zinc	32	211	307	0.7
Downstream	Field	Cycle 2	35 or 69 Days	Station 3A/B	Discharge	Recovery	Mussel	Zinc	67	445	307	**1**
Downstream	Field	Cycle 2	35 or 69 Days	Station 5	Downstream	Recovery	Mussel	Zinc	39	258	307	0.8
Downstream	Lab	Cycle 1	28 Days	50/50 Mix	Simulated Discharge	Recovery	Mussel	Zinc	37	249	307	0.8
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	Zinc	--	--	NA	NA
Background	Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	Zinc	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recharge	Mussel	Zinc	--	--	NA	NA
Downstream	Field	Cycle 4	Field Grab	SCI #1 or #2	Discharge	Recovery	Mussel	Zinc	--	--	NA	NA

Notes:
dw = dry weight
HQ = Hazard Quotient
-- = Not reported
NA = Not applicable

Table 2-12
Additional Analyses of Individual Samples for Parameters where the Maximum HQ >1
Risk-Based Assessment of Historical ASR Bioassay Data

Test Location	Cycle	Duration	Water	Zone	Phase	Tissue	Al (ww)	Al (dw)	TRV (dw)	HQ	Mn (ww)	Mn (dw)	TRV (dw)	HQ	Mo (ww)	Mo (dw)	TRV (dw)	HQ	Zn (ww)	Zn (dw)	TRV (dw)	HQ
Lab	All	28 Days	Lab	Control	All	Mussel	7.2	48.00	206.67	0.2	--	--	NA	NA	0.04	0.27	4.8	0.1	21.1	140.67	306.67	0.5
Lab	N/A	28 Days	Recharge	Recharge	Recharge	Mussel	32.4	216.00	206.67	**1**	--	--	NA	NA	0.05	0.33	4.8	0.1	27.9	186.00	306.67	0.6
Lab	Cycle 1	28 Days	Full	Discharge	Recovery	Mussel	15.1	100.67	206.67	0.5	--	--	NA	NA	0.12	0.80	4.8	0.2	31.7	211.33	306.67	0.7
Lab	Cycle 1	28 Days	Upstream	Upstream	Recovery	Mussel	55.5	370.00	206.67	**2**	--	--	NA	NA	0.07	0.47	4.8	0.1	43	286.67	306.67	0.9
Lab	Cycle 1	28 Days	Mix	Lab Mix	Recovery	Mussel	51.1	340.67	206.67	**2**	--	--	NA	NA	0.09	0.60	4.8	0.1	37.3	248.67	306.67	0.8
Field	Cycle 2	69 Days	Station 1	Upstream	Recovery	Mussel	96.47	643.13	206.67	**3**	--	--	NA	NA	0.06	0.40	4.8	0.1	18.7	124.67	306.67	0.4
Field	Cycle 2	35 Days	Station 1	Upstream	Recovery	Mussel	56.7	378.00	206.67	**2**	--	--	NA	NA	0.07	0.47	4.8	0.1	38.73	258.20	306.67	0.8
Field	Cycle 2	35 Days	Station 3A	Discharge	Recovery	Mussel	50.8	338.67	206.67	**2**	--	--	NA	NA	0.09	0.60	4.8	0.1	46	306.67	306.67	**1.0**
Field	Cycle 2	35 Days	Station 3B	Discharge	Recovery	Mussel	92.1	614.00	206.67	**3**	--	--	NA	NA	0.08	0.53	4.8	0.1	66.77	445.13	306.67	**1**
Field	Cycle 2	69 Days	Station 3A	Discharge	Recovery	Mussel	81.57	543.80	206.67	**3**	--	--	NA	NA	0.07	0.47	4.8	0.1	23.2	154.67	306.67	0.5
Field	Cycle 2	69 Days	Station 3B	Discharge	Recovery	Mussel	56.93	379.53	206.67	**2**	--	--	NA	NA	0.07	0.47	4.8	0.1	24.63	164.20	306.67	0.5
Field	Cycle 2	35 Days	Station 5	Downstream	Recovery	Mussel	50.8	338.67	206.67	**2**	--	--	NA	NA	0.06	0.40	4.8	0.1	38.67	257.80	306.67	0.8
Field	Cycle 2	69 Days	Station 5	Downstream	Recovery	Mussel	112.7	751.33	206.67	**4**	--	--	NA	NA	0.05	0.33	4.8	0.1	9.99	66.60	306.67	0.2
Field	Cycle 4	Field Grab	Upstream	Upstream	Recharge	Mussel	8.5	56.67	206.67	0.3	140	933.33	122.67	**8**	0.85	5.67	4.8	**1**	--	--	NA	NA
Field	Cycle 4	Field Grab	SCI #1	Discharge	Recharge	Mussel	11	73.33	206.67	0.4	340	2266.67	122.67	**18**	0.98	6.53	4.8	**1**	--	--	NA	NA
Field	Cycle 4	Field Grab	SCI #2	Discharge	Recharge	Mussel	9.8	65.33	206.67	0.3	140	933.33	122.67	**8**	0.98	6.53	4.8	**1**	--	--	NA	NA
Field	Cycle 4	Field Grab	Upstream	Upstream	Recovery	Mussel	24	160.00	206.67	0.8	840	5600.00	122.67	**46**	0.88	5.87	4.8	**1**	--	--	NA	NA
Field	Cycle 4	Field Grab	SCI #1	Discharge	Recovery	Mussel	9.7	64.67	206.67	0.3	450	3000.00	122.67	**24**	0.84	5.60	4.8	**1**	--	--	NA	NA
Field	Cycle 4	Field Grab	SCI #2	Discharge	Recovery	Mussel	22	146.67	206.67	0.7	81	540.00	122.67	**4**	0.84	5.60	4.8	**1**	--	--	NA	NA

Notes:
ww = wet weight, dw = dry weight
HQ = Hazard Quotient
TRV = Toxicity Reference Value
-- = Not reported
NA = Not applicable

Table 3-1
Summary of Toxicity Tests Completed during the ASR ERA
Risk-Based Assessment of Historical ASR Bioassay Data

Organism Level	Common Name	Species	Test Type	Duration/Endpoints	Cycle	Phase
Algae	Green Algae	*Selenastrum capricornutum*	Acute	96-hr growth test (NOEC)	1, 2	Recharge and Recovery
Invertebrate	Water Flea	*Ceriodaphnia dubia*	Acute	96-hr Survival test (LC50)	1,2,3,4	Recharge and Recovery
Invertebrate	Water Flea	*Ceriodaphnia dubia*	Sub-chronic	7-Day Survival test (NOEC)	1,2,3,4	Recharge and Recovery
Invertebrate	Water Flea	*Ceriodaphnia dubia*	Sub-chronic	7-Day Reproduction test (NOEC/IC25)	1,2,3,4	Recharge and Recovery
Invertebrate	Water Flea	*Daphnia magna*	Chronic	21 Day Survival test (NOEC)	1	Recharge and Recovery
Invertebrate	Water Flea	*Daphnia magna*	Chronic	21-Day Reproduction test (NOEC/ IC25)	1	Recharge and Recovery
Amphibian	Frog	*Xenopus*	Acute	96-hr Mortality sig. diff. from control	1,2	Recharge and Recovery
Amphibian	Frog	*Xenopus*	Acute	96-hr Malformation sig. from. than control	1,2	Recharge and Recovery
Amphibian	Frog	*Xenopus*	Acute	96-hr Growth sig. diff. from control	1,2	Recharge and Recovery
Fish	Fathead minnow	*Pimephales promelas*	Sub-chronic	7-Day Embryo-larval survival and teratogenesis test (NOEC)	1,2,3,4	Recharge and Recovery
Fish	Bannerfin Shiner	*Cyprinella leedsi*	Acute	96-hr Survival test (LC50)	1,2,3,4	Recharge and Recovery

Notes:
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%

Table 3-2
Toxicity Test Results from Original ASR ERA
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	Phase	Test Initiation Date	Green Algae 96-hr growth NOEC	*C. dubia* 7-day survival NOEC	*C. dubia* 7-day reproduction NOEC/IC25	*C. dubia* 96-hr survival LC50	Fathead Minnow 7-day survival and terata NOEC	*D. magna* 21-day survival NOEC	*D. magna* 21-day reproduction NOEC/IC_{25}	Frog 96-hr mortality[1]	Frog 96-hr terata[1]	Frog 96-hr growth[1]	Bannerfin Shiner 96- hr survival LC50
Cycle 1	RCG1	Jan. 2009	100%	100%	100%/ >100%	>100%	>100%	100%	100%/>100%	No	No	No	>100%
Cycle 1	RCG1	Feb. 2009	25%	100%	100%/ >100%	--	>100%	--	--	No	No	No	--
Cycle 1	RCV	Mar. 2009	100%	100%	>100%	>100%	--	100%	100%/>100%	No	No	No	>100%
Cycle 1	RCV	Mar. 2009	100%	100%	100%/ >100%	>100%	--	--	--	No	No	No	>100%
Cycle 1	RCV	Mar. 2009	100%	100%	100%/ IC_{25}95.5%	--	>100%	--	--	No	No	No	--
Cycle 1	RCV	Mar. - Apr. 2009	100%	100%	100%/ >100%	>100%	>100%	--	--	--	--	--	>100%
Cycle 1	RCV	Apr. 2009	--	--	--	--	>100%	--	--	--	--	--	--
Cycle 1	RCV	Apr. 2009	--	--	--	>100%	--	--	--	--	--	--	>100%
Cycle 2	RCV	Oct. 2009	100%	100%	100%/ >100%	>100%	>100%	--	--	No	No	No	>100%
Cycle 2	RCV	Nov. 2009	100%	100%	50% / >100%	>100%	>100%	--	--	--	--	--	>100%
Cycle 2	RCV	Dec. 2009	100%	100%	100%/ >100%	--	>100%	--	--	No	No	No	--
Cycle 2	RCV	Dec. 2009	--	--	50% / IC_{25} 76.4%	>100%	--	--	--	--	--	--	>100%
Cycle 2	RCV	Dec. 2009	--	--	--	--	>100%	--	--	--	--	--	--
Cycle 2	RCV	Jan. 2010	--	--	--	>100%	--	--	--	No	No	No	>100%
Cycle 3	RCV	Jan. 2011	--	--	100% / 100%	>100%	>100%	--	--	--	--	--	>100%
Cycle 3	RCV	Feb. 2011	--	--	No test	>100%	No test	--	--	--	--	--	>100%
Cycle 3	RCV	Mar. 2011	--	--	No test	>100%	No test	--	--	--	--	--	>100%
Cycle 3	RCV	May 2011	--	--	IC_{25} 7.2%	83.92%	>100%	--	--	--	--	--	>100%
Cycle 3	RCV	Jun. 2011	--	--	>100%/100%	>100%	>100%	--	--	--	--	--	>100%
Cycle 4	RCV	Jan. 2013	--	--	>100%/100%	>100%	>100%	--	--	--	--	--	>100%
Cycle 4	RCV	Feb. 2013	--	--	>100 / IC_{25} 83.9%	--	>100%	--	--	--	--	--	--
Cycle 4	RCV	Mar. 2013	--	--	>100% / IC_{25} 76.2%	>100%	>100%	--	--	--	--	--	>100%
Cycle 4	RCV	Apr. 2013	--	>100%	>100%/>100%	>100%	>100%	--	--	--	--	--	>100%
Cycle 4	RCV	May. 2013	--	>100%	>100%/>100%	>100%	>100%	--	--	--	--	--	>100%
Cycle 4	RCV	Jun. 2013	--	>100%	>100%/>100%	>100%	>100%	--	--	--	--	--	>100%

Notes:
RCG1 = Recharge water
RCV = Recovered water
IC25 = Inhibition Concentration 25%
Toxicity observed
Percentage values reflect the percentage of recharge or recovered water for test endpoint
[1] significantly different from control
-- = Not tested

Table 3-3
TRVs for Water Quality Parameters Screened with Corresponding Toxicity Test Results
Risk-Based Assessment of Historical ASR Bioassay Data

Parameter	Florida DEP Standard	Unit	Tier I or II criteria, Region 4 screening criteria	Unit	Criteria Type
METALS					
Aluminum	NC		380	ug/L	National Criteria (EPA 2018) - derived at ph = 7, DOC = 1, total hardness = 100 mg/L
Antimony	4300	ug/L			NA
Arsenic	50	ug/L			NA
Barium	NC		$e^{(1.0629*(lnH)+1.1928)}$	ug/L	Michigan Rule 57 2020
Boron	NC		7200	ug/L	Michigan Rule 57 2015
Cadmium	$e^{(0.7409[lnH]-4.719)}$	ug/L			NA
Chromium (hex)	11	ug/L			NA
Cobalt	NC		100	ug/L	Michigan Rule 57 1998
Copper	$e^{(0.8545[lnH]-1.702)}$	ug/L			NA
Iron	1	mg/L			NA
Lead	$e^{(1.273\ [lnH]\ -4.705)}$	ug/L			NA
Manganese	NC		$e^{(0.8784*(lnH)+3.5385)}$	ug/L	Michigan Rule 57 2012
Mercury	0.012	ug/L			NA
Methyl Mercury	NC		0.0028	ug/L	Region 4 screening values
Molybdenum	NC		3200	ug/L	Michigan Rule 57 2006
Nickel	$e^{(0.846[lnH]+0.0584)}$	ug/L			NA
Selenium	5	ug/L			NA
Strontium	NC		36000	ug/L	Michigan Rule 57 2019
Uranium	NC		2.6	ug/L	Region 4 screening values
Zinc	$e^{(0.8473[lnH]+0.884)}$	ug/L			NA
MAJOR AND MINOR IONS					
Bromide	NC		1000	ug/L	Flurey et al. 1993 and Gowda 2005 (EPA)
Calcium	116000	ug/L			NA
Chloride	NC		150000	ug/L	Michigan Rule 57 2019
Fluoride, total	10	mg/L			NA
Magnesium	NC		82000	ug/L	Region 4 screening criteria
Potassium	NC		53000	ug/L	Region 4 screening criteria
Silica	NC		NC		
Sodium	NC		680000	ug/l	Region 4 screening criteria
Sulfate	NC		370000	ug/L	Michigan Rule 57 2019
Sulfide	NC		2	ug/L	Region 4 screening criteria for H2S
Alkalinity	not less than 20 mg/L				NA
Total cyanide	5.2	ug/L			NA
RADIONUCLIDES					

Table 3-3
TRVs for Water Quality Parameters Screened with Corresponding Toxicity Test Results
Risk-Based Assessment of Historical ASR Bioassay Data

Parameter	Florida DEP Standard	Unit	Tier I or II criteria, Region 4 screening criteria	Unit	Criteria Type
Gross Alpha	15	pCi/L	NA		
Ra-226 + Ra-228	5	pCi/L	NA		
NUTRIENTS AND ORGANICS					
DOC	NC		NC		
TOC	NC		NC		
Ammonia	calculated - see footnote	mg/L	NA		
Nitrate N	NC		NC		
Nitrite N	NC		20	ug/L	Regions 4 screening value
Nitrogen organic	NC		NC		
Ortho-Phosphorus as P	NC		NC		
Phosphorus, Total as P	NC		1000	ug/L	Regions 4 screening value
Total Kjeldahl Nitrogen	NC		NC		
PHYSICAL CHEMISTRY					
Color	NC		NC		
Dissolved Oxygen	calculated - see footnote	% saturation	NA		
Hardness (calculated)	NC		NC		
Oxidation-Reduction Potential	NC		NC		
pH	6.5 to 8.5	pH units	NA		
Specific Conductance	NC		NC		
Temperature	narrative 62-320.520		NA		
Total Dissolved Solids	NC		NC		
Total Suspended Solids	NC		NC		
Turbidity	<or + to 29 NTU above natural background		NA		

Notes:
Metals criteria are expressed as total metal.
Florida DEP Standard (Florida Administrative Code 62-302)
Michigan Rule 57 Water Quality Values, February 2020. https://www.michigan.gov/documents/egle/egle-wrd-swas-rule57_662210_7.xlsx
EPA. 2018. Final Aquatic Life Ambient Water Quality Criteria for Aluminum. Washington, D.C, EPA-822-R-18-001.
Region 4 screening values - EPA 2018. March 2018 update, Region 4 Ecological Risk Assessment Supplemental Guidance. EPA Region 4, https://www.epa.gov/sites/default/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf
Flury, M. and A. Papritx. 1993. Bromide in the Natural Environment: Occurrence and Toxicity. Journal of Env Quality, Vol.22, no.4.
Gowda, S. 2005. Memorandum: Ecological Hazard and Environmental Risk Assessment of Bromine and Sodium Bromide for the Reregistration Eligibility(RED) Document. USEPA, Washington, D.C.

Ammonia $$30-\text{day Average} = 0.8876 \times \left(\frac{0.0278}{1+10^{7.688-pH}} + \frac{1.1994}{1+10^{pH-7.688}}\right) \times \left(2.126 \times 10^{0.0228\times(20-MAX(T,7))}\right)$$
Florida DEP calculation tool - https://floridadep.gov/dear/water-quality-standards-program/documents/total-ammonia-nitrogen-calculator%C2%A0

Dissolved Oxygen: No more than 10 percent of the daily average percent dissolved oxygen (DO) saturation values shall be below 38 percent in the Peninsula and Everglades bioregions. Florida DEP calculation tool - https://floridadep.gov/dear/water-quality-standards-program/documents/do-saturation-calculator%C2%A0

TRV = Toxicity Reference Value
NA = Not applicable because there is a Florida standard available.

