National Aeronautics and
Space Administration

White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

April 27, 2023

Reply to Attn of: RE-23-078

Mr. Dave Cobrain, Acting Bureau Chief
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: Groundwater Data Representativeness Phase 2: Water FLUTe Well Evaluation Abbreviated Investigation Report

NASA submitted the *Abbreviated Investigation Work Plan for Groundwater Data Representativeness, Phase 2: FLUTe Well Evaluation* [AIWP] on November 2, 2021. On August 8, 2022, NMED approved the AIWP and directed NASA to complete the investigation and submit the Abbreviated Investigation Report no later than April 28, 2023.

Enclosed is the required *Groundwater Data Representativeness Phase 2: Water FLUTe Well Evaluation Abbreviated Investigation Report*. This submittal includes a bound paper copy of the abbreviated investigation report as Enclosure 1, Excel analytical data spreadsheets as Enclosure 2, analytical lab reports as Enclosure 3, and a CD-ROM with the report in PDF as Enclosure 4.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for known violations.

If you have any questions or comments concerning this submittal, please contact Michael Zigmond of my staff at 575-524-5484.

Sincerely,

TIMOTHY DAVIS

Digitally signed by TIMOTHY DAVIS
Date: 2023.04.27 12:19:24 -06'00'

Timothy J. Davis
Chief, Environmental Office

4 Enclosures

cc: (with enclosure)
Mr. Gabriel Acevedo
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

National Aeronautics and Space Administration

Groundwater Data Representativeness Phase 2: Water FLUTe Well Evaluation Abbreviated Investigation Report

April 2023

NM8800019434

NASA Johnson Space Center White Sands Test Facility

Groundwater Data Representativeness Phase 2: Water FLUTe Well Evaluation Abbreviated Investigation Report

April 2023

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

TIMOTHY DAVIS Digitally signed by TIMOTHY DAVIS Date: 2023.04.27 12:19:55 -06'00'

See Electronic Signature

Timothy J. Davis
Chief, Environmental Office

Date

National Aeronautics and Space Administration

Johnson Space Center
White Sands Test Facility
12600 NASA Road
Las Cruces, NM 88012
www.nasa.gov/centers/wstf

www.nasa.gov

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List of Acronyms

AIWP	Abbreviated Investigation Work Plan
bgs	Below Ground Surface
CFR	Code of Federal Regulations
COPC	Constituent of Potential Concern
DP	Discharge Permit
FLUTe	Flexible Liner Underground Technologies, LLC
ft	Feet/Foot
GC/MS	Gas Chromatography-Mass Spectrometry
GMP	Groundwater Monitoring Plan
HWB	Hazardous Waste Bureau
IDW	Investigation-Derived Waste
L	Liter
MPITS	Mid-plume Interception and Treatment System
NASA	National Aeronautics and Space Administration
NBBS	N-butyl-benzenesulfonamide
ND	Not Detected
NDMA	N-nitrosodimethylamine
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
QA	Quality Assurance
QC	Quality Control
SIM	Selective Ion Monitoring
SVOC	Semi-volatile Organic Compound
TCE	Trichloroethene
TIC	Tentatively Identified Compound
VOC	Volatile Organic Compound
WSTF	White Sands Test Facility

1.0 Background

In 2013, the National Aeronautics and Space Administration (NASA) began a campaign to replace Westbay®[1] multiport sampling systems in several monitoring wells with sampling systems capable of being purged. To date, NASA has identified and installed two purgeable sampling systems believed to be capable of providing high quality, representative groundwater samples: dual-zone dedicated bladder pump systems and Water Flexible Liner Underground Technologies (FLUTe™) multilevel groundwater monitoring systems. NASA has collected groundwater samples from each reconfigured monitoring well since installation, typically on a quarterly schedule. NASA evaluates groundwater chemical analytical data on an ongoing basis and has observed inconsistencies in data from samples collected from Westbay systems and samples collected from the replacement Water FLUTe systems. Of primary consideration are initial and ongoing detections of several semi-volatile organic compounds (SVOCs), including low concentrations of N-nitrosodimethylamine (NDMA), as well as more recent detections of 1,4-dioxane. Although Water FLUTe wells are purged prior to sample collection, purge volume is somewhat limited to approximately 5 to 8 gallons per FLUTe sampling zone by the small diameter purge/sample tubing and time required to perform purging. As a result, the potential exists for groundwater samples collected with the Water FLUTe system to be impacted by components of the system.