Table 3-3
TRVs for Water Quality Parameters Screened with Corresponding Toxicity Test Results
Risk-Based Assessment of Historical ASR Bioassay Data

Parameter	Florida DEP Standard	Unit	Tier I or II criteria, Region 4 screening criteria	Unit	Criteria Type

NC = no criteria
NTU = Nephelometric Turbidity Unit
ug/L = microgram per liter
mg/L = milligram per liter

Table 3-4
Comparison of *Ceriodaphnia dubia* and *Selenastrum capricornutum* Toxicity Testing Data to Surface Water Metals Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	ToxID	Toxicity Data						Water Quality - Metals	Test Results	Exceeds Criteria																	
		Phase	Test Initiation Date	*C. dubia* 96-hr (Water Flea)	*C. dubia* 7-day (Water Flea)		*Selenastrum capricornutum* 96-hr (Green Algae)	Sample Collection Date	Toxicity	Aluminum	Antimony	Arsenic	Barium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury (Ultrace)	Methyl Mercury	Molybdenum	Nickel	Selenium	Strontium	Uranium	Zinc
				Acute survival test (LC50)	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*96-hr growth test (NOEC)*		Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no
1	SF1-1-2009	Recharge	Jan. 2009	>100%	100%/ >100%	100%	100%	Jan. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-2-2009	Recharge	Feb. 2009	Null	100%/ >100%	100%	25%	Feb. 2009	**Yes**	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-3-2009	Recovery	Mar. 2009	>100%	>100%	100%	100%	Mar. 2009	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No	ND	No	No	No	No	No	No
1	SF1-4-2009	Recovery	Mar. 2009	>100%	100%/ >100%	100%	100%	Mar. 2009	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-5-2009	Recovery	Mar. 2009	Null	100%/ IC2595.5%	100%	100%	Mar. 2009	**Yes**	No	No	**Yes**	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-6-2009	Recovery	Mar. - Apr. 2009	>100%	100%/ >100%	100%	100%	Mar. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-7-2009	Recovery	Apr. 2009	Null	Null	Null	Null	Apr. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-8-2009	Recovery	Apr. 2009	>100%	Null	Null	Null	Apr. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
2	SF2-1-2009	Recovery	Oct. 2009	>100%	100%/ >100%	100%	100%	Oct. 2009	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	ND	ND	ND	ND	ND	ND	ND
2	SF2-2-2009	Recovery	Nov. 2009	>100%	50% / >100%	100%	100%	Nov. 2009	**Yes**	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	No	ND	ND	ND	ND	ND
2	SF2-3-2009	Recovery	Dec. 2009	Null	100%/ >100%	100%	100%	Dec. 2009	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	No	ND	ND	ND	ND	ND
2	SF2-4-2009	Recovery	Dec. 2009	>100%	50% / IC25 76.4%	Null	Null	Dec. 2009	**Yes**	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	No	ND	ND	ND	ND	ND
2	SF2-5-2009	Recovery	Dec. 2009	Null	Null	Null	Null	Dec. 2009	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	No	ND	ND	ND	ND	ND
2	SF2-6-2010	Recovery	Jan. 2010	>100%	Null	Null	Null	Dec. 2009	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	No	ND	ND	ND	ND	ND
3	SF3-1-2011	Recovery	Jan. 2011	>100%	100% / 100%	Null	Null	Jan. 2011	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	No	ND	ND	ND	ND	ND
3	SF3-2-2011	Recovery	Feb. 2011	>100%	No test	Null	Null	Feb. 2011	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	No	ND	ND	ND	ND	ND
3	SF3-3-2011	Recovery	Mar. 2011	>100%	No test	Null	Null	Mar. 2011	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	No	No	ND	ND	ND	ND
3	SF3-4-2011	Recovery	May 2011	83.92%	IC25 7.2%	--	Null	May 2011	**Yes**	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND	ND
3	SF3-5-2011	Recovery	Jun. 2011	>100%	>100%/100%	--	Null	Jun. 2011	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND	ND
4	SF4-1-2013	Recovery	Jan. 2013	>100%	>100%/100%	Null	Null	Jan. 2013	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND	ND
4	SF4-2-2013	Recovery	Feb. 2013	Null	>100 / IC25 83.9	--	Null	Feb. 2013	**Yes**	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND	ND
4	SF4-3-2013	Recovery	Mar. 2013	>100%	>100% / IC25 76.2	Null	Null	Mar. 2013	**Yes**	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND	ND
4	SF4-4-2013	Recovery	Apr. 2013	>100%	>100%/>100%	>100%	Null	Apr. 2013	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND	ND
4	SF4-5-2013	Recovery	May. 2013	>100%	>100%/>100%	>100%	Null	May. 2013	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND	ND
4	SF4-6-2013	Recovery	Jun. 2013	>100%	>100%/>100%	>100%	Null	Jun. 2013	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	No	ND	ND

Notes:
ND - No data
Sample Collection Date - Sample surface water for this analysis came from a time period within this date range.
Toxicity
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%

Table 3-5
Comparison of *Daphnia magna* , Fish, and FETAX Toxicity Testing Data to Surface Water Metals Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	ToxID	Toxicity Data								Water Quality - Metals	Test Results	Exceeds Criteria																			
		Phase	Test Initiation Date	*Daphnia magna* 21-day (Water Flea)		*C. leedsi* 96-hr (Bannerfin Shiner)	*Pimephales promelas* 7-day (Fathead Minnow)	FETAX (Frog – *Xenopus*)			Sample Collection Date	Toxicity	Aluminum	Antimony	Arsenic	Barium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury (Ultrace)	Methyl Mercury	Molybdenum	Nickel	Selenium	Strontium	Uranium	Zinc
				Chronic reproduction test (NOEC/ IC25)	*Chronic survival test (NOEC)*	*Acute survival test (LC50)*	*Embryo-larval survival and teratogenesis test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*		Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no
1	SF1-1-2009	Recharge	Jan. 2009	100%/>100%	100%	>100%	>100%	No	No	No	Jan. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-2-2009	Recharge	Feb. 2009	Null	Null	>100%	>100%	No	No	No	Feb. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-3-2009	Recovery	Mar. 2009	100%/>100%	100%	>100%	Null	No	No	No	Mar. 2009	No	No	No	**Yes**	No	No	No	No	No	No	No	No	ND	No	No	No	No	No	No	No
1	SF1-4-2009	Recovery	Mar. 2009	Null	Null	>100%	Null	No	No	No	Mar. 2009	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-5-2009	Recovery	Mar. 2009	Null	Null	Null	>100%	No	No	No	Mar. 2009	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-6-2009	Recovery	Mar. - Apr. 2009	Null	Null	>100%	>100%	Null	Null	Null	Mar. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-7-2009	Recovery	Apr. 2009	Null	Null	Null	>100%	Null	Null	Null	Apr. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-8-2009	Recovery	Apr. 2009	Null	Null	>100%	Null	Null	Null	Null	Apr. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
2	SF2-1-2009	Recovery	Oct. 2009	Null	Null	>100%	>100%	No	No	No	Oct. 2009	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	ND	ND	ND	ND	ND	ND	ND
2	SF2-2-2009	Recovery	Nov. 2009	Null	Null	>100%	>100%	Null	Null	Null	Nov. 2009	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	ND	ND	ND	ND	ND	ND	ND
2	SF2-3-2009	Recovery	Dec. 2009	Null	Null	Null	>100%	No	No	No	Dec. 2009	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	ND	ND	ND	ND	ND
2	SF2-4-2009	Recovery	Dec. 2009	Null	Null	>100%	Null	Null	Null	Null	Dec. 2009	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	ND	ND	ND	ND	ND
2	SF2-5-2009	Recovery	Dec. 2009	Null	Null	Null	>100%	Null	Null	Null	Dec. 2009	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	ND	ND	ND	ND	ND
2	SF2-6-2010	Recovery	Jan. 2010	Null	Null	>100%	Null	No	No	No	Dec. 2009	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	ND	ND	ND	ND	ND
3	SF3-1-2011	Recovery	Jan. 2011	Null	Null	>100%	>100%	Null	Null	Null	Jan. 2011	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	ND	ND	ND	ND	ND
3	SF3-2-2011	Recovery	Feb. 2011	Null	Null	>100%	No test	Null	Null	Null	Feb. 2011	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	ND	ND	ND	ND	ND
3	SF3-3-2011	Recovery	Mar. 2011	Null	Null	>100%	No test	Null	Null	Null	Mar. 2011	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	ND	ND	ND	ND	ND
3	SF3-4-2011	Recovery	May 2011	Null	Null	>100%	>100%	Null	Null	Null	May 2011	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	ND	ND	ND	ND	ND
3	SF3-5-2011	Recovery	Jun. 2011	Null	Null	>100%	>100%	Null	Null	Null	Jun. 2011	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND
4	SF4-1-2013	Recovery	Jan. 2013	Null	Null	>100%	>100%	Null	Null	Null	Jan. 2013	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND
4	SF4-2-2013	Recovery	Feb. 2013	Null	Null	Null	>100%	Null	Null	Null	Feb. 2013	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND
4	SF4-3-2013	Recovery	Mar. 2013	Null	Null	>100%	>100%	Null	Null	Null	Mar. 2013	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND
4	SF4-4-2013	Recovery	Apr. 2013	Null	Null	>100%	>100%	Null	Null	Null	Apr. 2013	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	No	No	No	No	ND	ND	ND	ND
4	SF4-5-2013	Recovery	May. 2013	Null	Null	>100%	>100%	Null	Null	Null	May. 2013	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	ND	ND
4	SF4-6-2013	Recovery	Jun. 2013	Null	Null	>100%	>100%	Null	Null	Null	Jun. 2013	No	ND	ND	No	ND	ND	ND	ND	ND	ND	No	ND	ND	No	No	No	ND	ND	No	ND	ND

Notes:
ND - No data
Sample Collection Date - Sample surface water for this analysis came from a time period within this date range.
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%
FETAX =

Table 3-6
Comparison of *Ceriodaphnia dubia* and *Selenastrum capricornutum* Toxicity Testing Data to Surface Water Major and Minor Ion Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	ToxID	Toxicity Data						Water Quality - Major and Minor Ions	Test Results	Exceeds Criteria											
		Phase	Test Initiation Date	*C. dubia* 96-hr (Water Flea)	*C. dubia* 7-day (Water Flea)		*Selenastrum capricornutum* 96-hr (Green Algae)	Sample Collection Date	Toxicity	Bromide	Calcium	Chloride	Fluoride	Magnesium	Potassium	Silica	Sodium	Sulfate	Sulfide	Total Alkalinity	Total Cyanide
				Acute survival test (LC50)	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*96-hr growth test (NOEC)*		Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no
1	SF1-1-2009	Recharge	Jan. 2009	>100%	100%/ >100%	100%	100%	Jan. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-2-2009	Recharge	Feb. 2009	Null	100%/ >100%	100%	25%	Feb. 2009	Yes	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-3-2009	Recovery	Mar. 2009	>100%	>100%	100%	100%	Mar. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-4-2009	Recovery	Mar. 2009	>100%	100%/ >100%	100%	100%	Mar. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-5-2009	Recovery	Mar. 2009	Null	100%/ IC2595.5%	100%	100%	Mar. 2009	Yes	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-6-2009	Recovery	Mar. - Apr. 2009	>100%	100%/ >100%	100%	100%	Mar. 2009	No	No	No	Yes	No	No	No	No	No	No	No	No	No
1	SF1-7-2009	Recovery	Apr. 2009	Null	Null	Null	Null	Apr. 2009	No	No	No	Yes	No	No	No	No	No	No	No	No	No
1	SF1-8-2009	Recovery	Apr. 2009	>100%	Null	Null	Null	Apr. 2009	No	No	No	Yes	No	No	No	No	No	No	No	No	No
2	SF2-1-2009	Recovery	Oct. 2009	>100%	100%/ >100%	100%	100%	Oct. 2009	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
2	SF2-2-2009	Recovery	Nov. 2009	>100%	50% / >100%	100%	100%	Nov. 2009	Yes	ND	No	No	ND	No	No	ND	No	No	No	No	ND
2	SF2-3-2009	Recovery	Dec. 2009	Null	100%/ >100%	100%	100%	Dec. 2009	No	ND	No	Yes	ND	No	No	ND	No	No	No	No	ND
2	SF2-4-2009	Recovery	Dec. 2009	>100%	50% / IC25 76.4%	Null	Null	Dec. 2009	Yes	ND	No	Yes	ND	No	No	ND	No	No	No	No	ND
2	SF2-5-2009	Recovery	Dec. 2009	Null	Null	Null	Null	Dec. 2009	No	ND	No	Yes	ND	No	No	ND	No	No	No	No	ND
2	SF2-6-2010	Recovery	Jan. 2010	>100%	Null	Null	Null	Dec. 2009	No	ND	No	Yes	ND	No	No	ND	No	No	No	No	ND
3	SF3-1-2011	Recovery	Jan. 2011	>100%	100% / 100%	Null	Null	Jan. 2011	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
3	SF3-2-2011	Recovery	Feb. 2011	>100%	No test	Null	Null	Feb. 2011	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
3	SF3-3-2011	Recovery	Mar. 2011	>100%	No test	Null	Null	Mar. 2011	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
3	SF3-4-2011	Recovery	May 2011	83.92%	IC25 7.2%	--	Null	May 2011	Yes	ND	No	Yes	ND	No	No	ND	No	No	No	No	ND
3	SF3-5-2011	Recovery	Jun. 2011	>100%	>100%/100%	--	Null	Jun. 2011	No	ND	No	Yes	ND	No	No	ND	No	No	No	No	ND
4	SF4-1-2013	Recovery	Jan. 2013	>100%	>100%/100%	Null	Null	Jan. 2013	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
4	SF4-2-2013	Recovery	Feb. 2013	Null	>100 / IC25 83.9	--	Null	Feb. 2013	Yes	ND	No	No	ND	No	No	ND	No	No	No	No	ND
4	SF4-3-2013	Recovery	Mar. 2013	>100%	>100% / IC25 76.2	Null	Null	Mar. 2013	Yes	ND	No	No	ND	No	No	ND	No	No	No	No	ND
4	SF4-4-2013	Recovery	Apr. 2013	>100%	>100%/>100%	>100%	Null	Apr. 2013	No	ND	No	Yes	ND	No	No	ND	No	No	No	No	ND
4	SF4-5-2013	Recovery	May. 2013	>100%	>100%/>100%	>100%	Null	May. 2013	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
4	SF4-6-2013	Recovery	Jun. 2013	>100%	>100%/>100%	>100%	Null	Jun. 2013	No	ND	No	Yes	ND	No	No	ND	No	No	No	No	ND

Notes:
ND - No data
Sample Collection Date - Sample surface water for this analysis came from a time period within this date range.
Toxicity
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%

Table 3-7
Comparison of *Daphnia magna* , Fish, and FETAX Toxicity Testing Data to Surface Water Major and Minor Ion Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	ToxID	Toxicity Data								Water Quality - Major and Mnor Ions	Test Results	Exceeds Criteria											
		Phase	Test Initiation Date	*Daphnia magna* 21-day (Water Flea)		*C. leedsi* 96-hr (Bannerfin Shiner)	*Pimephales promelas* 7-day (Fathead Minnow)	FETAX (Frog – *Xenopus*)			Sample Collection Date	Toxicity	Bromide	Calcium	Chloride	Fluoride	Magnesium	Potassium	Silica	Sodium	Sulfate	Sulfide	Total Alkalinity	Total Cyanide
				Chronic reproduction test (NOEC/ IC25)	*Chronic survival test (NOEC)*	*Acute survival test (LC50)*	*Embryo-larval survival and teratogenesis test*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*		Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no
1	SF1-1-2009	Recharge	Jan. 2009	100%/>100%	100%	>100%	>100%	No	No	No	Jan. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-2-2009	Recharge	Feb. 2009	Null	Null	Null	>100%	No	No	No	Feb. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-3-2009	Recovery	Mar. 2009	100%/>100%	100%	>100%	Null	No	No	No	Mar. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-4-2009	Recovery	Mar. 2009	Null	Null	>100%	Null	No	No	No	Mar. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-5-2009	Recovery	Mar. 2009	Null	Null	Null	>100%	No	No	No	Mar. 2009	No	No	No	No	No	No	No	No	No	No	No	No	No
1	SF1-6-2009	Recovery	Mar. - Apr. 2009	Null	Null	>100%	>100%	Null	Null	Null	Mar. 2009	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
1	SF1-7-2009	Recovery	Apr. 2009	Null	Null	Null	>100%	Null	Null	Null	Apr. 2009	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
1	SF1-8-2009	Recovery	Apr. 2009	Null	Null	>100%	Null	Null	Null	Null	Apr. 2009	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No
2	SF2-1-2009	Recovery	Oct. 2009	Null	Null	>100%	>100%	No	No	No	Oct. 2009	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
2	SF2-2-2009	Recovery	Nov. 2009	Null	Null	>100%	>100%	Null	Null	Null	Nov. 2009	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
2	SF2-3-2009	Recovery	Dec. 2009	Null	Null	Null	>100%	No	No	No	Dec. 2009	No	ND	No	**Yes**	ND	No	No	ND	No	No	No	No	ND
2	SF2-4-2009	Recovery	Dec. 2009	Null	Null	>100%	Null	Null	Null	Null	Dec. 2009	No	ND	No	**Yes**	ND	No	No	ND	No	No	No	No	ND
2	SF2-5-2009	Recovery	Dec. 2009	Null	Null	Null	>100%	Null	Null	Null	Dec. 2009	No	ND	No	**Yes**	ND	No	No	ND	No	No	No	No	ND
2	SF2-6-2010	Recovery	Jan. 2010	Null	Null	>100%	Null	No	No	No	Dec. 2009	No	ND	No	**Yes**	ND	No	No	ND	No	No	No	No	ND
3	SF3-1-2011	Recovery	Jan. 2011	Null	Null	>100%	>100%	Null	Null	Null	Jan. 2011	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
3	SF3-2-2011	Recovery	Feb. 2011	Null	Null	>100%	No test	Null	Null	Null	Feb. 2011	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
3	SF3-3-2011	Recovery	Mar. 2011	Null	Null	>100%	No test	Null	Null	Null	Mar. 2011	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
3	SF3-4-2011	Recovery	May 2011	Null	Null	>100%	>100%	Null	Null	Null	May 2011	No	ND	No	**Yes**	ND	No	No	ND	No	No	No	No	ND
3	SF3-5-2011	Recovery	Jun. 2011	Null	Null	>100%	>100%	Null	Null	Null	Jun. 2011	No	ND	No	**Yes**	ND	No	No	ND	No	No	No	No	ND
4	SF4-1-2013	Recovery	Jan. 2013	Null	Null	>100%	>100%	Null	Null	Null	Jan. 2013	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
4	SF4-2-2013	Recovery	Feb. 2013	Null	Null	Null	>100%	Null	Null	Null	Feb. 2013	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
4	SF4-3-2013	Recovery	Mar. 2013	Null	Null	>100%	>100%	Null	Null	Null	Mar. 2013	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
4	SF4-4-2013	Recovery	Apr. 2013	Null	Null	>100%	>100%	Null	Null	Null	Apr. 2013	No	ND	No	**Yes**	ND	No	No	ND	No	No	No	No	ND
4	SF4-5-2013	Recovery	May. 2013	Null	Null	>100%	>100%	Null	Null	Null	May. 2013	No	ND	No	No	ND	No	No	ND	No	No	No	No	ND
4	SF4-6-2013	Recovery	Jun. 2013	Null	Null	>100%	>100%	Null	Null	Null	Jun. 2013	No	ND	No	**Yes**	ND	No	No	ND	No	No	No	No	ND

Notes:
ND - No data
Sample Collection Date - Sample surface water for this analysis came from a time period within this date range.
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%
FETAX =

Table 3-8
Comparison of *Ceriodaphnia dubia* and *Selenastrum capricornutum* Toxicity Testing Data to Surface Water Nutrient and Organic Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	ToxID	Toxicity Data						Water Quality - Nutrients and Organics	Test Results	Exceeds criteria							
		Phase	Test Initiation Date	*C. dubia* 96-hr (Water Flea)	*C. dubia* 7-day (Water Flea)		*Selenastrum capricornutum* 96-hr (Green Algae)	Sample Collection Date	Toxicity	Dissolved Organic Carbon	Total Organic Carbon	Ammonia	Nitrate N	Nitrite N	Nitrogen - Organic	Ortho-Phosphorus as P	Total Kjeldahl Nitrogen
				Acute survival test (LC50)	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*96-hr growth test (NOEC)*		Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no
1	SF1-1-2009	Recharge	Jan. 2009	>100%	100%/ >100%	100%	100%	Jan. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-2-2009	Recharge	Feb. 2009	Null	100%/ >100%	100%	25%	Feb. 2009	**Yes**	No	No	ND	No	No	ND	ND	ND
1	SF1-3-2009	Recovery	Mar. 2009	>100%	>100%	100%	100%	Mar. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-4-2009	Recovery	Mar. 2009	>100%	100%/ >100%	100%	100%	Mar. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-5-2009	Recovery	Mar. 2009	Null	100%/ IC2595.5%	100%	100%	Mar. 2009	**Yes**	No	No	ND	No	No	ND	ND	ND
1	SF1-6-2009	Recovery	Mar. - Apr. 2009	>100%	100%/ >100%	100%	100%	Mar. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-7-2009	Recovery	Apr. 2009	Null	Null	Null	Null	Apr. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-8-2009	Recovery	Apr. 2009	>100%	Null	Null	Null	Apr. 2009	No	No	No	ND	No	No	ND	ND	ND
2	SF2-1-2009	Recovery	Oct. 2009	>100%	100%/ >100%	100%	100%	Oct. 2009	No	No	No	ND	ND	ND	ND	ND	ND
2	SF2-2-2009	Recovery	Nov. 2009	>100%	50% / >100%	100%	100%	Nov. 2009	**Yes**	No	No	ND	ND	ND	ND	ND	ND
2	SF2-3-2009	Recovery	Dec. 2009	Null	100%/ >100%	100%	100%	Dec. 2009	No	No	No	ND	ND	ND	ND	ND	ND
2	SF2-4-2009	Recovery	Dec. 2009	>100%	50% / IC25 76.4%	Null	Null	Dec. 2009	**Yes**	No	No	ND	ND	ND	ND	ND	ND
2	SF2-5-2009	Recovery	Dec. 2009	Null	Null	Null	Null	Dec. 2009	No	No	No	ND	ND	ND	ND	ND	ND
2	SF2-6-2010	Recovery	Jan. 2010	>100%	Null	Null	Null	Dec. 2009	No	No	No	ND	ND	ND	ND	ND	ND
3	SF3-1-2011	Recovery	Jan. 2011	>100%	100% / 100%	Null	Null	Jan. 2011	No	No	No	No	No	No	ND	No	No
3	SF3-2-2011	Recovery	Feb. 2011	>100%	No test	Null	Null	Feb. 2011	No	No	No	No	No	No	ND	No	No
3	SF3-3-2011	Recovery	Mar. 2011	>100%	No test	Null	Null	Mar. 2011	No	No	No	No	No	No	ND	No	No
3	SF3-4-2011	Recovery	May 2011	83.92%	IC25 7.2%	--	Null	May 2011	**Yes**	No	No	No	No	No	ND	No	No
3	SF3-5-2011	Recovery	Jun. 2011	>100%	>100%/100%	--	Null	Jun. 2011	No	No	No	No	No	No	ND	No	No
4	SF4-1-2013	Recovery	Jan. 2013	>100%	>100%/100%	Null	Null	Jan. 2013	No	ND	No	No	No	No	No	ND	No
4	SF4-2-2013	Recovery	Feb. 2013	Null	>100 / IC25 83.9	--	Null	Feb. 2013	**Yes**	ND	No	No	No	No	ND	ND	No
4	SF4-3-2013	Recovery	Mar. 2013	>100%	>100% / IC25 76.2	Null	Null	Mar. 2013	**Yes**	ND	No	No	No	No	ND	ND	No
4	SF4-4-2013	Recovery	Apr. 2013	>100%	>100%/>100%	>100%	Null	Apr. 2013	No	ND	No	No	No	No	No	ND	No
4	SF4-5-2013	Recovery	May. 2013	>100%	>100%/>100%	>100%	Null	May. 2013	No	ND	No	No	No	No	ND	ND	No
4	SF4-6-2013	Recovery	Jun. 2013	>100%	>100%/>100%	>100%	Null	Jun. 2013	No	ND	No	No	No	**Yes**	ND	ND	No