On March 29, 2016, the New Mexico Environment Department (NMED) approved NASA's January 27, 2016, *NASA WSTF Periodic Monitoring Report – Fourth Quarter 2015,* with a comment expressing uncertainty about the source of detections of NDMA in groundwater monitoring wells BLM-30, PL-6, PL-7, PL-8, PL-10, ST-5, and WW-3 during 2015 (NMED, 2016). In response, NASA provided an evaluation of NDMA results from the identified wells and requested an extension of time for submittal of the NMED-required reconfiguration work plan for the wells (NASA, 2017). On October 4, 2017, NMED approved NASA's submittal with modifications (NMED, 2017b). NMED Modification 1 required NASA to evaluate monitoring well sampling data. While developing the required data representativeness work plan, NASA continued to collect comprehensive groundwater samples and evaluate chemical analytical data. NASA continued to observe detections of SVOCs in samples from Water FLUTe sampling systems, including NDMA and several tentatively identified compounds (TICs) that may interfere with the analysis of White Sands Test Facility (WSTF) groundwater contaminants.

NASA also observed detections of 1,4-dioxane in several Water FLUTe wells. Preliminary data indicated that 1,4-dioxane contamination may be present in Water FLUTe systems. In the April 25, 2018, *Request for Extension of Time for NASA WSTF Monitoring Well Groundwater Data Representativeness Work Plan* (NASA, 2018a), NASA recommended immediate 1,4-dioxane sampling at several wells with Water FLUTe systems with subsequent analysis using SW-846 Method 8270D with selective ion monitoring (SIM) to more effectively quantify concentrations of 1,4-dioxane in Water FLUTe wells. NASA also requested additional time in which to prepare and submit the required work plan for evaluating data representativeness. NMED approved the request on May 15, 2018, pointing out that "…additional data will be used to confirm recently reported 1,4-dioxane concentrations in several groundwater monitoring wells equipped with Water FLUTe sampling systems and provide additional information for system evaluation" (NMED, 2018).

During 2018, NASA continued to collect samples for the analysis of SVOCs, including NDMA and 1,4-dioxane, from several Water FLUTe wells. Chemical analytical data indicate a correlation between the Water FLUTe sampling system and detections of 1,4-dioxane and several tentatively identified SVOCs, leading NASA to conclude that the contamination may be originating with the sampling system. In efforts to verify this, NASA submitted *Abbreviated Investigation Work Plan for Groundwater Data Representativeness, Phase 1: FLUTe Well* on December 21, 2018 (NASA, 2018b). On May 13, 2019,

[1] Westbay is a registered trademark of Nova Metrix Ground Monitoring (Canada) Ltd.

NMED approved the abbreviated investigation work plan (AIWP) with modifications (NMED, 2019). NASA submitted the revised work plan with modifications on July 30, 2019 (NASA, 2019). NASA conducted the first phase of an evaluation of groundwater data representativeness in 2019, which comprised an evaluation of Water FLUTe monitoring well WW-4 to determine if the sampling system is the source of SVOCs, including NDMA and 1,4-dioxane. The fieldwork was conducted, and the Phase 1 Abbreviated Investigation Report was submitted to NMED (NASA, 2020). NMED approved the Phase 1 report with modifications (NMED, 2021), and NASA submitted a response to the approval with modifications on August 17, 2021 (NASA, 2021c).

In the Phase 1 report, NASA concluded that NDMA concentrations in groundwater samples collected from the Water FLUTe system may be representative of groundwater at that location. However, the uncertainty introduced by routine detections of NDMA in field quality control (QC) samples leads NASA to also conclude that further evaluation of NDMA at low levels is required at WSTF. In the Approval with Modifications of the Phase 1 report (NMED, 2021), NMED directed NASA to perform a Phase 2 investigation that expands upon the initial results at well WW-4 plus one or two other monitoring wells with Water FLUTe sampling systems.