Notes:
ND - No data
Sample Collection Date - Sample surface water for this analysis came from a time period within this date range.
Toxicity
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%

Table 3-9
Comparison of *Daphnia magna* , Fish, and FETAX Toxicity Testing Data to Surface Water Nutrients and Organics Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	ToxID	Toxicity Data									Water Quality - Nutrients & Organics	Test Results	Exceeds criteria							
		Phase	Test Initiation Date	*Daphnia magna* 21-day (Water Flea)		*C. leedsi* 96-hr (Bannerfin Shiner)	*Pimephales promelas* 7-day (Fathead Minnow)	FETAX (Frog – *Xenopus*)			Sample Collection Date	Toxicity	Dissolved Organic Carbon	Total Organic Carbon	Ammonia	Nitrate N	Nitrite N	Nitrogen - Organic	Ortho-Phosphorus as P	Total Kjeldahl Nitrogen
				Chronic reproduction test (NOEC/ IC25)	*Chronic survival test (NOEC)*	*Acute survival test (LC50)*	*Embryo-larval survival and teratogenesis test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*		Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no
1	SF1-1-2009	Recharge	Jan. 2009	100%/>100%	100%	>100%	>100%	No	No	No	Jan. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-2-2009	Recharge	Feb. 2009	Null	Null	Null	>100%	No	No	No	Feb. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-3-2009	Recovery	Mar. 2009	100%/>100%	100%	>100%	Null	No	No	No	Mar. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-4-2009	Recovery	Mar. 2009	Null	Null	>100%	Null	No	No	No	Mar. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-5-2009	Recovery	Mar. 2009	Null	Null	Null	>100%	No	No	No	Mar. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-6-2009	Recovery	Mar. - Apr. 2009	Null	Null	>100%	>100%	Null	Null	Null	Mar. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-7-2009	Recovery	Apr. 2009	Null	Null	Null	>100%	Null	Null	Null	Apr. 2009	No	No	No	ND	No	No	ND	ND	ND
1	SF1-8-2009	Recovery	Apr. 2009	Null	Null	>100%	Null	Null	Null	Null	Apr. 2009	No	No	No	ND	No	No	ND	ND	ND
2	SF2-1-2009	Recovery	Oct. 2009	Null	Null	>100%	>100%	No	No	No	Oct. 2009	No	No	No	ND	ND	ND	ND	ND	ND
2	SF2-2-2009	Recovery	Nov. 2009	Null	Null	>100%	>100%	Null	Null	Null	Nov. 2009	No	No	No	ND	ND	ND	ND	ND	ND
2	SF2-3-2009	Recovery	Dec. 2009	Null	Null	Null	>100%	No	No	No	Dec. 2009	No	No	No	ND	ND	ND	ND	ND	ND
2	SF2-4-2009	Recovery	Dec. 2009	Null	Null	>100%	Null	Null	Null	Null	Dec. 2009	No	No	No	ND	ND	ND	ND	ND	ND
2	SF2-5-2009	Recovery	Dec. 2009	Null	Null	Null	>100%	Null	Null	Null	Dec. 2009	No	No	No	ND	ND	ND	ND	ND	ND
2	SF2-6-2010	Recovery	Jan. 2010	Null	Null	>100%	Null	No	No	No	Dec. 2009	No	No	No	ND	ND	ND	ND	ND	ND
3	SF3-1-2011	Recovery	Jan. 2011	Null	Null	>100%	>100%	Null	Null	Null	Jan. 2011	No	No	No	No	No	No	ND	No	No
3	SF3-2-2011	Recovery	Feb. 2011	Null	Null	>100%	No test	Null	Null	Null	Feb. 2011	No	No	No	No	No	No	ND	No	No
3	SF3-3-2011	Recovery	Mar. 2011	Null	Null	>100%	No test	Null	Null	Null	Mar. 2011	No	No	No	No	No	No	ND	No	No
3	SF3-4-2011	Recovery	May 2011	Null	Null	>100%	>100%	Null	Null	Null	May 2011	No	No	No	No	No	No	ND	No	No
3	SF3-5-2011	Recovery	Jun. 2011	Null	Null	>100%	>100%	Null	Null	Null	Jun. 2011	No	No	No	No	No	No	ND	No	No
4	SF4-1-2013	Recovery	Jan. 2013	Null	Null	>100%	>100%	Null	Null	Null	Jan. 2013	No	ND	No	No	No	No	No	ND	No
4	SF4-2-2013	Recovery	Feb. 2013	Null	Null	Null	>100%	Null	Null	Null	Feb. 2013	No	ND	No	No	No	No	ND	ND	No
4	SF4-3-2013	Recovery	Mar. 2013	Null	Null	>100%	>100%	Null	Null	Null	Mar. 2013	No	ND	No	No	No	No	No	ND	No
4	SF4-4-2013	Recovery	Apr. 2013	Null	Null	>100%	>100%	Null	Null	Null	Apr. 2013	No	ND	No	No	No	No	No	ND	No
4	SF4-5-2013	Recovery	May. 2013	Null	Null	>100%	>100%	Null	Null	Null	May. 2013	No	ND	No	No	No	No	No	ND	No
4	SF4-6-2013	Recovery	Jun. 2013	Null	Null	>100%	>100%	Null	Null	Null	Jun. 2013	No	ND	No	No	No	**Yes**	ND	ND	No

Notes:
ND - No data
Sample Collection Date - Sample surface water for this analysis came from a time period within this date range.
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%
FETAX =

Table 3-10
Comparison of *Ceriodaphnia dubia* and *Selenastrum capricornutum* Toxicity Testing Data to Surface Water Radionuclide Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	ToxID	Toxicity						Water Quality - Radionuclides	Test Results	Exceeds Criteria	
		Phase	Test Initiation Date	*C. dubia* 96-hr (Water Flea)	*C. dubia* 7-day (Water Flea)		*Selenastrum capricornutum* 96-hr (Green Algae)	Sample Collection Date	Toxicity	Gross Alpha	Ra-226 + Ra-228
				Acute survival test (LC50)	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*96-hr growth test (NOEC)*		Yes/no	Yes/no	Yes/no
1	SF1-1-2009	Recharge	Jan. 2009	>100%	100%/ >100%	100%	100%	Jan. 2009	No	No	No
1	SF1-2-2009	Recharge	Feb. 2009	Null	100%/ >100%	100%	25%	Feb. 2009	**Yes**	No	No
1	SF1-3-2009	Recovery	Mar. 2009	>100%	>100%	100%	100%	Mar. 2009	No	No	No
1	SF1-4-2009	Recovery	Mar. 2009	>100%	100%/ >100%	100%	100%	Mar. 2009	No	No	No
1	SF1-5-2009	Recovery	Mar. 2009	Null	100%/ IC2595.5%	100%	100%	Mar. 2009	**Yes**	No	No
1	SF1-6-2009	Recovery	Mar. - Apr. 2009	>100%	100%/ >100%	100%	100%	Mar. 2009	No	No	No
1	SF1-7-2009	Recovery	Apr. 2009	Null	Null	Null	Null	Apr. 2009	No	No	No
1	SF1-8-2009	Recovery	Apr. 2009	>100%	Null	Null	Null	Apr. 2009	No	No	No
2	SF2-1-2009	Recovery	Oct. 2009	>100%	100%/ >100%	100%	100%	Oct. 2009	No	No	ND
2	SF2-2-2009	Recovery	Nov. 2009	>100%	50% / >100%	100%	100%	Nov. 2009	**Yes**	No	ND
2	SF2-3-2009	Recovery	Dec. 2009	Null	100%/ >100%	100%	100%	Dec. 2009	No	No	ND
2	SF2-4-2009	Recovery	Dec. 2009	>100%	50% / IC25 76.4%	Null	Null	Dec. 2009	**Yes**	No	ND
2	SF2-5-2009	Recovery	Dec. 2009	Null	Null	Null	Null	Dec. 2009	No	No	ND
2	SF2-6-2010	Recovery	Jan. 2010	>100%	Null	Null	Null	Dec. 2009	No	No	ND
3	SF3-1-2011	Recovery	Jan. 2011	>100%	100% / 100%	Null	Null	Jan. 2011	No	**Yes**	ND
3	SF3-2-2011	Recovery	Feb. 2011	>100%	No test	Null	Null	Feb. 2011	No	No	No
3	SF3-3-2011	Recovery	Mar. 2011	>100%	No test	Null	Null	Mar. 2011	No	No	ND
3	SF3-4-2011	Recovery	May 2011	83.92%	IC25 7.2%	--	Null	May 2011	**Yes**	No	ND
3	SF3-5-2011	Recovery	Jun. 2011	>100%	>100%/100%	--	Null	Jun. 2011	No	No	ND
4	SF4-1-2013	Recovery	Jan. 2013	>100%	>100%/100%	Null	Null	Jan. 2013	No	No	ND
4	SF4-2-2013	Recovery	Feb. 2013	Null	>100 / IC25 83.9	--	Null	Feb. 2013	**Yes**	No	ND
4	SF4-3-2013	Recovery	Mar. 2013	>100%	>100% / IC25 76.2	Null	Null	Mar. 2013	**Yes**	No	ND
4	SF4-4-2013	Recovery	Apr. 2013	>100%	>100%/>100%	>100%	Null	Apr. 2013	No	No	ND
4	SF4-5-2013	Recovery	May. 2013	>100%	>100%/>100%	>100%	Null	May. 2013	No	ND	ND
4	SF4-6-2013	Recovery	Jun. 2013	>100%	>100%/>100%	>100%	Null	Jun. 2013	No	ND	ND

Notes:
ND - No data
Sample Collection Date - Sample surface water for this analysis came from a time period within this date range.
Toxicity
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%

Table 3-11
Comparison of *Daphnia magna* , Fish, and FETAX Toxicity Testing Data to Surface Water Radionuclide Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	ToxID	Toxicity								Water Quality - Radionuclides	Test Results	Exceeds Criteria	
		Phase	Test Initiation Date	*Daphnia magna* 21-day (Water Flea)		*C. leedsi* 96-hr (Bannerfin Shiner)	*Pimephales promelas* 7-day (Fathead Minnow)	FETAX (Frog – *Xenopus*)			Sample Collection Date	Toxicity	Gross Alpha	Ra-226 + Ra-228
				Chronic reproduction test (NOEC/ IC25)	*Chronic survival test (NOEC)*	*Acute survival test (LC50)*	*Embryo-larval survival and teratogenesis test*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*		Yes/no	Yes/no	Yes/no
1	SF1-1-2009	Recharge	Jan. 2009	100%/>100%	100%	>100%	>100%	No	No	No	Jan. 2009	No	No	No
1	SF1-2-2009	Recharge	Feb. 2009	Null	Null	Null	>100%	No	No	No	Feb. 2009	No	No	No
1	SF1-3-2009	Recovery	Mar. 2009	100%/>100%	100%	>100%	Null	No	No	No	Mar. 2009	No	No	No
1	SF1-4-2009	Recovery	Mar. 2009	Null	Null	>100%	Null	No	No	No	Mar. 2009	No	No	No
1	SF1-5-2009	Recovery	Mar. 2009	Null	Null	Null	>100%	No	No	No	Mar. 2009	No	No	No
1	SF1-6-2009	Recovery	Mar. - Apr. 2009	Null	Null	>100%	>100%	Null	Null	Null	Mar. 2009	No	No	No
1	SF1-7-2009	Recovery	Apr. 2009	Null	Null	Null	>100%	Null	Null	Null	Apr. 2009	No	No	No
1	SF1-8-2009	Recovery	Apr. 2009	Null	Null	>100%	Null	Null	Null	Null	Apr. 2009	No	No	No
2	SF2-1-2009	Recovery	Oct. 2009	Null	Null	>100%	>100%	No	No	No	Oct. 2009	No	No	ND
2	SF2-2-2009	Recovery	Nov. 2009	Null	Null	>100%	>100%	Null	Null	Null	Nov. 2009	No	No	ND
2	SF2-3-2009	Recovery	Dec. 2009	Null	Null	Null	>100%	No	No	No	Dec. 2009	No	No	ND
2	SF2-4-2009	Recovery	Dec. 2009	Null	Null	>100%	Null	Null	Null	Null	Dec. 2009	No	No	ND
2	SF2-5-2009	Recovery	Dec. 2009	Null	Null	Null	>100%	Null	Null	Null	Dec. 2009	No	No	ND
2	SF2-6-2010	Recovery	Jan. 2010	Null	Null	>100%	Null	No	No	No	Dec. 2009	No	No	ND
3	SF3-1-2011	Recovery	Jan. 2011	Null	Null	>100%	>100%	Null	Null	Null	Jan. 2011	No	**Yes**	ND
3	SF3-2-2011	Recovery	Feb. 2011	Null	Null	>100%	No test	Null	Null	Null	Feb. 2011	No	No	No
3	SF3-3-2011	Recovery	Mar. 2011	Null	Null	>100%	No test	Null	Null	Null	Mar. 2011	No	No	ND
3	SF3-4-2011	Recovery	May 2011	Null	Null	>100%	>100%	Null	Null	Null	May 2011	No	No	ND
3	SF3-5-2011	Recovery	Jun. 2011	Null	Null	>100%	>100%	Null	Null	Null	Jun. 2011	No	No	ND
4	SF4-1-2013	Recovery	Jan. 2013	Null	Null	>100%	>100%	Null	Null	Null	Jan. 2013	No	No	ND
4	SF4-2-2013	Recovery	Feb. 2013	Null	Null	Null	>100%	Null	Null	Null	Feb. 2013	No	No	ND
4	SF4-3-2013	Recovery	Mar. 2013	Null	Null	>100%	>100%	Null	Null	Null	Mar. 2013	No	No	ND
4	SF4-4-2013	Recovery	Apr. 2013	Null	Null	>100%	>100%	Null	Null	Null	Apr. 2013	No	No	ND
4	SF4-5-2013	Recovery	May. 2013	Null	Null	>100%	>100%	Null	Null	Null	May. 2013	No	ND	ND
4	SF4-6-2013	Recovery	Jun. 2013	Null	Null	>100%	>100%	Null	Null	Null	Jun. 2013	No	ND	ND

Notes:
ND - No data
Sample Collection Date - Sample surface water for this analysis came from a time period within this date range.
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%
FETAX =

Table 3-12
Comparison of *Ceriodaphnia dubia* and *Selenastrum capricornutum* Toxicity Testing Data to Surface Water Field Parameter Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	ToxID	Toxicity Data						Water Quality - Field Measurements	Test Results	Exceeds Criteria								
		Phase	Test Initiation Date	*C. dubia* 96-hr (Water Flea)	*C. dubia* 7-day (Water Flea)		*Selenastrum capricornutum* 96-hr (Green Algae)	Sample Collection Date	Toxicity	Color	Dissolved Oxygen	Hardness (calculated)	Oxidation-Reduction Potential	pH	Specific Conductance	Temperature	Total Dissolved Solids	Total Suspended Solids	Turbidity
				Acute survival test (LC50)	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*96-hr growth test (NOEC)*		Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no
1	SF1-1-2009	Recharge	Jan. 2009	>100%	100%/ >100%	100%	100%	Jan. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-2-2009	Recharge	Feb. 2009	Null	100%/ >100%	100%	25%	Feb. 2009	Yes	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-3-2009	Recovery	Mar. 2009	>100%	>100%	100%	100%	Mar. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-4-2009	Recovery	Mar. 2009	>100%	100%/ >100%	100%	100%	Mar. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-5-2009	Recovery	Mar. 2009	Null	100%/ IC2595.5%	100%	100%	Mar. 2009	Yes	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-6-2009	Recovery	Mar. - Apr. 2009	>100%	100%/ >100%	100%	100%	Mar. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-7-2009	Recovery	Apr. 2009	Null	Null	Null	Null	Apr. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-8-2009	Recovery	Apr. 2009	>100%	Null	Null	Null	Apr. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-1-2009	Recovery	Oct. 2009	>100%	100%/ >100%	100%	100%	Oct. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-2-2009	Recovery	Nov. 2009	>100%	50% / >100%	100%	100%	Nov. 2009	Yes	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-3-2009	Recovery	Dec. 2009	Null	100%/ >100%	100%	100%	Dec. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-4-2009	Recovery	Dec. 2009	>100%	50% / IC25 76.4%	Null	Null	Dec. 2009	Yes	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-5-2009	Recovery	Dec. 2009	Null	Null	Null	Null	Dec. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-6-2010	Recovery	Jan. 2010	>100%	Null	Null	Null	Dec. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
3	SF3-1-2011	Recovery	Jan. 2011	>100%	100% / 100%	Null	Null	Jan. 2011	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
3	SF3-2-2011	Recovery	Feb. 2011	>100%	No test	Null	Null	Feb. 2011	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
3	SF3-3-2011	Recovery	Mar. 2011	>100%	No test	Null	Null	Mar. 2011	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
3	SF3-4-2011	Recovery	May 2011	83.92%	IC25 7.2%	--	Null	May 2011	Yes	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
3	SF3-5-2011	Recovery	Jun. 2011	>100%	>100%/100%	--	Null	Jun. 2011	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-1-2013	Recovery	Jan. 2013	>100%	>100%/100%	Null	Null	Jan. 2013	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-2-2013	Recovery	Feb. 2013	Null	>100 / IC25 83.9	--	Null	Feb. 2013	Yes	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-3-2013	Recovery	Mar. 2013	>100%	>100% / IC25 76.2	Null	Null	Mar. 2013	Yes	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-4-2013	Recovery	Apr. 2013	>100%	>100%/>100%	>100%	Null	Apr. 2013	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-5-2013	Recovery	May. 2013	>100%	>100%/>100%	>100%	Null	May. 2013	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-6-2013	Recovery	Jun. 2013	>100%	>100%/>100%	>100%	Null	Jun. 2013	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No

Notes:
ND - No data
Sample Collection Date - Sample surface water for this analysis came from a time period within this date range.
Toxicity
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%
NC =
ND/NC =

Table 3-13
Comparison of *Daphnia magna* , Fish, and FETAX Toxicity Testing Data to Surface Water Field Parameter Concentrations
Risk-Based Assessment of Historical ASR Bioassay Data