NASA developed the *Abbreviated Investigation Work Plan* [AIWP] *for Groundwater Data Representativeness, Phase 2: FLUTe Well Evaluation* on November 2, 2021 (NASA, 2021d). NMED approved the work plan on August 8, 2022 and required submittal of the Phase 2 report by April 28, 2023 (NMED, 2022). The NMED-required Phase 2 investigation consisted of extended purging and time series sampling of four of the WW-4 groundwater monitoring zones (423, 589, 848, and 948), plus comparable purging and sampling at four other FLUTe monitoring zones including BLM-32-543, BLM-32-571, JER-2-684, and WW-5-909.

2.0 Location

Groundwater monitoring wells WW-4 and WW-5 are located approximately three miles west of the WSTF test areas near the western site boundary within the southern Jornada del Muerto Basin. Wells JER-2 and BLM-32 are approximately 2.5 miles northwest of the test area near the northwest WSTF boundary with the Jornada experimental range. Figure 2.1 shows the locations of these four wells.

3.0 Investigation Activities

The first phase of the data representativeness evaluation consisted of serial sampling and analysis of groundwater samples from the four sampling zones in well WW-4 (-423, -589, -848, -948) after the Water FLUTe sampling system was reinstalled, plus serial sampling and analysis of groundwater samples from the following Water FLUTe wells and zones including BLM-32-543, BLM-32-571, JER-2-684, and WW-5-909. Each selected Water FLUTe sampling zone will be tested in three steps: collection of pre-purge (“time zero”) groundwater samples from the Water FLUTe system just as water comes to surface; purging and serial sampling of groundwater from each interval for trending the concentrations of NDMA, 1,4-dioxane and SVOC TICs as purging progresses; and evaluation of the sequential sampling analytical data of the constituents of potential concern (COPCs) to determine if there is an effect from expanded purging on COPC concentrations.

3.1 Constituents of Concern

Based on the Phase 1 analytical data from groundwater monitoring well WW-4, NASA identified NDMA and 1,4-dioxane as the primary constituents of concern for this investigation. Several additional SVOC TICs in groundwater samples by SW-846 Method 8270D are of interest to NASA. These compounds are 2,5-dimethyl-1,4-dioxane, N-butyl-benzenesulfonamide (NBBS), and N, N-dimethyl-formamide. NASA measured groundwater indicator parameters such as temperature, turbidity, pH, and conductivity prior to collection of each set of samples.

3.1.1 Analytical Methods

NASA collected and analyzed groundwater samples for the COPCs using the analytical methods and equipment indicated below:

- Groundwater indicator parameters – field instruments
- NDMA – approved low-level analytical method (Southwest Research Institute TAP 01-0403-015)
- 1,4-dioxane – SW-846 Method 8270D with SIM
- SVOCs – SW-846 Method 8270D

3.1.2 Groundwater Quality Control Samples

NASA collected groundwater samples and analyzed them as described in preceding sections of this plan and the NMED-approved WSTF Groundwater Monitoring Plan (GMP; NASA, 2021a). QC samples were collected to ensure quality and representativeness of field data generated during the investigation. Field QC samples were collected as follows:

- Low-level NDMA trip blanks were collected prior to proceeding to a well for purging and sampling activities and carried by the sampling crew throughout activity at each well. There were four trip blanks collected during the project.
- A set of field blanks for all analytical methods were collected at each Water FLUTe sampling interval.
- Adequate field duplicate samples were collected for all analytical methods to ensure that at least eight samples were collected for these analyses at each Water FLUTe sampling interval.
- One low-level NDMA matrix spike/matrix spike duplicate sample was collected at each Water FLUTe sampling interval.

QC samples collected during this investigation are provided in Table 3.1. Laboratory QC samples were analyzed as required by the accredited contracted laboratory's Quality Manual or Standard Operating Procedures.

3.2 Field Activities

3.2.1 WW-4 FLUTe Liner Installation

NASA retained the services of FLUTe to construct and install a new Water FLUTe sampling system in well WW-4. NASA and FLUTe technicians installed the new liner on February 22 and 23, 2022. The new liner sampling zones were installed at the same depths as the removed (and damaged) liner, so the FLUTe sampling zones remain the same as with the previous liner. Following installation, each sampling zone was tested by purging using gaseous nitrogen at a pressure of 225 pounds per square inch (psi). Each zone produced water slowly at 225 psi, so the test pressure was raised to 250 psi. Each zone produced approximately ¾ gallon of groundwater per each purge cycle. FLUTe technicians performed all installation and testing services and certified the proper installation and operation of the new liner. The logbook pages documenting liner installation at WW-4 are provided in Appendix A.