Cycle	ToxID	Toxicity Data								Water Quality - Field Measurements	Test Results	Exceeds Criteria									
		Phase	Test Initiation Date	*Daphnia magna* 21-day (Water Flea)		*C. leedsi* 96-hr (Bannerfin Shiner)	*Pimephales promelas* 7-day (Fathead Minnow)	FETAX (Frog – *Xenopus*)			Sample Collection Date	Toxicity	Color	Dissolved Oxygen	Hardness (calculated)	Oxidation-Reduction Potential	pH	Specific Conductance	Temperature	Total Dissolved Solids	Total Suspended Solids	Turbidity
				Chronic reproduction test (NOEC/ IC25)	*Chronic survival test (NOEC)*	*Acute survival test (LC50)*	*Embryo-larval survival and teratogenesis test*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*		Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no	Yes/no
1	SF1-1-2009	Recharge	Jan. 2009	100%/>100%	100%	>100%	>100%	Null	Null	Null	Jan. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-2-2009	Recharge	Feb. 2009	Null	Null	Null	>100%	Null	No	No	Feb. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-3-2009	Recovery	Mar. 2009	100%/>100%	100%	>100%	Null	Null	No	No	Mar. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-4-2009	Recovery	Mar. 2009	Null	Null	>100%	Null	Null	No	No	Mar. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-5-2009	Recovery	Mar. 2009	Null	Null	Null	>100%	Null	No	No	Mar. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-6-2009	Recovery	Mar. - Apr. 2009	Null	Null	>100%	>100%	Null	Null	Null	Mar. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-7-2009	Recovery	Apr. 2009	Null	Null	Null	>100%	Null	Null	Null	Apr. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
1	SF1-8-2009	Recovery	Apr. 2009	Null	Null	>100%	Null	Null	Null	Null	Apr. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-1-2009	Recovery	Oct. 2009	Null	Null	>100%	>100%	Null	No	No	Oct. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-2-2009	Recovery	Nov. 2009	Null	Null	>100%	>100%	Null	Null	Null	Nov. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-3-2009	Recovery	Dec. 2009	Null	Null	Null	>100%	Null	No	No	Dec. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-4-2009	Recovery	Dec. 2009	Null	Null	>100%	Null	Null	Null	Null	Dec. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-5-2009	Recovery	Dec. 2009	Null	Null	Null	>100%	Null	Null	Null	Dec. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
2	SF2-6-2010	Recovery	Jan. 2010	Null	Null	>100%	Null	Null	No	No	Dec. 2009	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
3	SF3-1-2011	Recovery	Jan. 2011	Null	Null	>100%	>100%	Null	Null	Null	Jan. 2011	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
3	SF3-2-2011	Recovery	Feb. 2011	Null	Null	>100%	No test	Null	Null	Null	Feb. 2011	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
3	SF3-3-2011	Recovery	Mar. 2011	Null	Null	>100%	No test	Null	Null	Null	Mar. 2011	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
3	SF3-4-2011	Recovery	May 2011	Null	Null	>100%	>100%	Null	Null	Null	May 2011	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
3	SF3-5-2011	Recovery	Jun. 2011	Null	Null	>100%	>100%	Null	Null	Null	Jun. 2011	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-1-2013	Recovery	Jan. 2013	Null	Null	>100%	>100%	Null	Null	Null	Jan. 2013	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-2-2013	Recovery	Feb. 2013	Null	Null	Null	>100%	Null	Null	Null	Feb. 2013	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-3-2013	Recovery	Mar. 2013	Null	Null	>100%	>100%	Null	Null	Null	Mar. 2013	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-4-2013	Recovery	Apr. 2013	Null	Null	>100%	>100%	Null	Null	Null	Apr. 2013	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-5-2013	Recovery	May. 2013	Null	Null	>100%	>100%	Null	Null	Null	May. 2013	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No
4	SF4-6-2013	Recovery	Jun. 2013	Null	Null	>100%	>100%	Null	Null	Null	Jun. 2013	No	NC	No	ND/NC	NC	No	NC	No	NC	NC	No

Notes:
ND - No data
Sample Collection Date - Sample surface water for this analysis came from a time period within this date range.
NOEC = No Observed Effect Concentrations
LC50 = Lethal Concentration
IC25 = Inhibition Concentration 25%
FETAX =
NC =
ND/NC =

APPENDIX A – UPPER-TROPHIC-LEVEL RECEPTOR EXPOSURE PARAMETERS

Table A1 - Values and References for Receptor Parameters - Body Weight and Ingestion Rates

Receptors	Body Weight (kg)		Food Ingestion Rate (kg/day)		Water Ingestion Rate (L/day)	
	Value	Reference Code	Value	Reference Code	Value	Reference Code
Clapper rail	0.297	3	0.022	1	0.026	1
Everglade Snail Kite	0.378	2	0.031	1	0.031	1
Great Blue Heron	2.229	1	0.098	1	0.100	1
Little blue heron	0.34	3	0.029	1	0.029	1
Mottled Duck	1.04	1	0.055	1	0.061	1
Osprey	1.486	3	0.073	1	0.077	1
Tri-colored Heron	0.75	3	0.048	1	0.049	1
White Ibis	0.9	3	0.050	1	0.055	1
Wood Stork	2.376	3	0.103	1	0.105	1
Raccoon	3.91	4	0.211	1	0.338	1
River otter	7.4	1	0.356	1	0.600	1
American Alligator	10.0	5	0.360	5	0.360	5

Notes:
Values (except American Aligator) represent default values from Goodrich, M. 2002. Prospective Ecological Risk Assessment - Risk Analysis Simulator For Water Attenuation Reservoirs, Version 1.3. South Florida Water Management District, FL. September 2002
kg/day - kilogram per day L/day - liter per day

Reference Codes

1 U.S. Environmental Protection Agency (USEPA). 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/1987a. Volumes I & II.

2 Beissinger, S.R. 1983. Hunting behavior, prey selection, and energetics of snail kites in Guyana: consumer choice by a specialist. The Auk 100: 84-92. January 1983.

3 Dunning. J.B., Jr. 1993. CRC Handbook of Avian Body Masses. CRC Press, Boca Raton, FL.

4 Silva, M., and J.A. Downing. 1995. CRC Handbook of Mammalian Body Masses. CRC Press, Boca Raton, Florida.

5 Southern Regional Aquaculture Center. 1993. Alligator Production. Grow-out and Harvest. SRAC Publication No. 232

APPENDIX B – COMPARISON OF TOXICITY TEST DATA AND WATER QUALITY PARAMETERS

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ	DOC	Total Hardness	pH	Ca	Mg	Criteria
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*																
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Aluminum	110	ug/L			870	0.126	14	93.3886	7.3	28	5.7	derived from EPA calculator
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Aluminum	95	ug/L			840	0.113	14	86.7474	7.22	26	5.3	derived from EPA calculator
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Aluminum	4.5	ug/L	U		970	0.005	8.7	55.5357	7.72	4.1	11	derived from EPA calculator
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Aluminum	4.5	ug/L	U		1000	0.005	5.9	181.495	7.85	43	18	derived from EPA calculator
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Aluminum	4.9	ug/L	I		1000	0.005	4.5	213.694	7.88	46	24	derived from EPA calculator
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Aluminum	4.5	ug/L	U		980	0.005	3.9	226.048	7.85	46	27	derived from EPA calculator
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Aluminum	4.9	ug/L	I		960	0.005	3.1	218.688	7.83	48	24	derived from EPA calculator
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Aluminum	5.9	ug/L	I		1100	0.005	2.5	258.247	8.03	49	33	derived from EPA calculator
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Aluminum	Null	ug/L										
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Aluminum	Null	ug/L										
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Aluminum	Null	ug/L										
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Aluminum	Null	ug/L										
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Aluminum	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.								
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Aluminum	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.								
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Aluminum	Null	ug/L										
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Aluminum	Null	ug/L										
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Aluminum	Null	ug/L										
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Aluminum	Null	ug/L										
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Aluminum	Null	ug/L										
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Aluminum	Null	ug/L										
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Aluminum	Null	ug/L										
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Aluminum	Null	ug/L										
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Aluminum	Null	ug/L										
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Aluminum	Null	ug/L										
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Aluminum	Null	ug/L										

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Antimony	0.115	ug/L	IV		4300	0.000
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Antimony	0.26	ug/L	I		4300	0.000
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Antimony	0.31	ug/L	I		4300	0.000
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Antimony	0.35	ug/L	I		4300	0.000
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Antimony	0.51	ug/L	V		4300	0.000
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Antimony	0.12	ug/L	I		4300	0.000
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Antimony	0.12	ug/L	I		4300	0.000
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Antimony	0.082	ug/L	U		4300	0.000
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Antimony	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Antimony	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Antimony	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Antimony	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Antimony	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Antimony	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Antimony	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Antimony	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Antimony	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Antimony	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Antimony	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Antimony	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Antimony	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Antimony	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Antimony	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Antimony	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Antimony	Null	ug/L				

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Arsenic	0.39	ug/L	I		50	0.008
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Arsenic	0.86	ug/L	I		50	0.017
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Arsenic	75	ug/L		Changed Well from POD-SW	50	1.500
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Arsenic	59	ug/L		Changed Well from POD-SW	50	1.180
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Arsenic	56	ug/L		Changed Well from POD-SW	50	1.120
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Arsenic	43	ug/L		Changed Well from POD-SW	50	0.860
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Arsenic	37	ug/L			50	0.740
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Arsenic	28	ug/L			50	0.560
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Arsenic	3.7	ug/L	U		50	0.074
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Arsenic	1.8	ug/L			50	0.036
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Arsenic	2	ug/L			50	0.040
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Arsenic	1.8	ug/L	U		50	0.036
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Arsenic	1.8	ug/L	U	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	50	0.036
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Arsenic	1.8	ug/L	U	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	50	0.036
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Arsenic	18	ug/L			50	0.360
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/16/2011	Cascade Aerator-Base	Arsenic	3.9	ug/L	V		50	0.078
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/10/2011	Cascade Aerator-Base	Arsenic	3	ug/L			50	0.060
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/25/2011	Cascade Aerator-Base	Arsenic	2.6	ug/L			50	0.052
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/16/2011	Cascade Aerator-Base	Arsenic	1.9	ug/L			50	0.038
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Arsenic	10	ug/L			50	0.200
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Arsenic	2.4	ug/L			50	0.048
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Arsenic	1.9	ug/L			50	0.038
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/12/2013	Recovered Water	Arsenic	1.6	ug/L			50	0.032
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Arsenic	1.4	ug/L			50	0.028
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Arsenic	1.8	ug/L			50	0.036
Toxicity Data																Water Quality - Metals							Notes		

Toxicity Data / **Water Quality - Metals**

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ	Total Hardness	pH	Ca	Mg
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*														
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Barium	19	ug/L			409.50	0.046	93.3886	7.3	28	5.7
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Barium	20	ug/L			378.62	0.053	86.7474	7.22	26	5.3
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Barium	34	ug/L			235.69	0.144	55.5357	7.72	4.1	11
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Barium	39	ug/L			829.80	0.047	181.495	7.85	43	18
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Barium	42	ug/L			987.10	0.043	213.694	7.88	46	24
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Barium	42	ug/L			1047.87	0.040	226.048	7.85	46	27
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Barium	47	ug/L			1011.64	0.046	218.688	7.83	48	24
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Barium	44	ug/L			1207.20	0.036	258.247	8.03	49	33
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Barium	Null	ug/L								
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Barium	Null	ug/L								
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Barium	Null	ug/L								
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Barium	Null	ug/L								
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Barium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.						
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Barium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.						
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Barium	Null	ug/L								
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Barium	Null	ug/L								
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Barium	Null	ug/L								
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Barium	Null	ug/L								
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Barium	Null	ug/L								
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Barium	Null	ug/L								
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Barium	Null	ug/L								
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Barium	Null	ug/L								
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Barium	Null	ug/L								
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Barium	Null	ug/L								
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Barium	Null	ug/L								

Toxicity Data / **Water Quality - Metals**

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Boron	34	ug/L			7200	0.005
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Boron	40	ug/L			7200	0.006
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Boron	42	ug/L			7200	0.006
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Boron	53	ug/L			7200	0.007
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Boron	67	ug/L			7200	0.009
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Boron	65	ug/L			7200	0.009
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Boron	78	ug/L			7200	0.011
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Boron	76	ug/L			7200	0.011
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Boron	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Boron	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Boron	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Boron	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Boron	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Boron	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Boron	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Boron	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Boron	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Boron	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Boron	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Boron	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Boron	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Boron	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Boron	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Boron	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Boron	Null	ug/L				

Toxicity Data / **Water Quality - Metals**

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ	Total Hardness	pH	Ca	Mg
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*														
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Cadmium	0.058	ug/L	U		0.257249811	0.225	93.3886	7.3	28	5.7
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Cadmium	0.058	ug/L	U		0.243567061	0.238	86.7474	7.22	26	5.3
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Cadmium	0.058	ug/L	U		0.175032187	0.331	55.5357	7.72	4.1	11
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Cadmium	0.058	ug/L	U		0.420878916	0.138	181.495	7.85	43	18
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Cadmium	0.058	ug/L	U		0.475015166	0.122	213.694	7.88	46	24
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Cadmium	0.058	ug/L	U		0.495212519	0.117	226.048	7.85	46	27
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Cadmium	0.058	ug/L	U		0.483215267	0.120	218.688	7.83	48	24
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Cadmium	0.058	ug/L	U		0.546564327	0.106	258.247	8.03	49	33
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Cadmium	Null	ug/L								
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Cadmium	Null	ug/L								
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Cadmium	Null	ug/L								
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Cadmium	Null	ug/L								
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Cadmium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.						
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Cadmium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.						
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Cadmium	Null	ug/L								
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Cadmium	Null	ug/L								
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Cadmium	Null	ug/L								
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Cadmium	Null	ug/L								
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Cadmium	Null	ug/L								
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Cadmium	Null	ug/L								
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Cadmium	Null	ug/L								
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Cadmium	Null	ug/L								
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Cadmium	Null	ug/L								
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Cadmium	Null	ug/L								
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Cadmium	Null	ug/L								

Toxicity Data															Water Quality - Metals										
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Chromium	2.3	ug/L	V		11	0.209
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Chromium	0.88	ug/L	I		11	0.080
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Chromium	0.24	ug/L	U		11	0.022
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Chromium	0.24	ug/L	U		11	0.022
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Chromium	1.4	ug/L	V		11	0.127
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Chromium	0.24	ug/L	U		11	0.022
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Chromium	0.24	ug/L	U		11	0.022
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Chromium	0.24	ug/L	U		11	0.022
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Chromium	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Chromium	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Chromium	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Chromium	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Chromium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Chromium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Chromium	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Chromium	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Chromium	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Chromium	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Chromium	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Chromium	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Chromium	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Chromium	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Chromium	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Chromium	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Chromium	Null	ug/L				

Toxicity Data															Water Quality - Metals										
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Cobalt	0.15	ug/L	I		100	0.002
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Cobalt	0.14	ug/L	I		100	0.001
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Cobalt	0.12	ug/L	U		100	0.001
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Cobalt	0.12	ug/L	U		100	0.001
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Cobalt	0.12	ug/L	U		100	0.001
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Cobalt	0.12	ug/L	U		100	0.001
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Cobalt	0.12	ug/L	U		100	0.001
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Cobalt	0.12	ug/L	I		100	0.001
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Cobalt	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Cobalt	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Cobalt	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Cobalt	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Cobalt	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Cobalt	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Cobalt	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Cobalt	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Cobalt	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Cobalt	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Cobalt	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Cobalt	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Cobalt	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Cobalt	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Cobalt	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Cobalt	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Cobalt	Null	ug/L				

Toxicity Data															Water Quality - Metals										
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Copper	0.75	ug/L	I		8.799275175	0.085
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Copper	0.76	ug/L	I		8.261729954	0.092
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Copper	0.26	ug/L	U		5.643750156	0.046
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Copper	0.26	ug/L	U		15.52496566	0.017
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Copper	0.83	ug/L	I		17.85000477	0.046
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Copper	0.37	ug/L	I		18.72816657	0.020
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Copper	0.46	ug/L	I		18.20586064	0.025
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Copper	0.26	ug/L	U		20.98528844	0.012
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Copper	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Copper	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Copper	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Copper	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Copper	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Copper	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Copper	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Copper	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Copper	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Copper	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Copper	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Copper	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Copper	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Copper	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Copper	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Copper	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Copper	Null	ug/L				

Total Hardness	pH	Ca	Mg
93.3886	7.3	28	5.7
86.7474	7.22	26	5.3
55.5357	7.72	4.1	11
181.495	7.85	43	18
213.694	7.88	46	24
226.048	7.85	46	27
218.688	7.83	48	24
258.247	8.03	49	33

Toxicity Data																Water Quality - Metals										
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Iron	260	ug/L			1000	0.260
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Iron	220	ug/L			1000	0.220
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Iron	260	ug/L		Changed Well from POD-SW	1000	0.260
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Iron	180	ug/L			1000	0.180
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Iron	200	ug/L			1000	0.200
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Iron	200	ug/L		Changed Well from POD-SW	1000	0.200
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Iron	240	ug/L		Changed Well from POD-SW	1000	0.240
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Iron	260	ug/L			1000	0.260
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Iron	760	ug/L			1000	0.760
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Iron	110	ug/L			1000	0.110
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Iron	79	ug/L			1000	0.079
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Iron	80	ug/L			1000	0.080
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Iron	73	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	1000	0.073
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Iron	73	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	1000	0.073
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Iron	950	ug/L			1000	0.950
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Iron	130	ug/L			1000	0.130
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/10/2011	Cascade Aerator-Base	Iron	120	ug/L			1000	0.120
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/16/2011	Cascade Aerator-Base	Iron	100	ug/L			1000	0.100
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/7/2011	Cascade Aerator-Base	Iron	170	ug/L			1000	0.170
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Iron	250	ug/L			1000	0.250
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Iron	81	ug/L			1000	0.081
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Iron	59	ug/L			1000	0.059
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/12/2013	Recovered Water	Iron	230	ug/L			1000	0.230
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/8/2013	Recovered Water	Iron	190	ug/L			1000	0.190
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Iron	390	ug/L			1000	0.390

Toxicity Data																Water Quality - Metals										
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Lead	0.44	ug/L			2.916275522	0.151
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Lead	0.32	ug/L			2.654880301	0.121
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Lead	0.054	ug/L	U		1.504821326	0.036
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Lead	0.054	ug/L	U		6.794839166	0.008
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Lead	0.076	ug/L	I		8.365079961	0.009
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Lead	0.054	ug/L	U		8.985493082	0.006
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Lead	0.054	ug/L	U		8.614729148	0.006
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Lead	0.054	ug/L	U		10.64548324	0.005
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Lead	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Lead	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Lead	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Lead	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Lead	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Lead	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Lead	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Lead	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Lead	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Lead	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Lead	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Lead	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Lead	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Lead	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Lead	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Lead	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Lead	Null	ug/L				

Toxicity Data																Water Quality - Metals										
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Manganese	4.5	ug/L			1851.216255	0.002
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Manganese	3.5	ug/L			1735.064023	0.002
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Manganese	4.9	ug/L			1172.690181	0.004
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Manganese	2.9	ug/L			3318.468856	0.001
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Manganese	2	ug/L			3830.368926	0.001
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Manganese	2.1	ug/L			4024.212371	0.001
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Manganese	2.4	ug/L			3908.888322	0.001
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Manganese	2	ug/L	I		4523.88566	0.000
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	10/29/2009	Recovered Water	Manganese	3.1	ug/L			2686.248868	0.001
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	EXKR-1	11/19/2009	Recovered Water	Manganese	6	ug/L	U		3410.466267	0.002
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Manganese	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	EXKR-1	12/22/2009	Recovered Water	Manganese	6	ug/L	U		3920.582968	0.002
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	12/29/2009	Recovered Water	Manganese	6	ug/L	U	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	4049.550041	0.001
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	EXKR-1	12/29/2009	Recovered Water	Manganese	6	ug/L	U	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	4049.550041	0.001
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	1/4/2011	Recovered Water	Manganese	13	ug/L			2999.666368	0.004
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	2/23/2011	Recovered Water	Manganese	3	ug/L	U			
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	3/9/2011	Recovered Water	Manganese	1.6	ug/L	I		3224.004675	0.000
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Manganese	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Manganese	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Manganese	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Manganese	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Manganese	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/8/2013	Recovered Water	Manganese	32	ug/L			2234.772729	0.014
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Manganese	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Manganese	Null	ug/L				

Total Hardness	pH	Ca	Mg
93.3886	7.3	28	5.7
86.7474	7.22	26	5.3
55.5357	7.72	4.1	11
181.495	7.85	43	18
213.694	7.88	46	24
226.048	7.85	46	27
218.688	7.83	48	24
258.247	8.03	49	33
219.433		45	26
227.669		45	28
227.669		45	28
161.781		45	12
		nd	nd
175.625		39	19
188.855		41	21