3.2.2 Serial Sampling of FLUTe Sampling Zones

NASA performed investigation fieldwork between May 9 and June 6, 2022. NASA completed serial sampling of each selected FLUTe zone in wells WW-4, BLM-32, JER-2, and WW-5 in accordance with the NMED-approved AIWP. FLUTe zones sampled are as follows:

- WW-4-423, screened from 419 to 429 feet (ft) below ground surface (bgs) (previously referred to as WW-4-419)
- WW-4-589, screened from 589 to 599 ft bgs
- WW-4-848, screened from 848 to 858 ft bgs
- WW-4-948, screened from 948 to 958 ft bgs
- BLM-32-543, screened from 543 to 563 ft bgs
- BLM-32-571, screened from 571 to 591 ft bgs
- JER-2-684, screened from 683.4 to 693.4 ft bgs
- WW-5-909, screened from 909 to 919 ft bgs

The FLUTe well construction details are shown on Figure 3.1 (WW-4), Figure 3.2 (BLM-32), Figure 3.3 (JER-2), and Figure 3.4 (WW-5). Serial sampling was completed at each zone at five purge volume intervals:

- Initial groundwater samples were collected from the drop pipe prior to purging and are provided in Table 3.1 as "0" under Cumulative Purge Volume, in gallons.
- The second, third, fourth, and fifth groundwater samples were collected following purging of each FLUTe zone at intervals of 4, 8, 13, and 17 gallons, and are provided as "4," "8," "13," and "17" under the Cumulative Purge Volume column of Table 3.1.

NASA collected all groundwater samples in accordance with the GMP (NASA, 2021a) requirements and the approved AIWP (NASA, 2022). Field activities are documented in logbooks, provided in Appendix A.

Serial sampling events should ideally be completed in a continuous manner, with initiation of each subsequent purge/sample event immediately following completion of the previous purge/sampling event. However, NASA was unable to complete serial sampling in this manner because of the time required to purge each FLUTe internal and competent personnel were tasked with several other project activities concurrently with this investigation. Project personnel completed the serial sampling as quickly as possible under these constraints, but completion of purging/sampling activities at each FLUTe zone required multiple days as shown in Table 3.1.

3.3 Performance or Acceptance Criteria

The purpose of this investigation was to determine if the detections of constituents of concern at eight FLUTe sampling zones are representative of groundwater conditions or the result of contamination introduced by leaching of Water FLUTe sampling system components into groundwater in contact with the FLUTe materials. The Phase 2 investigation was conducted to comply with NMED direction to evaluate groundwater sampling data representativeness (NMED, 2016, 2017a).

QC samples were collected using deionized filtered water that met or exceeded the qualifications for ASTM International Type 1 water. Equipment blank samples were collected using deionized filtered water that was run through the wellhead manifold and flow meter. Analytical data from equipment blanks were evaluated to ensure cross contamination did not occur. Field blank samples were collected using deionized filtered water in conjunction with groundwater samples during fieldwork. Analytical data from field blanks were evaluated to ensure field contamination did not negatively affect sample data quality. Analytical data from trip blank samples were evaluated to ensure possible contamination from the shipping process did not negatively affect sample data quality. The number and type of QC samples for this investigation are summarized in Table 3.1.

3.4 Investigation-Derived Waste Management

NASA managed all investigation-derived waste (IDW) in accordance with 40 Code of Federal Regulations (CFR) 262.17 and 20.4.1.300 New Mexico Administrative Code (NMAC) and the approved AIWP. All groundwater and decontamination fluids generated were transferred to the onsite Mid-plume Interception and Treatment System (MPITS), where it was treated in accordance with the MPITS Interim Measure Work Plan (NASA, 2008) and discharged in accordance with DP-1255 (NMED, 2017a).

3.5 Investigation Deviations

NASA did not complete any activities other than those approved in the AIWP (NASA, 2022).

4.0 Investigation Results and Interpretation

Analytical results from the groundwater samples collected at the eight FLUTe zones in the four wells are provided in Enclosure 2. The laboratory analytical reports are provided in Enclosure 3. Detections for COPCs are summarized in the following sections.