Toxicity Data															Water Quality - Metals										
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Mercury (Ultrace)	1.25	ng/L			12	0.104
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Mercury (Ultrace)	1.22	ng/L			12	0.102
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Mercury (Ultrace)	Null	ng/L		Changed original well name from POD-SW.	12	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Mercury (Ultrace)	0.29	ng/L	I	Changed original well name from POD-SW.	12	0.024
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Mercury (Ultrace)	0.15	ng/L		Changed original well name from POD-SW.	12	0.013
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Mercury (Ultrace)	0.15	ng/L	U	Changed original well name from POD-SW.	12	0.013
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Mercury (Ultrace)	0.15	ng/L	U	Changed original well name from POD-SW.	12	0.013
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Mercury (Ultrace)	0.15	ng/L	U	Changed original well name from POD-SW.	12	0.013
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Mercury (Ultrace)	Null	ng/L			12	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Mercury (Ultrace)	0.16	ng/L	I		12	0.013
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Mercury (Ultrace)	0.15	ng/L	U		12	0.013
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Mercury (Ultrace)	0.15	ng/L	U		12	0.013
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Mercury (Ultrace)	0.15	ng/L	U	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	12	0.013
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Mercury (Ultrace)	0.15	ng/L	U	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	12	0.013
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Mercury (Ultrace)	0.19	ng/L	I		12	0.016
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Mercury (Ultrace)	0.15	ng/L	U		12	0.013
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/10/2011	Cascade Aerator-Base	Mercury (Ultrace)	0.15	ng/L	U		12	0.013
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/25/2011	Cascade Aerator-Base	Mercury (Ultrace)	0.68	ng/L	U		12	0.057
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/7/2011	Cascade Aerator-Base	Mercury (Ultrace)	0.15	ng/L	U		12	0.013
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Mercury (Ultrace)	0.16	ng/L	U		12	0.013
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Mercury (Ultrace)	0.15	ng/L	U		12	0.013
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/6/2013	Recovered Water	Mercury (Ultrace)	0.15	ng/L	U		12	0.013
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Mercury (Ultrace)	0.15	ng/L	U		12	0.013
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Mercury (Ultrace)	0.15	ng/L	U		12	0.013
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Mercury (Ultrace)	0.15	ng/L	U		12	0.013

Toxicity Data															Water Quality - Metals										
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Methyl Mercury	0.024	ng/L	I		2.8	0.009
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Methyl Mercury	0.063	ng/L			2.8	0.023
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Methyl Mercury	0.02	ng/L	U		2.8	0.007
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Methyl Mercury	0.02	ng/L	U	Changed Well from POD-SW	2.8	0.007
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Methyl Mercury	0.02	ng/L	U	Changed Well from POD-SW	2.8	0.007
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Methyl Mercury	0.02	ng/L	U	Changed Well from POD-SW	2.8	0.007
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Methyl Mercury	0.02	ng/L	U	Changed Well from POD-SW	2.8	0.007
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Methyl Mercury	0.021	ng/L	U	Changed Well from POD-SW	2.8	0.008
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Methyl Mercury	Null	ng/L			2.8	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Methyl Mercury	0.02	ng/L	U		2.8	0.007
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Methyl Mercury	0.02	ng/L	U		2.8	0.007
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Methyl Mercury	0.02	ng/L	U		2.8	0.007
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Methyl Mercury	0.019	ng/L	U	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	2.8	0.007
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Methyl Mercury	0.019	ng/L	U	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	2.8	0.007
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Methyl Mercury	0.022	ng/L	I		2.8	0.008
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/24/2011	Cascade Aerator-Base	Methyl Mercury	0.02	ng/L	U		2.8	0.007
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/10/2011	Cascade Aerator-Base	Methyl Mercury	0.054	ng/L			2.8	0.019
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Methyl Mercury	0.02	ng/L	U		2.8	0.007
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Methyl Mercury	0.025	ng/L	I		2.8	0.009
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Methyl Mercury	0.02	ng/L	U		2.8	0.007
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Methyl Mercury	0.02	ng/L	U		2.8	0.007
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/6/2013	Recovered Water	Methyl Mercury	0.02	ng/L	U		2.8	0.007
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Methyl Mercury	0.019	ng/L	U		2.8	0.007
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Methyl Mercury	0.02	ng/L	U		2.8	0.007
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Methyl Mercury	0.02	ng/L	U		2.8	0.007

Toxicity Data															Water Quality - Metals										
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Molybdenum	1.4	ug/L			3200	0.000
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Molybdenum	1.4	ug/L	I		3200	0.000
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Molybdenum	330	ug/L			3200	0.103
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Molybdenum	230	ug/L			3200	0.072
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Molybdenum	190	ug/L			3200	0.059
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Molybdenum	130	ug/L			3200	0.041
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Molybdenum	92	ug/L			3200	0.029
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Molybdenum	78	ug/L			3200	0.024
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Molybdenum	Null	ug/L			3200	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Molybdenum	Null	ug/L			3200	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Molybdenum	Null	ug/L			3200	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Molybdenum	Null	ug/L			3200	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Molybdenum	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	3200	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Molybdenum	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	3200	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Molybdenum	Null	ug/L			3200	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Molybdenum	Null	ug/L			3200	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	3/22/2011	Recovered Water	Molybdenum	39	ug/L			3200	0.012
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	EXKR-1	5/3/2011	Recovered Water	Molybdenum	35	ug/L			3200	0.011
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	6/2/2011	Recovered Water	Molybdenum	32	ug/L			3200	0.010
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Molybdenum	44	ug/L			3200	0.014
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Molybdenum	37	ug/L			3200	0.012
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Molybdenum	29	ug/L			3200	0.009
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/10/2013	Recovered Water	Molybdenum	28	ug/L			3200	0.009
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Molybdenum	26	ug/L			3200	0.008
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Molybdenum	22	ug/L			3200	0.007

Toxicity Data / **Water Quality - Metals**

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea) *Acute survival test (LC50)*	C. leedsi 96-hr (Bannerfin Shiner) *Acute survival test (LC50)*	Ceriodaphnia dubia 7-day (Water Flea) *Reproduction test (NOEC/IC25)*	Ceriodaphnia dubia 7-day (Water Flea) *Survival test (NOEC)*	Daphnia magna 21-day (Water Flea) *Chronic reproduction test (NOEC/ IC25)*	Daphnia magna 21-day (Water Flea) *Chronic survival test (NOEC)*	FETAX (Frog – Xenopus) *Growth sig. diff. from control*	FETAX (Frog – Xenopus) *Malformation sig. from. than control*	FETAX (Frog – Xenopus) *Mortality sig. diff. from control*	Pimephales promelas 7-day (Fathead Minnow) *Embryo-larval survival and teratogenesis test (NOEC)*	Selenastrum capricornutum 96-hr (Green Algae) *96-hr growth test (NOEC)*	Toxicity *yes/no*	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ	Total Hardness	pH	Ca	Mg
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Nickel	1.2	ug/L			49.23017816	0.024	93.3886	7.3	28	5.7
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Nickel	0.79	ug/L			46.25170732	0.017	86.7474	7.22	26	5.3
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Nickel	3.7	ug/L			31.71545319	0.117	55.5357	7.72	4.1	11
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Nickel	3.9	ug/L			86.36987767	0.045	181.495	7.85	43	18
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Nickel	3.3	ug/L	V		99.16698457	0.033	213.694	7.88	46	24
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Nickel	3.3	ug/L			103.9959828	0.032	226.048	7.85	46	27
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Nickel	2.3	ug/L	V		101.1241089	0.023	218.688	7.83	48	24
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Nickel	2.1	ug/L			116.397767	0.018	258.247	8.03	49	33
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Nickel	Null	ug/L								
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Nickel	Null	ug/L								
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Nickel	Null	ug/L								
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Nickel	Null	ug/L								
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Nickel	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.						
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Nickel	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.						
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Nickel	Null	ug/L								
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Nickel	Null	ug/L								
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Nickel	Null	ug/L								
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Nickel	Null	ug/L								
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Nickel	Null	ug/L								
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Nickel	Null	ug/L								
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Nickel	Null	ug/L								
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Nickel	Null	ug/L								
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Nickel	Null	ug/L								
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Nickel	Null	ug/L								
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Nickel	Null	ug/L								

Toxicity Data / **Water Quality - Metals**

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea) *Acute survival test (LC50)*	C. leedsi 96-hr (Bannerfin Shiner) *Acute survival test (LC50)*	Ceriodaphnia dubia 7-day (Water Flea) *Reproduction test (NOEC/IC25)*	Ceriodaphnia dubia 7-day (Water Flea) *Survival test (NOEC)*	Daphnia magna 21-day (Water Flea) *Chronic reproduction test (NOEC/ IC25)*	Daphnia magna 21-day (Water Flea) *Chronic survival test (NOEC)*	FETAX (Frog – Xenopus) *Growth sig. diff. from control*	FETAX (Frog – Xenopus) *Malformation sig. from. than control*	FETAX (Frog – Xenopus) *Mortality sig. diff. from control*	Pimephales promelas 7-day (Fathead Minnow) *Embryo-larval survival and teratogenesis test (NOEC)*	Selenastrum capricornutum 96-hr (Green Algae) *96-hr growth test (NOEC)*	Toxicity *yes/no*	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Selenium	1.4	ug/L			5	0.280
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Selenium	0.96	ug/L			5	0.192
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Selenium	0.66	ug/L			5	0.132
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Selenium	1.3	ug/L			5	0.260
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Selenium	0.89	ug/L			5	0.178
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Selenium	1.4	ug/L			5	0.280
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Selenium	0.46	ug/L			5	0.092
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Selenium	1.6	ug/L	V		5	0.320
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Selenium	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Selenium	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Selenium	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Selenium	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Selenium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Selenium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Selenium	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Selenium	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Selenium	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Selenium	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Selenium	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Selenium	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Selenium	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Selenium	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Selenium	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Selenium	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Selenium	Null	ug/L				

Toxicity Data / **Water Quality - Metals**

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea) *Acute survival test (LC50)*	C. leedsi 96-hr (Bannerfin Shiner) *Acute survival test (LC50)*	Ceriodaphnia dubia 7-day (Water Flea) *Reproduction test (NOEC/IC25)*	Ceriodaphnia dubia 7-day (Water Flea) *Survival test (NOEC)*	Daphnia magna 21-day (Water Flea) *Chronic reproduction test (NOEC/ IC25)*	Daphnia magna 21-day (Water Flea) *Chronic survival test (NOEC)*	FETAX (Frog – Xenopus) *Growth sig. diff. from control*	FETAX (Frog – Xenopus) *Malformation sig. from. than control*	FETAX (Frog – Xenopus) *Mortality sig. diff. from control*	Pimephales promelas 7-day (Fathead Minnow) *Embryo-larval survival and teratogenesis test (NOEC)*	Selenastrum capricornutum 96-hr (Green Algae) *96-hr growth test (NOEC)*	Toxicity *yes/no*	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Strontium	460	ug/L			36000	0.013
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Strontium	400	ug/L			36000	0.011
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Strontium	2500	ug/L			36000	0.069
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Strontium	6000	ug/L			36000	0.167
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Strontium	8500	ug/L			36000	0.236
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Strontium	12000	ug/L			36000	0.333
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Strontium	11000	ug/L			36000	0.306
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Strontium	15000	ug/L			36000	0.417
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Strontium	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Strontium	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Strontium	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Strontium	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Strontium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Strontium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Strontium	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Strontium	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Strontium	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Strontium	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Strontium	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Strontium	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Strontium	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Strontium	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Strontium	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Strontium	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Strontium	Null	ug/L				

Toxicity Data															Water Quality - Metals									
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Uranium	0.327	ug/L	U		2.6	0.126
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Uranium	0.264	ug/L	U		2.6	0.102
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Uranium	0.759	ug/L	J		2.6	0.292
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Uranium	1.06	ug/L			2.6	0.408
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Uranium	0.493	ug/L	J		2.6	0.190
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Uranium	0.466	ug/L	J		2.6	0.179
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Uranium	0.386	ug/L	U		2.6	0.148
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Uranium	1.2	ug/L			2.6	0.462
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Uranium	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Uranium	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Uranium	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Uranium	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Uranium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Uranium	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Uranium	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Uranium	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Uranium	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Uranium	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Uranium	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Uranium	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Uranium	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Uranium	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Uranium	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Uranium	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Uranium	Null	ug/L				

Toxicity Data															Water Quality - Metals									
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Zinc	7.7	ug/L	I		113.0697192	0.068
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Zinc	6	ug/L	I		106.2187109	0.056
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Zinc	6.9	ug/L			72.79346453	0.095
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Zinc	5.1	ug/L	I		198.5419819	0.026
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Zinc	7.8	ug/L			228.0076203	0.034
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Zinc	5.2	ug/L	I		239.1280645	0.022
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Zinc	4.3	ug/L	U		232.5144802	0.018
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Zinc	4.3	ug/L			267.6910302	0.016
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Zinc	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Zinc	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Zinc	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Zinc	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Zinc	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Zinc	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Zinc	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Zinc	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Zinc	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Zinc	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Zinc	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Zinc	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Zinc	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Zinc	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Zinc	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Zinc	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Zinc	Null	ug/L				

Total Hardness	pH	Ca	Mg
93.3886	7.3	28	5.7
86.7474	7.22	26	5.3
55.5357	7.72	4.1	11
181.495	7.85	43	18
213.694	7.88	46	24
226.048	7.85	46	27
218.688	7.83	48	24
258.247	8.03	49	33

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes		
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									criteria	HQ
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Bromide	88	ug/L			1000	0.088
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Bromide	91	ug/L			1000	0.091
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Bromide	210	ug/L			1000	0.210
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Bromide	380	ug/L			1000	0.380
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Bromide	480	ug/L			1000	0.480
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Bromide	550	ug/L			1000	0.550
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Bromide	630	ug/L			1000	0.630
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Bromide	670	ug/L			1000	0.670
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Bromide	Null	ug/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Bromide	Null	ug/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Bromide	Null	ug/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Bromide	Null	ug/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Bromide	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Bromide	Null	ug/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Bromide	Null	ug/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Bromide	Null	ug/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Bromide	Null	ug/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Bromide	Null	ug/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Bromide	Null	ug/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Bromide	Null	ug/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Bromide	Null	ug/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Bromide	Null	ug/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Bromide	Null	ug/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/8/2013	Recovered Water	Bromide	Null	ug/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Bromide	Null	ug/L				

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes		
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									criteria	HQ
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Calcium	28	mg/L			116	0.241
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Calcium	26	mg/L			116	0.224
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Calcium	4.1	mg/L			116	0.035
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Calcium	43	mg/L			116	0.371
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Calcium	46	mg/L			116	0.397
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Calcium	46	mg/L			116	0.397
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Calcium	48	mg/L			116	0.414
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Calcium	49	mg/L			116	0.422
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	10/29/2009	Recovered Water	Calcium	39	mg/L			116	0.336
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	EXKR-1	11/19/2009	Recovered Water	Calcium	42	mg/L			116	0.362
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	12/10/2009	Recovered Water	Calcium	46	mg/L			116	0.397
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	EXKR-1	12/22/2009	Recovered Water	Calcium	45	mg/L			116	0.388
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	12/29/2009	Recovered Water	Calcium	45	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	116	0.388
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	EXKR-1	12/29/2009	Recovered Water	Calcium	45	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	116	0.388
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	1/4/2011	Recovered Water	Calcium	45	mg/L			116	0.388
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	2/9/2011	Recovered Water	Calcium	37	mg/L			116	0.319
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	3/22/2011	Recovered Water	Calcium	40	mg/L			116	0.345
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	EXKR-1	5/25/2011	Recovered Water	Calcium	44	mg/L			116	0.379
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	6/7/2011	Recovered Water	Calcium	45	mg/L			116	0.388
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Calcium	33	mg/L			116	0.284
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Calcium	37	mg/L			116	0.319
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Calcium	36	mg/L			116	0.310
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/12/2013	Recovered Water	Calcium	41	mg/L			116	0.353
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/8/2013	Recovered Water	Calcium	41	mg/L			116	0.353
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Calcium	43	mg/L			116	0.371

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes		
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									criteria	HQ
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Chloride	39	mg/L			150	0.260
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Chloride	25	mg/L			150	0.167
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Chloride	70	mg/L		Changed Well from POD-SW	150	0.467
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Chloride	94	mg/L		Changed Well from POD-SW	150	0.627
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Chloride	150	mg/L		Changed Well from POD-SW	150	1.000
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Chloride	160	mg/L		Changed Well from POD-SW	150	1.067
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Chloride	190	mg/L		Changed Well from POD-SW	150	1.267
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Chloride	200	mg/L		Changed Well from POD-SW	150	1.333
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Chloride	65	mg/L			150	0.433
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Chloride	110	mg/L			150	0.733
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Chloride	160	mg/L			150	1.067
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Chloride	180	mg/L			150	1.200
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Chloride	190	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	150	1.267
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Chloride	190	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	150	1.267
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/27/2011	Cascade Aerator-Base	Chloride	80	mg/L			150	0.533
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/24/2011	Cascade Aerator-Base	Chloride	100	mg/L			150	0.667
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/30/2011	Cascade Aerator-Base	Chloride	140	mg/L			150	0.933
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/16/2011	Cascade Aerator-Base	Chloride	160	mg/L			150	1.067
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/13/2011	Cascade Aerator-Base	Chloride	180	mg/L			150	1.200
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Chloride	62	mg/L			150	0.413
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Chloride	90	mg/L			150	0.600
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Chloride	100	mg/L			150	0.667
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/10/2013	Recovered Water	Chloride	300	mg/L			150	2.000
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Chloride	130	mg/L			150	0.867
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Chloride	160	mg/L			150	1.067

		Toxicity Data													Water Quality - Physcial Chemistry								Notes		
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag		criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Fluoride	0.091	mg/L	I		10	0.009
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Fluoride	0.1	mg/L	I		10	0.010
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Fluoride	0.27	mg/L			10	0.027
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Fluoride	0.29	mg/L			10	0.029
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Fluoride	0.33	mg/L			10	0.033
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Fluoride	0.35	mg/L			10	0.035
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Fluoride	0.38	mg/L			10	0.038
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Fluoride	0.4	mg/L			10	0.040
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Fluoride	Null	mg/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Fluoride	Null	mg/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Fluoride	Null	mg/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Fluoride	Null	mg/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Fluoride	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Fluoride	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Fluoride	Null	mg/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Fluoride	Null	mg/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Fluoride	Null	mg/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Fluoride	Null	mg/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Fluoride	Null	mg/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Fluoride	Null	mg/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Fluoride	Null	mg/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Fluoride	Null	mg/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Fluoride	Null	mg/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Fluoride	Null	mg/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Fluoride	Null	mg/L				

		Toxicity Data													Water Quality - Physcial Chemistry								Notes		
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag		criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Magnesium	5.7	mg/L			820	0.007
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Magnesium	5.3	mg/L			820	0.006
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Magnesium	11	mg/L			820	0.013
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Magnesium	18	mg/L			820	0.022
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Magnesium	24	mg/L			820	0.029
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Magnesium	27	mg/L			820	0.033
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Magnesium	24	mg/L			820	0.029
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Magnesium	33	mg/L			820	0.040
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	10/29/2009	Recovered Water	Magnesium	11	mg/L			820	0.013
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	EXKR-1	11/19/2009	Recovered Water	Magnesium	20	mg/L			820	0.024
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	12/10/2009	Recovered Water	Magnesium	25	mg/L			820	0.030
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	EXKR-1	12/22/2009	Recovered Water	Magnesium	26	mg/L			820	0.032
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	12/29/2009	Recovered Water	Magnesium	28	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	820	0.034
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	EXKR-1	12/29/2009	Recovered Water	Magnesium	28	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	820	0.034
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	1/27/2011	Recovered Water	Magnesium	14	mg/L			820	0.017
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	2/9/2011	Recovered Water	Magnesium	16	mg/L			820	0.020
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	3/30/2011	Recovered Water	Magnesium	21	mg/L			820	0.026
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	EXKR-1	5/18/2011	Recovered Water	Magnesium	39	mg/L			820	0.048
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	6/2/2011	Recovered Water	Magnesium	27	mg/L			820	0.033
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Magnesium	13	mg/L			820	0.016
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Magnesium	16	mg/L			820	0.020
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Magnesium	16	mg/L			820	0.020
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/10/2013	Recovered Water	Magnesium	22	mg/L			820	0.027
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Magnesium	23	mg/L			820	0.028
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Magnesium	25	mg/L			820	0.030