4.1 WW-4-423 Serial Sample Results

NASA collected five sets of groundwater samples from FLUTe zone WW-4-423 on May 9 through 11, 2022. The initial sample was collected prior to purging actions (0 gallons) followed by sample collection following purging to remove 4, 8, 13, and 17 gallons.

Table 4.1 presents the analytical results of the five serial sampling events for the COPCs. The TIC N,N-dimethylformamide was not detected (ND) in any sample. As anticipated, the pre-purge (0 gallons) samples generally had the highest concentrations of COPCs. Figure 4.1 provides graphs of the analytical results of each COPC for each serial sampling event, including a graph of NDMA, a graph of 1,4-dioxane, and a graph of the TICs NBBS, 2,5-dimethyl-1,4-dioxane, and N, N-dimethylformamide.

4.1.1 WW-4-423 NDMA

The highest detected concentrations of NDMA identified in this FLUTe zone during the two most recent years of sampling are 0.99 ng/L (9/15/2018) and 0.94 ng/L (6/18/2019). The pre-purge sample identified NDMA at 113.34 ng/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified NDMA concentrations that decreased from 7.51 (4 gallons) to 2.11 ng/L (17 gallons).

Concentrations of NDMA generally decreased with each subsequent purge/sampling event. The one exception occurred with the 13-gallon purge/sample (5/11/2022) that contained 5.44 ng/L NDMA that is greater than the 8-gallon purge/sample (5/10/2022) that contained 3.97 ng/L NDMA.

4.1.2 WW-4-423 1,4-Dioxane

The highest detected concentrations of 1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling are 21 µg/L (6/29/2016) and 2 µg/L (6/14/2018). The pre-purge sample identified 1,4-dioxane at 95 µg/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified 1,4-dioxane concentrations that decreased from 1.6 (4 gallons) to 0.85 µg/L (8 gallons), then increased to 3.1 µg/L (13 gallons) and 8.3 µg/L (17 gallons).

4.1.3 WW-4-423 Tentatively Identified Compounds

The highest detected concentrations of NBBS identified in this FLUTe zone during the two most recent years of sampling are 320 µg/L (9/15/2018) and 260 µg/L (6/18/2019). Serial samples collected identified NBBS concentrations at 10 µg/L (0 gallons), 220 µg/L (4 gallons), 68 µg/L (8 gallons), was ND in the 13-gallon sample, and 24 µg/L (17 gallons).

The highest detected concentrations of 2,5-dimethyl-1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling are 13 µg/L (12/15/2018) and 7.1 µg/L (6/18/2019). Serial samples collected identified 2,5-dimethyl-1,4-dioxane concentrations at 190 µg/L (0 gallons), 7.4 µg/L (4 gallons), and 13 µg/L (13 gallons). 2,5-dimethyl-1,4-dioxane was ND in the 8- and 17-gallon samples.

N, N-dimethylformamide has not been detected in historical samples from WW-4-423 and was ND in any serial samples collected from this FLUTe zone.

4.2 WW-4-589 Serial Sample Results

NASA collected five sets of groundwater samples from FLUTe zone WW-4-589 on May 9 through 11, 2022. The initial sample was collected prior to purging actions (0 gallons) followed by sample collection following purging to remove 4, 8, 13, and 17 gallons.

Table 4.1 presents the analytical results of the five serial sampling events for the COPCs. Figure 4.2 provides graphs of the analytical results of each COPC for each serial sampling event, including a graph of NDMA, a graph of 1,4-dioxane, and a graph of the TICs NBBS, 2,5-dimethyl-1,4-dioxane, and N, N-dimethylformamide.

4.2.1 WW-4-589 NDMA

The highest detected concentrations of NDMA identified in this FLUTe zone during the two most recent years of sampling are 7 ng/L (3/15/2018) to 1 ng/L (6/18/2019). The pre-purge sample identified NDMA at 104.32 ng/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified NDMA concentrations that decreased from 3.72 (4 gallons) to 0.58 ng/L (17 gallons).

Concentrations of NDMA generally decreased with each subsequent purge/sampling event. The one exception occurred with the 13-gallon purge/sample (5/11/2022) that contained 0.99 ng/L NDMA that is greater than the 8-gallon purge/sample (5/10/2022) that contained 0.62 ng/L NDMA.