		Toxicity Data													Water Quality - Physcial Chemistry								Notes		
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag		criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Potassium	3.7	mg/L			53	0.070
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Potassium	3.7	mg/L			53	0.070
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Potassium	4.8	mg/L			53	0.091
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Potassium	6	mg/L			53	0.113
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Potassium	6.1	mg/L			53	0.115
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Potassium	6.9	mg/L			53	0.130
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Potassium	7.6	mg/L			53	0.143
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Potassium	7.1	mg/L			53	0.134
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	10/29/2009	Recovered Water	Potassium	4	mg/L			53	0.075
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	EXKR-1	11/19/2009	Recovered Water	Potassium	5.9	mg/L			53	0.111
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	12/10/2009	Recovered Water	Potassium	6.6	mg/L			53	0.125
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	EXKR-1	12/22/2009	Recovered Water	Potassium	7	mg/L			53	0.132
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	12/29/2009	Recovered Water	Potassium	7.2	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	53	0.136
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	EXKR-1	12/29/2009	Recovered Water	Potassium	7.2	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	53	0.136
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	1/27/2011	Recovered Water	Potassium	5.5	mg/L			53	0.104
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	2/16/2011	Recovered Water	Potassium	5.6	mg/L			53	0.106
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	3/22/2011	Recovered Water	Potassium	6.4	mg/L			53	0.121
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	EXKR-1	5/18/2011	Recovered Water	Potassium	8.6	mg/L			53	0.162
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	6/15/2011	Recovered Water	Potassium	6.9	mg/L			53	0.130
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Potassium	4.2	mg/L			53	0.079
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Potassium	5.3	mg/L			53	0.100
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Potassium	4.9	mg/L			53	0.092
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/10/2013	Recovered Water	Potassium	5.8	mg/L			53	0.109
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Potassium	6.1	mg/L			53	0.115
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Potassium	6.3	mg/L			53	0.119

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes		
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									criteria	HQ
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Silica	1.3	mg/L				nc	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Silica	0.9	mg/L				nc	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Silica	2	mg/L				nc	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Silica	3.3	mg/L				nc	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Silica	4.3	mg/L				nc	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Silica	4.3	mg/L				nc	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Silica	4.7	mg/L				nc	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Silica	5.1	mg/L				nc	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Silica	Null	mg/L					
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Silica	Null	mg/L					
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Silica	Null	mg/L					
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Silica	Null	mg/L					
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Silica	Null	mg/L				Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Silica	Null	mg/L				Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Silica	Null	mg/L					
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Silica	Null	mg/L					
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Silica	Null	mg/L					
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Silica	Null	mg/L					
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Silica	Null	mg/L					
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Silica	Null	mg/L					
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Silica	Null	mg/L					
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Silica	Null	mg/L					
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Silica	Null	mg/L					
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Silica	Null	mg/L					
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Silica	Null	mg/L					

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes		
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									criteria	HQ
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Sodium	20	mg/L				680	0.029
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Sodium	18	mg/L				680	0.026
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Sodium	39	mg/L				680	0.057
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Sodium	70	mg/L				680	0.103
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Sodium	85	mg/L				680	0.125
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Sodium	99	mg/L				680	0.146
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Sodium	100	mg/L				680	0.147
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Sodium	130	mg/L				680	0.191
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	10/29/2009	Recovered Water	Sodium	33	mg/L				680	0.049
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	EXKR-1	11/19/2009	Recovered Water	Sodium	71	mg/L				680	0.104
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	12/10/2009	Recovered Water	Sodium	91	mg/L				680	0.134
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	EXKR-1	12/22/2009	Recovered Water	Sodium	97	mg/L				680	0.143
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	12/29/2009	Recovered Water	Sodium	100	mg/L				680	0.147
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	EXKR-1	12/29/2009	Recovered Water	Sodium	100	mg/L				680	0.147
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	1/27/2011	Recovered Water	Sodium	52	mg/L				680	0.076
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	2/23/2011	Recovered Water	Sodium	66	mg/L				680	0.097
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	3/30/2011	Recovered Water	Sodium	77	mg/L				680	0.113
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	EXKR-1	5/18/2011	Recovered Water	Sodium	140	mg/L				680	0.206
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	6/7/2011	Recovered Water	Sodium	100	mg/L				680	0.147
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Sodium	38	mg/L				680	0.056
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Sodium	57	mg/L				680	0.084
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Sodium	57	mg/L				680	0.084
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/12/2013	Recovered Water	Sodium	85	mg/L				680	0.125
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Sodium	88	mg/L				680	0.129
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Sodium	90	mg/L				680	0.132

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes		
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									criteria	HQ
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Sulfate	17	mg/L				370	0.046
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Sulfate	43	mg/L				370	0.116
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Sulfate	61	mg/L		Changed Well from POD-SW		370	0.165
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Sulfate	95	mg/L		Changed Well from POD-SW		370	0.257
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Sulfate	120	mg/L				370	0.324
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Sulfate	130	mg/L		Changed Well from POD-SW		370	0.351
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Sulfate	160	mg/L		Changed Well from POD-SW		370	0.432
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Sulfate	160	mg/L		Changed Well from POD-SW		370	0.432
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Sulfate	25	mg/L				370	0.068
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Sulfate	91	mg/L				370	0.246
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Sulfate	120	mg/L				370	0.324
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Sulfate	140	mg/L				370	0.378
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Sulfate	140	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		370	0.378
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Sulfate	140	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		370	0.378
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/27/2011	Cascade Aerator-Base	Sulfate	68	mg/L				370	0.184
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/16/2011	Cascade Aerator-Base	Sulfate	91	mg/L				370	0.246
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/22/2011	Cascade Aerator-Base	Sulfate	110	mg/L				370	0.297
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/25/2011	Cascade Aerator-Base	Sulfate	140	mg/L				370	0.378
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/13/2011	Cascade Aerator-Base	Sulfate	150	mg/L				370	0.405
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Sulfate	54	mg/L				370	0.146
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Sulfate	77	mg/L				370	0.208
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Sulfate	86	mg/L				370	0.232
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/10/2013	Recovered Water	Sulfate	250	mg/L				370	0.676
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/8/2013	Recovered Water	Sulfate	110	mg/L				370	0.297
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Sulfate	120	mg/L				370	0.324

Toxicity Data — Water Quality - Physcial Chemistry

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Sulfide	1	mg/L	U		2	0.500
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Sulfide	1	mg/L	U		2	0.500
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Sulfide	1	mg/L	U		2	0.500
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Sulfide	1	mg/L	U		2	0.500
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Sulfide	1	mg/L	U		2	0.500
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Sulfide	0.055	mg/L			2	0.028
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Sulfide	0.12	mg/L			2	0.060
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Sulfide	0.007	mg/L	U<		2	0.004
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Sulfide	0.045	mg/L			2	0.023
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Sulfide	0.22	mg/L			2	0.110
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Sulfide	0.23	mg/L			2	0.115
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Sulfide	0.54	mg/L			2	0.270
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Sulfide	0.54	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	2	0.270
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Sulfide	0.54	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	2	0.270
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/17/2011	Cascade Aerator-Base	Sulfide	0.46	mg/L			2	0.230
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/24/2011	Cascade Aerator-Base	Sulfide	0.55	mg/L			2	0.275
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/16/2011	Cascade Aerator-Base	Sulfide	0.9	mg/L			2	0.450
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/16/2011	Cascade Aerator-Base	Sulfide	0.8	mg/L			2	0.400
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Sulfide	0.8	mg/L			2	0.400
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Sulfide	0.68	mg/L			2	0.340
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Sulfide	0.84	mg/L			2	0.420
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Sulfide	0.4	mg/L			2	0.200
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/12/2013	Recovered Water	Sulfide	0.9	mg/L			2	0.450
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/8/2013	Recovered Water	Sulfide	0.14	mg/L	U		2	0.070
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Sulfide	0.51	mg/L			2	0.255

Toxicity Data — Water Quality - Physcial Chemistry

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Total Alkalinity	63	mg/L as CaCO3			>20	yes
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Total Alkalinity	64	mg/L as CaCO3			>20	yes
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Total Alkalinity	88	mg/L as CaCO3			>20	yes
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Total Alkalinity	90	mg/L as CaCO3			>20	yes
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Total Alkalinity	89	mg/L as CaCO3			>20	yes
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Total Alkalinity	85	mg/L as CaCO3			>20	yes
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Total Alkalinity	87	mg/L as CaCO3			>20	yes
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Total Alkalinity	88	mg/L as CaCO3			>20	yes
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	10/29/2009	Recovered Water	Total Alkalinity	89	mg/L as CaCO3			>20	yes
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	EXKR-1	11/19/2009	Recovered Water	Total Alkalinity	83	mg/L as CaCO3			>20	yes
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	EXKR-1	12/10/2009	Recovered Water	Total Alkalinity	88	mg/L as CaCO3			>20	yes
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	EXKR-1	12/22/2009	Recovered Water	Total Alkalinity	85	mg/L as CaCO3			>20	yes
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	12/29/2009	Recovered Water	Total Alkalinity	87	mg/L as CaCO3		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	>20	yes
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	EXKR-1	12/29/2009	Recovered Water	Total Alkalinity	87	mg/L as CaCO3		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	>20	yes
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Total Alkalinity	93	mg/L as CaCO3			>20	yes
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Total Alkalinity	66	mg/L as CaCO3			>20	yes
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Total Alkalinity	69	mg/L as CaCO3			>20	yes
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Total Alkalinity	68	mg/L as CaCO3			>20	yes
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/7/2011	Cascade Aerator-Base	Total Alkalinity	78	mg/L as CaCO3			>20	yes
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Total Alkalinity	89	mg/L as CaCO3			>20	yes
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Total Alkalinity	72	mg/L as CaCO3			>20	yes
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Total Alkalinity	77	mg/L as CaCO3			>20	yes
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Total Alkalinity	81	mg/L as CaCO3			>20	yes
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/8/2013	Recovered Water	Total Alkalinity	90	mg/L as CaCO3			>20	yes
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Total Alkalinity	83	mg/L as CaCO3			>20	yes

Toxicity Data — Water Quality - Physcial Chemistry

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Total Cyanide	0.005	mg/L	U		0.0052	1
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Total Cyanide	0.005	mg/L	U		0.0052	1
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Total Cyanide	0.005	mg/L	U		0.0052	1
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Total Cyanide	0.005	mg/L	U		0.0052	1
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Total Cyanide	0.005	mg/L	U		0.0052	1
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Total Cyanide	0.005	mg/L	U		0.0052	1
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Total Cyanide	0.005	mg/L	U		0.0052	1
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Total Cyanide	0.005	mg/L	U		0.0052	1
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Total Cyanide	Null	mg/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Total Cyanide	Null	mg/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Total Cyanide	Null	mg/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Total Cyanide	Null	mg/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Total Cyanide	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Total Cyanide	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Total Cyanide	Null	mg/L				
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Total Cyanide	Null	mg/L				
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Total Cyanide	Null	mg/L				
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Total Cyanide	Null	mg/L				
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Total Cyanide	Null	mg/L				
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Total Cyanide	Null	mg/L				
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Total Cyanide	Null	mg/L				
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Total Cyanide	Null	mg/L				
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Total Cyanide	Null	mg/L				
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Total Cyanide	Null	mg/L				
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Total Cyanide	Null	mg/L				

ph temp criteria

7.48	27.5	2.2
7.92	25.8	1.5
7.89	25.9	1.5
7.79	25.6	1.8
7.74	25.6	1.9
7.53	23.7	2.7
7.93	24.6	1.6
8.03	24.6	1.4
7.98	24.9	1.5
7.85	25	1.7
7.66	25.1	2.1

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data													Water Quality - Physcial Chemistry								
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity										
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	Criteria	HQ
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Dissolved Organic Carbon	14	mg/L			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Dissolved Organic Carbon	14	mg/L			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Dissolved Organic Carbon	8.7	mg/L			NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Dissolved Organic Carbon	5.9	mg/L			NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Dissolved Organic Carbon	4.5	mg/L			NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Dissolved Organic Carbon	3.9	mg/L			NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Dissolved Organic Carbon	3.1	mg/L			NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Dissolved Organic Carbon	2.5	mg/L			NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Dissolved Organic Carbon	11	mg/L			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Dissolved Organic Carbon	6	mg/L			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Dissolved Organic Carbon	4.4	mg/L			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Dissolved Organic Carbon	3.4	mg/L			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Dissolved Organic Carbon	3.2	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Dissolved Organic Carbon	3.2	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Dissolved Organic Carbon	9.6	mg/L			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Dissolved Organic Carbon	6.3	mg/L			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Dissolved Organic Carbon	5.2	mg/L			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Dissolved Organic Carbon	4.3	mg/L			NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/13/2011	Cascade Aerator-Base	Dissolved Organic Carbon	4.5	mg/L			NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Dissolved Organic Carbon	Null	mg/L			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Dissolved Organic Carbon	Null	mg/L			NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Dissolved Organic Carbon	Null	mg/L			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Dissolved Organic Carbon	Null	mg/L			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Dissolved Organic Carbon	Null	mg/L			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Dissolved Organic Carbon	Null	mg/L			NC	

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data													Water Quality - Physcial Chemistry								
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity										
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Total Organic Carbon	17	mg/L			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Total Organic Carbon	15	mg/L			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Total Organic Carbon	9.2	mg/L		Changed Well from POD-SW	NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Total Organic Carbon	5.8	mg/L			NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Total Organic Carbon	4.9	mg/L			NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Total Organic Carbon	4.1	mg/L			NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Total Organic Carbon	3.3	mg/L			NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Total Organic Carbon	2.8	mg/L			NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Total Organic Carbon	14	mg/L			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Total Organic Carbon	6.4	mg/L			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Total Organic Carbon	4.4	mg/L			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Total Organic Carbon	3.7	mg/L			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Total Organic Carbon	3.3	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Total Organic Carbon	3.3	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Total Organic Carbon	9.8	mg/L			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/9/2011	Cascade Aerator-Base	Total Organic Carbon	6.2	mg/L			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Total Organic Carbon	5.3	mg/L			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/10/2011	Cascade Aerator-Base	Total Organic Carbon	4.2	mg/L			NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Total Organic Carbon	3.9	mg/L			NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Total Organic Carbon	9.5	mg/L			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/6/2013	Recovered Water	Total Organic Carbon	6.4	mg/L			NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Total Organic Carbon	5.8	mg/L			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Total Organic Carbon	5.5	mg/L			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/8/2013	Recovered Water	Total Organic Carbon	5	mg/L			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Total Organic Carbon	4.1	mg/L			NC	

		Toxicity Data														Water Quality - Physcial Chemistry								criteria	HQ					
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes			ph	temp	30-day average criteria	singel sample	
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*															
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Ammonia	Null	mg/L									
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Ammonia	Null	mg/L									
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Ammonia	Null	mg/L									
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Ammonia	Null	mg/L									
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Ammonia	Null	mg/L									
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Ammonia	Null	mg/L									
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Ammonia	Null	mg/L									
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Ammonia	Null	mg/L									
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Ammonia	Null	mg/L									
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Ammonia	Null	mg/L									
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Ammonia	Null	mg/L									
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Ammonia	Null	mg/L									
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Ammonia	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample							
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Ammonia	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample							
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	1/4/2011	Recovered Water	Ammonia	0.93	mg/L			2.2	0.425571386	7.48	27.5	0.874118919	2.2	Derived from FDEP calculator
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	2/9/2011	Recovered Water	Ammonia	0.24	mg/L			1.5	0.160481423	7.92	25.8	0.598200078	1.5	Derived from FDEP calculator
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	3/2/2011	Recovered Water	Ammonia	0.26	mg/L			1.5	0.168042796	7.89	25.9	0.618889964	1.5	Derived from FDEP calculator
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	EXKR-1	5/12/2011	Recovered Water	Ammonia	0.23	mg/L			1.8	0.128325462	7.79	25.6	0.716927087	1.8	Derived from FDEP calculator
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	6/15/2011	Recovered Water	Ammonia	0.19	mg/L			1.9	0.099879396	7.74	25.6	0.760917697	1.9	Derived from FDEP calculator
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Ammonia	0.67	mg/L			2.7	0.250741164	7.53	23.7	1.068831282	2.7	Derived from FDEP calculator
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Ammonia	0.16	mg/L			1.6	0.100387643	7.93	24.6	0.637528665	1.6	Derived from FDEP calculator
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Ammonia	0.16	mg/L			1.4	0.115748621	8.03	24.6	0.552922354	1.4	Derived from FDEP calculator
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Ammonia	0.19	mg/L			1.5	0.130348964	7.98	24.9	0.58305028	1.5	Derived from FDEP calculator
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Ammonia	0.19	mg/L			1.7	0.109959462	7.85	25	0.691163806	1.7	Derived from FDEP calculator
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Ammonia	0.16	mg/L			2.1	0.074499678	7.66	25.1	0.859064121	2.1	Derived from FDEP calculator

		Toxicity Data														Water Quality - Physcial Chemistry									
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Nitrate N	0.28	mg/L			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Nitrate N	0.22	mg/L			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Nitrate N	0.079	mg/L	J		NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Nitrate N	0.025	mg/L	U		NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Nitrate N	0.025	mg/L	U		NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Nitrate N	0.025	mg/L	U		NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Nitrate N	0.025	mg/L	I		NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Nitrate N	0.025	mg/L	U		NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Nitrate N	Null	mg/L			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Nitrate N	Null	mg/L			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Nitrate N	Null	mg/L			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Nitrate N	Null	mg/L			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Nitrate N	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Nitrate N	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	1/4/2011	Recovered Water	Nitrate N	0.019	mg/L	I		NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/24/2011	Cascade Aerator-Base	Nitrate N	0.015	mg/L	U		NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	3/2/2011	Recovered Water	Nitrate N	0.015	mg/L	U		NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	EXKR-1	5/25/2011	Recovered Water	Nitrate N	0.015	mg/L	U		NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	6/15/2011	Recovered Water	Nitrate N	0.015	mg/L	U		NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Nitrate N	0.015	mg/L	U		NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Nitrate N	0.015	mg/L	U		NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Nitrate N	0.015	mg/L	N		NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/10/2013	Recovered Water	Nitrate N	0.015	mg/L	U		NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Nitrate N	0.015	mg/L	U		NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Nitrate N	0.069	mg/L			NC	

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes	criteria	HQ
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity										
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Nitrite N	0.01	mg/L	U		0.02	0.5
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Nitrite N	0.01	mg/L	U		0.02	0.5
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Nitrite N	0.01	mg/L	U		0.02	0.5
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Nitrite N	0.012	mg/L	I		0.02	0.6
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Nitrite N	0.01	mg/L	I		0.02	0.5
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Nitrite N	0.01	mg/L	U		0.02	0.5
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Nitrite N	0.01	mg/L	U		0.02	0.5
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Nitrite N	0.01	mg/L	U		0.02	0.5
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Nitrite N	Null	mg/L				
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Nitrite N	Null	mg/L				
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Nitrite N	Null	mg/L				
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Nitrite N	Null	mg/L				
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Nitrite N	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample		
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Nitrite N	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample		
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	1/4/2011	Recovered Water	Nitrite N	0.015	mg/L	U		0.02	0.75
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/24/2011	Cascade Aerator-Base	Nitrite N	0.015	mg/L	U		0.02	0.75
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	3/9/2011	Recovered Water	Nitrite N	0.015	mg/L	U		0.02	0.75
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	EXKR-1	5/18/2011	Recovered Water	Nitrite N	0.015	mg/L	U		0.02	0.75
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	6/2/2011	Recovered Water	Nitrite N	0.015	mg/L	U		0.02	0.75
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Nitrite N	0.015	mg/L	U		0.02	0.75
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Nitrite N	0.015	mg/L	U		0.02	0.75
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Nitrite N	0.015	mg/L	N		0.02	0.75
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Nitrite N	0.015	mg/L	U		0.02	0.75
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/8/2013	Recovered Water	Nitrite N	0.015	mg/L	U		0.02	0.75
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Nitrite N	0.025	mg/L	U		0.02	1.25

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes	criteria	HQ
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity										
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Nitrogen - Organic	Null	mg/L			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Nitrogen - Organic	Null	mg/L			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Nitrogen - Organic	Null	mg/L			NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Nitrogen - Organic	Null	mg/L			NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Nitrogen - Organic	Null	mg/L			NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Nitrogen - Organic	Null	mg/L			NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Nitrogen - Organic	Null	mg/L			NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Nitrogen - Organic	Null	mg/L			NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Nitrogen - Organic	Null	mg/L			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Nitrogen - Organic	Null	mg/L			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Nitrogen - Organic	Null	mg/L			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Nitrogen - Organic	Null	mg/L			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Nitrogen - Organic	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Nitrogen - Organic	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Nitrogen - Organic	Null	mg/L			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Nitrogen - Organic	Null	mg/L			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Nitrogen - Organic	Null	mg/L			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Nitrogen - Organic	Null	mg/L			NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Nitrogen - Organic	Null	mg/L			NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Nitrogen - Organic	0.29	mg/L			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Nitrogen - Organic	Null	mg/L			NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Nitrogen - Organic	Null	mg/L			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Nitrogen - Organic	0.31	mg/L			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Nitrogen - Organic	Null	mg/L			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Nitrogen - Organic	Null	mg/L			NC	

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes	criteria	HQ
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Ortho-Phosphorus as P	Null	mg/L			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Ortho-Phosphorus as P	Null	mg/L			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Ortho-Phosphorus as P	Null	mg/L			NC	
2	SF2-2-2009	RCV	November 22, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Ortho-Phosphorus as P	Null	mg/L			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Ortho-Phosphorus as P	Null	mg/L			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/29/2009	Discharged Water	Ortho-Phosphorus as P	Null	mg/L			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	12/29/2009	Discharged Water	Ortho-Phosphorus as P	Null	mg/L			NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Ortho-Phosphorus as P	Null	mg/L			NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/17/2011	Cascade Aerator-Base	Ortho-Phosphorus as P	Null	mg/L			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Ortho-Phosphorus as P	Null	mg/L			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/16/2011	Cascade Aerator-Base	Ortho-Phosphorus as P	Null	mg/L			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Ortho-Phosphorus as P	Null	mg/L			NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/7/2011	Cascade Aerator-Base	Ortho-Phosphorus as P	Null	mg/L			NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
4	SF4-3-2013	RCV	Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Ortho-Phosphorus as P	Null	mg/L			NC	

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes	criteria	HQ
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Phosphorus, Total as P	0.04	mg/L			1	0.04
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Phosphorus, Total as P	0.036	mg/L	J		1	0.036
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Phosphorus, Total as P	0.016	mg/L		Changed Well from POD-SW	1	0.016
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Phosphorus, Total as P	0.004	mg/L	U	Changed Well from POD-SW	1	0.004
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Phosphorus, Total as P	0.0048	mg/L	I		1	0.0048
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Phosphorus, Total as P	0.0083	mg/L	I	Changed Well from POD-SW	1	0.0083
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Phosphorus, Total as P	0.0059	mg/L	I	Changed Well from POD-SW	1	0.0059
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Phosphorus, Total as P	0.0054	mg/L	I	Changed Well from POD-SW	1	0.0054
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Phosphorus, Total as P	0.012	mg/L			1	0.012
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Phosphorus, Total as P	0.0088	mg/L	I		1	0.0088
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Phosphorus, Total as P	0.0076	mg/L	I		1	0.0076
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Phosphorus, Total as P	0.0044	mg/L	U		1	0.0044
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	12/29/2009	Discharged Water	Phosphorus, Total as P	0.009	mg/L	I	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	1	0.009
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Phosphorus, Total as P	0.009	mg/L	I	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	1	0.009
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/17/2011	Cascade Aerator-Base	Phosphorus, Total as P	0.012	mg/L			1	0.012
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Phosphorus, Total as P	0.014	mg/L			1	0.014
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/16/2011	Cascade Aerator-Base	Phosphorus, Total as P	0.078	mg/L	I		1	0.078
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Phosphorus, Total as P	0.011	mg/L			1	0.011
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/7/2011	Cascade Aerator-Base	Phosphorus, Total as P	0.0076	mg/L	I		1	0.0076
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Phosphorus, Total as P	0.052	mg/L			1	0.052
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Phosphorus, Total as P	0.027	mg/L	I		1	0.027
4	SF4-3-2013	RCV	Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Phosphorus, Total as P	0.008	mg/L	I		1	0.008
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Phosphorus, Total as P	0.01	mg/L	I		1	0.01
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Phosphorus, Total as P	0.012	mg/L			1	0.012
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Phosphorus, Total as P	0.012	mg/L			1	0.012

Cycle	ToxID	Phase	Test Initiation Date	Toxicity Data											Water Quality - Physcial Chemistry							Notes	criteria	HQ
				C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag			
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Total Kjeldahl Nitrogen	Null	mg/L			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Total Kjeldahl Nitrogen	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Total Kjeldahl Nitrogen	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	1/4/2011	Recovered Water	Total Kjeldahl Nitrogen	1.5	mg/L			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	2/2/2011	Recovered Water	Total Kjeldahl Nitrogen	0.66	mg/L			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	EXKR-1	3/2/2011	Recovered Water	Total Kjeldahl Nitrogen	0.91	mg/L			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	EXKR-1	5/25/2011	Recovered Water	Total Kjeldahl Nitrogen	0.67	mg/L	IV		NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	6/15/2011	Recovered Water	Total Kjeldahl Nitrogen	0.52	mg/L	I		NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Total Kjeldahl Nitrogen	0.96	mg/L			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Total Kjeldahl Nitrogen	0.7	mg/L			NC	
4	SF4-3-2013	RCV	Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Total Kjeldahl Nitrogen	0.46	mg/L			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/10/2013	Recovered Water	Total Kjeldahl Nitrogen	0.56	mg/L			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/8/2013	Recovered Water	Total Kjeldahl Nitrogen	0.47	mg/L			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Total Kjeldahl Nitrogen	0.96	mg/L			NC	

		Toxicity Data														Water Quality - Field Measurements									
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Color	90	PCU			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Color	80	PCU			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Color	45	PCU		Changed Well from POD-SW	NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Color	15	PCU		Changed Well from POD-SW	NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Color	10	PCU		Changed Well from POD-SW	NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Color	20	PCU		Changed Well from POD-SW	NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Color	5	PCU		Changed Well from POD-SW	NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Color	10	PCU		Changed Well from POD-SW	NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Color	90	PCU			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Color	20	PCU			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Color	20	PCU			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Color	10	PCU			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Color	20	PCU		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Color	20	PCU		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Color	70	PCU			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Color	40	PCU			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/30/2011	Cascade Aerator-Base	Color	40	PCU			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Color	30	PCU			NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/7/2011	Cascade Aerator-Base	Color	15	PCU			NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Color	50	PCU			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Color	40	PCU			NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Color	30	PCU			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/12/2013	Recovered Water	Color	30	PCU			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Color	30	PCU			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Color	30	PCU			NC	

		Toxicity Data														Water Quality - Field Measurements													
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ	time	%sat	Do Sat criteria achieved	
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*														
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Dissolved Oxygen	7.9	mg/L			87.40520998	Yes	10:45	87.40520998	Yes	derived from FDEP calculator
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Dissolved Oxygen	7.23	mg/L			74.97704137	Yes	11:00	74.97704137	Yes	derived from FDEP calculator
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Dissolved Oxygen	8.43	mg/L		Changed Well from POD-SW	92.38015503	Yes	14:25	92.38015503	Yes	derived from FDEP calculator
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Dissolved Oxygen	8.21	mg/L		Changed Well from POD-SW	93.33153382	Yes	12:35	93.33153382	Yes	derived from FDEP calculator
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Dissolved Oxygen	7.92	mg/L		Changed Well from POD-SW	91.89124198	Yes	11:26	91.89124198	Yes	derived from FDEP calculator
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Dissolved Oxygen	8.39	mg/L		Changed Well from POD-SW	98.62088364	Yes	11:40	98.62088364	Yes	derived from FDEP calculator
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Dissolved Oxygen	8.14	mg/L		Changed Well from POD-SW	96.44525174	Yes	11:45	96.44525174	Yes	derived from FDEP calculator
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Dissolved Oxygen	7.21	mg/L		Changed Well from POD-SW	86.07552	Yes	12:35	86.07552	Yes	derived from FDEP calculator
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Dissolved Oxygen	6.59	mg/L			86.93865447	Yes	11:10	86.93865447	Yes	derived from FDEP calculator
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Dissolved Oxygen	7.19	mg/L			91.02389543	Yes	11:29	91.02389543	Yes	derived from FDEP calculator
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Dissolved Oxygen	7.18	mg/L			89.63455271	Yes	10:40	89.63455271	Yes	derived from FDEP calculator
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Dissolved Oxygen	6.62	mg/L			81.91473659	Yes	12:30	81.91473659	Yes	derived from FDEP calculator
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Dissolved Oxygen	7.47	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	92.59538129	Yes	10:53	92.59538129	Yes	derived from FDEP calculator
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Dissolved Oxygen	7.47	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	92.59538129	Yes	10:53	92.59538129	Yes	derived from FDEP calculator
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/21/2011	Cascade Aerator-Base	Dissolved Oxygen	7.38	mg/L			93.74989829	Yes	11:10	93.74989829	Yes	derived from FDEP calculator
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/28/2011	Cascade Aerator-Base	Dissolved Oxygen	7.56	mg/L			93.18898613	Yes	9:45	93.18898613	Yes	derived from FDEP calculator
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Dissolved Oxygen	7.56	mg/L			92.19413541	Yes	11:10	92.19413541	Yes	derived from FDEP calculator
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Dissolved Oxygen	7.6	mg/L			92.21796352	Yes	10:00	92.21796352	Yes	derived from FDEP calculator
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Dissolved Oxygen	7.84	mg/L			95.14701298	Yes	12:30	95.14701298	Yes	derived from FDEP calculator
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Dissolved Oxygen	6.94	mg/L			81.9827591	Yes	13:35	81.9827591	Yes	derived from FDEP calculator
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Dissolved Oxygen	7.25	mg/L			86.77191209	Yes	13:40	86.77191209	Yes	derived from FDEP calculator
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Dissolved Oxygen	6.96	mg/L			83.61077462	Yes	14:00	83.61077462	Yes	derived from FDEP calculator
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/25/2013	Recovered Water	Dissolved Oxygen	7.37	mg/L			89.02866858	Yes	13:20	89.02866858	Yes	derived from FDEP calculator
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/10/2013	Recovered Water	Dissolved Oxygen	7.87	mg/L			95.24407923	Yes	11:50	95.24407923	Yes	derived from FDEP calculator
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Dissolved Oxygen	6.93	mg/L			84.02262221	Yes	14:00	84.02262221	Yes	derived from FDEP calculator

		Toxicity Data														Water Quality - Field Measurements									
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Hardness (calculated)	Null	mg/L			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Hardness (calculated)	Null	mg/L			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Hardness (calculated)	Null	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Hardness (calculated)	Null	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Hardness (calculated)	Null	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Hardness (calculated)	Null	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Hardness (calculated)	Null	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Hardness (calculated)	Null	mg/L		Changed original well name from POD-SW.	NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Hardness (calculated)	Null	mg/L			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Hardness (calculated)	Null	mg/L			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Hardness (calculated)	Null	mg/L			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Hardness (calculated)	Null	mg/L			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Hardness (calculated)	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Hardness (calculated)	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Hardness (calculated)	Null	mg/L			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Hardness (calculated)	Null	mg/L			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Hardness (calculated)	Null	mg/L			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Hardness (calculated)	Null	mg/L			NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Hardness (calculated)	Null	mg/L			NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Hardness (calculated)	130	mg/L			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Hardness (calculated)	160	mg/L			NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Hardness (calculated)	160	mg/L			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Hardness (calculated)	190	mg/L			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/8/2013	Recovered Water	Hardness (calculated)	200	mg/L			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	Hardness (calculated)	210	mg/L			NC	

		Toxicity Data														Water Quality - Field Measurements									
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Oxidation-Reduction Potential	236	mV			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Oxidation-Reduction Potential	265	mV			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Oxidation-Reduction Potential	-100.2	mV		Changed Well from POD-SW	NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Oxidation-Reduction Potential	-100	mV		Changed Well from POD-SW	NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Oxidation-Reduction Potential	-107	mV		Changed Well from POD-SW	NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Oxidation-Reduction Potential	-121	mV		Changed Well from POD-SW	NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Oxidation-Reduction Potential	-101	mV		Changed Well from POD-SW	NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Oxidation-Reduction Potential	69	mV		Changed Well from POD-SW	NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Oxidation-Reduction Potential	-91	mV			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Oxidation-Reduction Potential	-115	mV			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Oxidation-Reduction Potential	-112	mV			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Oxidation-Reduction Potential	-143	mV			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Oxidation-Reduction Potential	-103	mV		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Oxidation-Reduction Potential	-103	mV		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/21/2011	Cascade Aerator-Base	Oxidation-Reduction Potential	-110	mV			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/28/2011	Cascade Aerator-Base	Oxidation-Reduction Potential	-137	mV			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Oxidation-Reduction Potential	-117	mV			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/10/2011	Cascade Aerator-Base	Oxidation-Reduction Potential	-129	mV			NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/7/2011	Cascade Aerator-Base	Oxidation-Reduction Potential	-126	mV			NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Oxidation-Reduction Potential	-146	mV			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Oxidation-Reduction Potential	-150	mV			NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/6/2013	Recovered Water	Oxidation-Reduction Potential	-155	mV			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/27/2013	Recovered Water	Oxidation-Reduction Potential	-129	mV			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Oxidation-Reduction Potential	-184	mV			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Oxidation-Reduction Potential	-127	mV			NC	

		Toxicity Data														Water Quality - Field Measurements									
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ - within the range
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	pH	7.3	Null			6.5 to 8.5	yes
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	pH	7.22	Null			6.5 to 8.5	yes
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	pH	7.95	Null		Changed Well from POD-SW	6.5 to 8.5	yes
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	pH	7.91	Null		Changed Well from POD-SW	6.5 to 8.5	yes
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	pH	7.98	Null		Changed Well from POD-SW	6.5 to 8.5	yes
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	pH	7.94	Null		Changed Well from POD-SW	6.5 to 8.5	yes
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	pH	7.9	Null		Changed Well from POD-SW	6.5 to 8.5	yes
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	pH	7.65	Null		Changed Well from POD-SW	6.5 to 8.5	yes
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	pH	7.79	Null			6.5 to 8.5	yes
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	pH	7.75	Null			6.5 to 8.5	yes
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	pH	8.02	Null			6.5 to 8.5	yes
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	pH	7.98	Null			6.5 to 8.5	yes
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	pH	7.93	Null		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	6.5 to 8.5	yes
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	pH	7.93	Null		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	6.5 to 8.5	yes
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/21/2011	Cascade Aerator-Base	pH	8.03	Null			6.5 to 8.5	yes
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	pH	8.03	Null			6.5 to 8.5	yes
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/22/2011	Cascade Aerator-Base	pH	8.03	Null			6.5 to 8.5	yes
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/16/2011	Cascade Aerator-Base	pH	8	Null			6.5 to 8.5	yes
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	pH	8.02	Null			6.5 to 8.5	yes
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	pH	7.86	Null			6.5 to 8.5	yes
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	pH	8.07	Null			6.5 to 8.5	yes
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	pH	8.03	Null			6.5 to 8.5	yes
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	pH	7.98	Null			6.5 to 8.5	yes
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/10/2013	Recovered Water	pH	7.87	Null			6.5 to 8.5	yes
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/18/2013	Recovered Water	pH	7.89	Null			6.5 to 8.5	yes

Toxicity Data / Water Quality - Field Measurements

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	Acute survival test (LC50)	Reproduction test (NOEC/IC25)	Survival test (NOEC)	Chronic reproduction test (NOEC/ IC25)	Chronic survival test (NOEC)	Growth sig. diff. from control	Malformation sig. from. than control	Mortality sig. diff. from control	Embryo-larval survival and teratogenesis test (NOEC)	96-hr growth test (NOEC)	yes/no										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Specific Conductance	289	uS/cm			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Specific Conductance	282	uS/cm			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Specific Conductance	545	uS/cm		Changed Well from POD-SW	NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Specific Conductance	731	uS/cm		Changed Well from POD-SW	NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Specific Conductance	879	uS/cm		Changed Well from POD-SW	NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Specific Conductance	270	uS/cm		Changed Well from POD-SW	NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Specific Conductance	1069	uS/cm		Changed Well from POD-SW	NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Specific Conductance	1101	uS/cm		Changed Well from POD-SW	NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Specific Conductance	512	uS/cm			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Specific Conductance	723	uS/cm			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Specific Conductance	908	uS/cm			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Specific Conductance	970	uS/cm			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Specific Conductance	1015	uS/cm		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Specific Conductance	1015	uS/cm		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/27/2011	Cascade Aerator-Base	Specific Conductance	547	uS/cm			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/28/2011	Cascade Aerator-Base	Specific Conductance	712	uS/cm			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/22/2011	Cascade Aerator-Base	Specific Conductance	789	uS/cm			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/16/2011	Cascade Aerator-Base	Specific Conductance	959	uS/cm			NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/15/2011	Cascade Aerator-Base	Specific Conductance	1020	uS/cm			NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Specific Conductance	24.2	uS/cm			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Specific Conductance	24.6	uS/cm			NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/8/2013	Recovered Water	Specific Conductance	24.7	uS/cm			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/25/2013	Recovered Water	Specific Conductance	25	uS/cm			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/10/2013	Recovered Water	Specific Conductance	25.1	uS/cm			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/10/2013	Recovered Water	Specific Conductance	25.2	uS/cm			NC	

Toxicity Data / Water Quality - Field Measurements

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	Criteria <90F =	HQ <than
				Acute survival test (LC50)	Acute survival test (LC50)	Reproduction test (NOEC/IC25)	Survival test (NOEC)	Chronic reproduction test (NOEC/ IC25)	Chronic survival test (NOEC)	Growth sig. diff. from control	Malformation sig. from. than control	Mortality sig. diff. from control	Embryo-larval survival and teratogenesis test (NOEC)	96-hr growth test (NOEC)	yes/no										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Temperature	20.26	C			<32.2 C	yes
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Temperature	17.07	C			<32.2 C	yes
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Temperature	19.74	C		Changed original well name from POD-SW.	<32.2 C	yes
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Temperature	21.58	C		Changed original well name from POD-SW.	<32.2 C	yes
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Temperature	22.62	C		Changed original well name from POD-SW.	<32.2 C	yes
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Temperature	23.4	C		Changed original well name from POD-SW.	<32.2 C	yes
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Temperature	23.7	C		Changed original well name from POD-SW.	<32.2 C	yes
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Temperature	24.1	C		Changed original well name from POD-SW.	<32.2 C	yes
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Temperature	29.76	C			<32.2 C	yes
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Temperature	27.38	C			<32.2 C	yes
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Temperature	26.57	C			<32.2 C	yes
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Temperature	26.07	C			<32.2 C	yes
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Temperature	26.16	C		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	<32.2 C	yes
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Temperature	26.16	C		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	<32.2 C	yes
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Temperature	27.6	C			<32.2 C	yes
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Temperature	25.9	C			<32.2 C	yes
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Temperature	25.3	C			<32.2 C	yes
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Temperature	25	C			<32.2 C	yes
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Temperature	25	C			<32.2 C	yes
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Temperature	23.7	C			<32.2 C	yes
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Temperature	24.4	C			<32.2 C	yes
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Temperature	24.6	C			<32.2 C	yes
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Temperature	24.9	C			<32.2 C	yes
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Temperature	25	C			<32.2 C	yes
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Temperature	25.1	C			<32.2 C	yes