4.2.2 WW-4-589 1,4-Dioxane

The highest detected concentrations of 1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling are 50 µg/L (6/29/2016) and 28 µg/L (6/14/2018). The pre-purge sample identified 1,4-dioxane at 95 µg/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified 1,4-dioxane concentrations that remained relatively steady for each purge/sample event at 1.1 µg/L (4 gallons), 0.49 µg/L (8 gallons), 2.9 µg/L (13 gallons) and 1.8 µg/L (17 gallons).

4.2.3 WW-4-589 Tentatively Identified Compounds

The highest detected concentrations of NBBS identified in this FLUTe zone during the two most recent years of sampling are 320 µg/L (9/15/2018) and 260 µg/L (6/18/2019). Serial samples collected identified NBBS concentrations at 35 µg/L (4 gallons), 17 µg/L (8 gallons), and 9.4 µg/L (17 gallons), was ND at 0- and 13-gallon samples.

The highest detected concentrations of 2,5-dimethyl-1,4-dioxane identified in this FLUTe during the two most recent years of sampling are 3.9 µg/L (6/14/2018) and 5.1 µg/L (3/19/2019). Serial samples collected identified 2,5-dimethyl-1,4-dioxane concentrations at 210 µg/L (0 gallons), 5.7 µg/L (4 gallons), and 15 µg/L (13 gallons). 2,5-dimethyl-1,4-dioxane was ND in the 8- and 17-gallon samples.

N, N-dimethylformamide has not been detected in historical samples from WW-4-589 and was ND in any serial samples collected from this FLUTe zone.

4.3 WW-4-848 Serial Sample Results

NASA collected five sets of groundwater samples from FLUTe zone WW-4-848 on May 12 through 16, 2022. The initial sample was collected prior to purging actions (0 gallons purge) followed by sample collection following purging to remove 4, 8, 13, and 17 gallons.

Table 4.1 presents the analytical results of the five serial sampling events for the COPCs. Figure 4.3 provides graphs of the analytical results of each COPC for each serial sampling event, including a graph of NDMA, a graph of 1,4-dioxane, and a graph of the TICs NBBS, 2,5-dimethyl-1,4-dioxane, and N, N-dimethylformamide.

4.3.1 WW-4-848 NDMA

The highest detected concentrations of NDMA identified in this FLUTe zone during the two most recent years of sampling are 1 ng/L (6/19/2018) to 0.33 ng/L (3/21/2019). The pre-purge sample identified NDMA at 122.43 ng/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified NDMA concentrations that remained relatively consistent at 0.49 ng/L (4 gallons), 0.91 ng/L (8 gallons), 0.73 ng/L (13 gallons), and 0.46 ng/L (17 gallons).

Concentrations of NDMA generally decreased with each subsequent purge/sampling event. The one exception occurred with the 8-gallon purge/sample (5/13/2022) that contained 0.91 ng/L NDMA that is greater than the 4-gallon purge/sample (5/12/2022) that contained 0.62 ng/L NDMA.

4.3.2 WW-4-848 1,4-Dioxane

The only detected concentration of 1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling is 1.8 µg/L (6/19/2018). The pre-purge sample identified 1,4-dioxane at 120 µg/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified 1,4-dioxane concentrations that remained relatively steady for each purge/sample event at 1.8 µg/L (4 gallons), 2.3 µg/L (8 gallons), 1.5 µg/L (13 gallons) and 1.6 µg/L (17 gallons).

4.3.3 WW-4-848 Tentatively Identified Compounds

The highest detected concentrations of NBBS identified in this FLUTe zone during the two most recent years of sampling are 110 µg/L (6/19/2018) and 67 µg/L (3/21/2019). Serial samples collected following purging activities identified NBBS concentrations at 12 µg/L (4 gallons), 6.4 µg/L (8 gallons), 5.6 µg/L (13 gallons), and 7.8 µg/L (17 gallons), was ND in the 0-gallon sample.

The highest detected concentrations of 2,5-dimethyl-1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling are 17 µg/L (1/3/2018) and 11 µg/L (3/21/2019). Serial samples collected identified 2,5-dimethyl-1,4-dioxane concentrations at 170 µg/L (0 gallons) but this TIC was ND in the remaining serial samples.