Toxicity Data / Water Quality - Field Measurements

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	Acute survival test (LC50)	Reproduction test (NOEC/IC25)	Survival test (NOEC)	Chronic reproduction test (NOEC/ IC25)	Chronic survival test (NOEC)	Growth sig. diff. from control	Malformation sig. from. than control	Mortality sig. diff. from control	Embryo-larval survival and teratogenesis test (NOEC)	96-hr growth test (NOEC)	yes/no										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Total Dissolved Solids	180	mg/L			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Total Dissolved Solids	180	mg/L			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Total Dissolved Solids	290	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Total Dissolved Solids	400	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Total Dissolved Solids	480	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Total Dissolved Solids	520	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Total Dissolved Solids	600	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Total Dissolved Solids	1700	mg/L		Changed original well name from POD-SW.	NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Total Dissolved Solids	330	mg/L			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Total Dissolved Solids	420	mg/L			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Total Dissolved Solids	490	mg/L			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Total Dissolved Solids	540	mg/L			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Total Dissolved Solids	570	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Total Dissolved Solids	570	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Total Dissolved Solids	290	mg/L			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Total Dissolved Solids	340	mg/L			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Total Dissolved Solids	430	mg/L			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Total Dissolved Solids	520	mg/L			NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Total Dissolved Solids	530	mg/L			NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Total Dissolved Solids	300	mg/L			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Total Dissolved Solids	360	mg/L			NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Total Dissolved Solids	400	mg/L			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Total Dissolved Solids	430	mg/L			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Total Dissolved Solids	480	mg/L			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Total Dissolved Solids	540	mg/L			NC	

Toxicity Data / Water Quality - Field Measurements

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	Acute survival test (LC50)	Reproduction test (NOEC/IC25)	Survival test (NOEC)	Chronic reproduction test (NOEC/ IC25)	Chronic survival test (NOEC)	Growth sig. diff. from control	Malformation sig. from. than control	Mortality sig. diff. from control	Embryo-larval survival and teratogenesis test (NOEC)	96-hr growth test (NOEC)	yes/no										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Total Suspended Solids	5	mg/L			NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Total Suspended Solids	5	mg/L			NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Total Suspended Solids	5	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Total Suspended Solids	5	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Total Suspended Solids	Null	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Total Suspended Solids	5	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Total Suspended Solids	Null	mg/L		Changed original well name from POD-SW.	NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Total Suspended Solids	5	mg/L		Changed original well name from POD-SW.	NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Total Suspended Solids	Null	mg/L			NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Total Suspended Solids	Null	mg/L			NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Total Suspended Solids	Null	mg/L			NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Total Suspended Solids	Null	mg/L			NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Total Suspended Solids	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Total Suspended Solids	Null	mg/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Total Suspended Solids	Null	mg/L			NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Total Suspended Solids	5	mg/L			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Total Suspended Solids	10	mg/L			NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Total Suspended Solids	5	mg/L			NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Total Suspended Solids	5	mg/L			NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Total Suspended Solids	5	mg/L			NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Total Suspended Solids	5	mg/L			NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Total Suspended Solids	5	mg/L			NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Total Suspended Solids	5	mg/L			NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Total Suspended Solids	5	mg/L			NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Total Suspended Solids	5	mg/L			NC	

Toxicity Data / Water Quality - Field Measurements

Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Units	Flag	Notes	criteria	HQ less than
				Acute survival test (LC50)	Acute survival test (LC50)	Reproduction test (NOEC/IC25)	Survival test (NOEC)	Chronic reproduction test (NOEC/ IC25)	Chronic survival test (NOEC)	Growth sig. diff. from control	Malformation sig. from. than control	Mortality sig. diff. from control	Embryo-larval survival and teratogenesis test (NOEC)	96-hr growth test (NOEC)	yes/no										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/ >100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Turbidity	2.7	NTU			<29 NTU	yes
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Turbidity	3.26	NTU			<29 NTU	yes
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Turbidity	0.62	NTU		Changed original well name from POD-SW.	<29 NTU	yes
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Turbidity	0.25	NTU		Changed original well name from POD-SW.	<29 NTU	yes
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Turbidity	0.13	NTU		Changed original well name from POD-SW.	<29 NTU	yes
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Turbidity	0.22	NTU		Changed original well name from POD-SW.	<29 NTU	yes
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Turbidity	0.19	NTU		Changed original well name from POD-SW.	<29 NTU	yes
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Turbidity	0.22	NTU		Changed original well name from POD-SW.	<29 NTU	yes
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Turbidity	7.2	NTU			<29 NTU	yes
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Turbidity	0.56	NTU			<29 NTU	yes
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Turbidity	0.41	NTU			<29 NTU	yes
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Turbidity	0.41	NTU			<29 NTU	yes
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Turbidity	0.52	NTU		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	<29 NTU	yes
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Turbidity	0.52	NTU		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	<29 NTU	yes
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Turbidity	1.37	NTU			<29 NTU	yes
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Turbidity	0.33	NTU			<29 NTU	yes
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Turbidity	0.28	NTU			<29 NTU	yes
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Turbidity	0.32	NTU			<29 NTU	yes
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Turbidity	0.69	NTU			<29 NTU	yes
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Turbidity	0.53	NTU			<29 NTU	yes
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Turbidity	1.3	NTU			<29 NTU	yes
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Turbidity	0.56	NTU			<29 NTU	yes
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Turbidity	0.46	NTU			<29 NTU	yes
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Turbidity	0.48	NTU			<29 NTU	yes
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Turbidity	0.59	NTU			<29 NTU	yes

				Toxicity											Water Quality - Radionuclides											
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Total Uncertainty	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/>100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Gross Alpha	1.35	pCi/L	0.95	J		15	0.09
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/>100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Gross Alpha	1.3	pCi/L	1	U		15	0.086666667
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Gross Alpha	3.3	pCi/L			Changed Well from POD-SW	15	0.22
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Gross Alpha	2.9	pCi/L		U		15	0.193333333
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Gross Alpha	2.3	pCi/L		U		15	0.153333333
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/>100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Gross Alpha	5.4	pCi/L				15	0.36
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Gross Alpha	6.9	pCi/L				15	0.46
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Gross Alpha	5.1	pCi/L			Changed Well from POD-SW	15	0.34
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Gross Alpha	3	pCi/L		U		15	0.2
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Gross Alpha	5	pCi/L				15	0.333333333
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/>100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Gross Alpha	8	pCi/L				15	0.533333333
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Gross Alpha	7.3	pCi/L				15	0.486666667
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Gross Alpha	2.5	pCi/L		J	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	15	0.166666667
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Gross Alpha	2.5	pCi/L		J	Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	15	0.166666667
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/21/2011	Cascade Aerator-Base	Gross Alpha	18.2	pCi/L				15	1.213333333
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/24/2011	Cascade Aerator-Base	Gross Alpha	5.1	pCi/L				15	0.34
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/10/2011	Cascade Aerator-Base	Gross Alpha	7.7	pCi/L				15	0.513333333
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/10/2011	Cascade Aerator-Base	Gross Alpha	10.8	pCi/L				15	0.72
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/15/2011	Cascade Aerator-Base	Gross Alpha	8.92	pCi/L		V		15	0.594666667
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/16/2013	Recovered Water	Gross Alpha	2.71	pCi/L		U		15	0.180666667
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/20/2013	Recovered Water	Gross Alpha	2.71	pCi/L		U		15	0.180666667
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Gross Alpha	1.93	pCi/L		U		15	0.128666667
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Gross Alpha	1.42	pCi/L		U		15	0.094666667
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Gross Alpha	Null	pCi/L				15	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Gross Alpha	Null	pCi/L				15	

				Toxicity											Water Quality - Radionuclides											
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Total Uncertainty	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/>100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Ra-226	0.18	pCi/L	0.1	J		NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/>100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Ra-226	0.31	pCi/L	0.18	J		NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Ra-226	1.15	pCi/L				NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Ra-226	1.54	pCi/L				NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Ra-226	1.92	pCi/L				NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/>100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Ra-226	2.22	pCi/L				NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Ra-226	2.79	pCi/L				NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Ra-226	2.35	pCi/L				NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Ra-226	Null	pCi/L				NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Ra-226	Null	pCi/L				NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/>100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Ra-226	Null	pCi/L				NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Ra-226	Null	pCi/L				NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Ra-226	Null	pCi/L			Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Ra-226	Null	pCi/L			Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Ra-226	Null	pCi/L				NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/24/2011	Cascade Aerator-Base	Ra-226	1.47	pCi/L	0.2			NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Ra-226	Null	pCi/L				NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Ra-226	Null	pCi/L				NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Ra-226	Null	pCi/L				NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Ra-226	Null	pCi/L				NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Ra-226	Null	pCi/L				NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Ra-226	Null	pCi/L				NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Ra-226	Null	pCi/L				NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Ra-226	Null	pCi/L				NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Ra-226	Null	pCi/L				NC	

				Toxicity											Water Quality - Radionuclides											
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Total Uncertainty	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/>100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Ra-226 + Ra-228	Null	pCi/L				5	0.122 used RA 226+228 summed values to compare to criteria
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/>100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Ra-226 + Ra-228	Null	pCi/L				5	0.106 used RA 226+228 summed values to compare to criteria
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0.28 used RA 226+228 summed values to compare to criteria
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0.354 used RA 226+228 summed values to compare to criteria
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0.442 used RA 226+228 summed values to compare to criteria
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/>100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0.444 used RA 226+228 summed values to compare to criteria
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0.678 used RA 226+228 summed values to compare to criteria
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0.532 used RA 226+228 summed values to compare to criteria
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/>100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Ra-226 + Ra-228	Null	pCi/L			Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	5	0 used RA 226+228 summed values to compare to criteria
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Ra-226 + Ra-228	Null	pCi/L			Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	5	0 used RA 226+228 summed values to compare to criteria
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Ra-226 + Ra-228	Null	pCi/L				5	0.276 used RA 226+228 summed values to compare to criteria
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Ra-226 + Ra-228	Null	pCi/L				5	0 used RA 226+228 summed values to compare to criteria

				Toxicity											Water Quality - Radionuclides											
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Total Uncertainty	Flag	Notes	criteria	HQ
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*										
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/>100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Ra-228	0.43	pCi/L	0.38	U		NC	
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/>100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Ra-228	0.22	pCi/L	0.42	U		NC	
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	EXKR-1	3/10/2009	Recovered Water	Ra-228	0.25	pCi/L		U		NC	
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	Null	100%	no	EXKR-1	3/17/2009	Recovered Water	Ra-228	0.23	pCi/L		U		NC	
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	EXKR-1	3/24/2009	Recovered Water	Ra-228	0.29	pCi/L		U		NC	
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/>100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	EXKR-1	3/31/2009	Recovered Water	Ra-228	0	pCi/L		U		NC	
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	EXKR-1	4/7/2009	Recovered Water	Ra-228	0.6	pCi/L		J		NC	
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	EXKR-1	4/15/2009	Recovered Water	Ra-228	0.31	pCi/L		U		NC	
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Ra-228	Null	pCi/L				NC	
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Ra-228	Null	pCi/L				NC	
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/>100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Ra-228	Null	pCi/L				NC	
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Ra-228	Null	pCi/L				NC	
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Ra-228	Null	pCi/L			Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Ra-228	Null	pCi/L			Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	NC	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Ra-228	Null	pCi/L				NC	
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/24/2011	Cascade Aerator-Base	Ra-228	-0.09	pCi/L	0.32	U		NC	
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Ra-228	Null	pCi/L				NC	
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Ra-228	Null	pCi/L				NC	
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Ra-228	Null	pCi/L				NC	
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Ra-228	Null	pCi/L				NC	
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Ra-228	Null	pCi/L				NC	
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Ra-228	Null	pCi/L				NC	
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Ra-228	Null	pCi/L				NC	
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Ra-228	Null	pCi/L				NC	
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Ra-228	Null	pCi/L				NC	

				Toxicity											Water Quality - Radionuclides									
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Total Uncertainty	Flag	Notes
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/>100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Uranium-234	Null	pCi/L			
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/>100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Uranium-234	Null	pCi/L			
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Uranium-234	Null	pCi/L			
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Uranium-234	Null	pCi/L			
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Uranium-234	Null	pCi/L			
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Uranium-234	Null	pCi/L			
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Uranium-234	Null	pCi/L			
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Uranium-234	Null	pCi/L			
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Uranium-234	Null	pCi/L			
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Uranium-234	Null	pCi/L			
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Uranium-234	Null	pCi/L			
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Uranium-234	Null	pCi/L			
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Uranium-234	Null	pCi/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Uranium-234	Null	pCi/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Uranium-234	Null	pCi/L			
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Uranium-234	Null	pCi/L			
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Uranium-234	Null	pCi/L			
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Uranium-234	Null	pCi/L			
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Uranium-234	Null	pCi/L			
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Uranium-234	Null	pCi/L			
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Uranium-234	Null	pCi/L			
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Uranium-234	Null	pCi/L			
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Uranium-234	Null	pCi/L			
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Uranium-234	Null	pCi/L			
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Uranium-234	Null	pCi/L			

				Toxicity											Water Quality - Radionuclides									
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Total Uncertainty	Flag	Notes
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/>100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Uranium-235	Null	pCi/L			
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/>100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Uranium-235	Null	pCi/L			
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Uranium-235	Null	pCi/L			
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Uranium-235	Null	pCi/L			
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Uranium-235	Null	pCi/L			
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Uranium-235	Null	pCi/L			
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Uranium-235	Null	pCi/L			
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Uranium-235	Null	pCi/L			
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Uranium-235	Null	pCi/L			
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Uranium-235	Null	pCi/L			
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Uranium-235	Null	pCi/L			
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Uranium-235	Null	pCi/L			
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Uranium-235	Null	pCi/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Uranium-235	Null	pCi/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Uranium-235	Null	pCi/L			
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Uranium-235	Null	pCi/L			
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Uranium-235	Null	pCi/L			
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Uranium-235	Null	pCi/L			
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Uranium-235	Null	pCi/L			
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Uranium-235	Null	pCi/L			
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Uranium-235	Null	pCi/L			
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Uranium-235	Null	pCi/L			
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Uranium-235	Null	pCi/L			
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Uranium-235	Null	pCi/L			
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Uranium-235	Null	pCi/L			

				Toxicity											Water Quality - Radionuclides									
Cycle	ToxID	Phase	Test Initiation Date	C. dubia 96-hr (Water Flea)	C. leedsi 96-hr (Bannerfin Shiner)	Ceriodaphnia dubia 7-day (Water Flea)		Daphnia magna 21-day (Water Flea)		FETAX (Frog – Xenopus)			Pimephales promelas 7-day (Fathead Minnow)	Selenastrum capricornutum 96-hr (Green Algae)	Toxicity	Well	Sample Collection Date	Aquifer or Water Source	Parameter	Result	Unit	Total Uncertainty	Flag	Notes
				Acute survival test (LC50)	*Acute survival test (LC50)*	*Reproduction test (NOEC/IC25)*	*Survival test (NOEC)*	*Chronic reproduction test (NOEC/ IC25)*	*Chronic survival test (NOEC)*	*Growth sig. diff. from control*	*Malformation sig. from. than control*	*Mortality sig. diff. from control*	*Embryo-larval survival and teratogenesis test (NOEC)*	*96-hr growth test (NOEC)*	*yes/no*									
1	SF1-1-2009	RCG1	Jan 13-15, 2009	>100%	>100%	100%/>100%	100%	100%/>100%	100%	No	No	No	>100%	100%	no	EXKR-1	1/14/2009	Surface Water	Uranium-238	Null	pCi/L			
1	SF1-2-2009	RCG1	Feb 2-3, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	25%	yes	EXKR-1	2/4/2009	Surface Water	Uranium-238	Null	pCi/L			
1	SF1-3-2009	Recovered water (RCV)	Mar 10-12, 2009	>100%	>100%	>100%	100%	100%/>100%	100%	No	No	No	Null	100%	no	POD	3/11/2009	Recovered Water	Uranium-238	Null	pCi/L			
1	SF1-4-2009	Recovered water (RCV)	Mar 16-20, 2009	>100%	>100%	100%/>100%	100%	Null	Null	No	No	No	Null	100%	no	POD	3/17/2009	Recovered Water	Uranium-238	Null	pCi/L			
1	SF1-5-2009	Recovered water (RCV)	Mar 23-26, 2009	Null	Null	100%/ IC2595.5%	100%	Null	Null	No	No	No	>100%	100%	yes	POD	3/24/2009	Recovered Water	Uranium-238	Null	pCi/L			
1	SF1-6-2009	Recovered water (RCV)	Mar 31–Apr 2, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	Null	Null	Null	>100%	100%	no	POD	3/31/2009	Recovered Water	Uranium-238	Null	pCi/L			
1	SF1-7-2009	Recovered water (RCV)	April 7, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/7/2009	Recovered Water	Uranium-238	Null	pCi/L			
1	SF1-8-2009	Recovered water (RCV)	April 17, 2009	>100%	>100%	Null	Null	Null	Null	Null	Null	Null	Null	Null	no	POD	4/15/2009	Recovered Water	Uranium-238	Null	pCi/L			
2	SF2-1-2009	RCV	Oct 28-29, 2009	>100%	>100%	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	10/27/2009	Discharged Water	Uranium-238	Null	pCi/L			
2	SF2-2-2009	RCV	Nov 17-19, 2009	>100%	>100%	50% / >100%	100%	Null	Null	Null	Null	Null	>100%	100%	yes	POD	11/17/2009	Discharged Water	Uranium-238	Null	pCi/L			
2	SF2-3-2009	RCV	Dec 7-10, 2009	Null	Null	100%/ >100%	100%	Null	Null	No	No	No	>100%	100%	no	POD	12/8/2009	Discharged Water	Uranium-238	Null	pCi/L			
2	SF2-4-2009	RCV	December 22, 2009	>100%	>100%	50% / IC25 76.4%	Null	Null	Null	Null	Null	Null	Null	Null	yes	POD	12/21/2009	Discharged Water	Uranium-238	Null	pCi/L			
2	SF2-5-2009	RCV	December 31, 2009	Null	Null	Null	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	12/29/2009	Discharged Water	Uranium-238	Null	pCi/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	
2	SF2-6-2010	RCV	Jan 2-4, 2010	>100%	>100%	Null	Null	Null	Null	No	No	No	Null	Null	no	POD	12/29/2009	Discharged Water	Uranium-238	Null	pCi/L		Water quality data from 12/29/2009 matched with both ToxIDs: SF2-5-2009 & SF2-6-2010. No other closer date with data found for January sample.	
3	SF3-1-2011	RCV	Jan-11	>100%	>100%	100% / 100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/4/2011	Cascade Aerator-Base	Uranium-238	Null	pCi/L			
3	SF3-2-2011	RCV	Feb-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	2/2/2011	Cascade Aerator-Base	Uranium-238	Null	pCi/L			
3	SF3-3-2011	RCV	Mar-11	>100%	>100%	No test	Null	Null	Null	Null	Null	Null	No test	Null	no	POD	3/3/2011	Cascade Aerator-Base	Uranium-238	Null	pCi/L			
3	SF3-4-2011	RCV	May-11	83.92%	>100%	IC25 7.2%	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	5/5/2011	Cascade Aerator-Base	Uranium-238	Null	pCi/L			
3	SF3-5-2011	RCV	Jun-11	>100%	>100%	>100%/100%	--	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/2/2011	Cascade Aerator-Base	Uranium-238	Null	pCi/L			
4	SF4-1-2013	RCV	Jan-13	>100%	>100%	>100%/100%	Null	Null	Null	Null	Null	Null	>100%	Null	no	POD	1/3/2013	Recovered Water	Uranium-238	Null	pCi/L			
4	SF4-2-2013	RCV	Feb-13	Null	Null	>100 / IC25 83.9	--	Null	Null	Null	Null	Null	>100%	Null	yes	POD	2/4/2013	Recovered Water	Uranium-238	Null	pCi/L			
4	SF4-3-2013		Mar-13	>100%	>100%	>100% / IC25 76.2	Null	Null	Null	Null	Null	Null	>100%	Null	yes	POD	3/4/2013	Recovered Water	Uranium-238	Null	pCi/L			
4	SF4-4-2013		Apr-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	4/8/2013	Recovered Water	Uranium-238	Null	pCi/L			
4	SF4-5-2013		May-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	5/6/2013	Recovered Water	Uranium-238	Null	pCi/L			
4	SF4-6-2013		Jun-13	>100%	>100%	>100%/>100%	>100%	Null	Null	Null	Null	Null	>100%	Null	no	POD	6/14/2013	Recovered Water	Uranium-238	Null	pCi/L			