N, N-dimethylformamide has not been detected in historical samples from WW-4-848, but was identified at 27 µg/L (4 gallons) and 11 µg/L (13 gallons), and was ND in the 0-, 8-, or 17-gallon samples collected from this FLUTe zone.

4.4 WW-4-948 Serial Sample Results

NASA collected five sets of groundwater samples from FLUTe zone WW-4-948 on May 12 through 16, 2022. The initial sample was collected prior to purging actions (0 gallons) followed by sample collection following purging to remove 4, 8, 13, and 17 gallons.

Table 4.1 presents the analytical results of the five serial sampling events for the COPCs. Figure 4.4 provides graphs of the analytical results of each COPC for each serial sampling event, including a graph of NDMA, a graph of 1,4-dioxane, and a graph of the TICs NBBS, 2,5-dimethyl-1,4-dioxane, and N, N-dimethylformamide.

4.4.1 WW-4-948 NDMA

The highest detected concentrations of NDMA identified in this FLUTe zone during the two most recent years of sampling are 3.6 ng/L (3/20/2018) and 2.8 ng/L (6/20/2019). The pre-purge sample identified NDMA at 71.1 ng/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified NDMA concentrations that remained consistent at 0.48 ng/L (4 gallons), 0.48 ng/L (8 gallons), 0.47 ng/L (13 gallons), and 0.49 ng/L (17 gallons).

4.4.2 WW-4-948 1,4-Dioxane

The only detected concentration of 1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling is 1.5 µg/L (6/19/2018). The pre-purge sample identified 1,4-dioxane at 160 µg/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified 1,4-dioxane concentrations that remained relatively steady for each purge/sample event at 2.4 µg/L (4 gallons), 6.2 µg/L (8 gallons), 1.3 µg/L (13 gallons) and 1.8 µg/L (17 gallons).

4.4.3 WW-4-948 Tentatively Identified Compounds

The highest detected concentrations of NBBS identified in this FLUTe zone during the two most recent years of sampling are 1500 µg/L (6/19/2018) and 38 µg/L (6/20/2019). Serial samples collected identified NBBS concentrations at 310 µg/L (0 gallons), 8.8 µg/L (4 gallons), 5.9 µg/L (8 gallons), and 5.5 µg/L (17 gallons). It was ND in the 13-gallon sample.

The highest detected concentrations of 2,5-dimethyl-1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling are 18 µg/L (1/3/2018) and 8.5 µg/L (3/21/2019). Serial samples collected identified 2,5-dimethyl-1,4-dioxane concentrations at 200 µg/L (0 gallons) but this TIC was ND in the remaining serial samples.

The highest detected concentrations of N, N-dimethylformamide in this FLUTe zone during the two most recent years of sampling are 23 µg/L (1/6/2017) and 7.8 µg/L (9/18/2018). It was detected in WW-4-848 at 27 µg/L (4 gallons) and 11 µg/L (13 gallons), but was ND in the 0-, 8-, or 17-gallon samples collected from this FLUTe zone.

4.5 BLM-32-543 Serial Sample Results

NASA collected five sets of groundwater samples from FLUTe zone BLM-32-543 on May 16 through 23, 2022. The initial sample was collected prior to purging actions (0 gallons) followed by sample collection following purging to remove 4, 8, 13, and 17 gallons.

Table 4.1 presents the analytical results of the five serial sampling events for the COPCs. Figure 4.5 provides graphs of the analytical results of each COPC for each serial sampling event, including a graph of NDMA, a graph of 1,4-dioxane, and a graph of the TICs NBBS, 2,5-dimethyl-1,4-dioxane, and N, N-dimethylformamide.

4.5.1 BLM-32-543 NDMA

The highest detected concentrations of NDMA identified in this FLUTe zone during the two most recent years of sampling are 3.4 ng/L (2/12/2020) to 2.7 ng/L (2/2/2021). The pre-purge sample identified NDMA at 3.18 ng/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified NDMA concentrations that decreased from 1.68 ng/L (4 gallons) to 0.48 ng/L (8 gallons), then remained consistent at 0.49 ng/L (13 gallons), and 0.47 ng/L (17 gallons).

4.5.2 BLM-32-543 1,4-Dioxane

The only detected concentration of 1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling is 11 µg/L (8/7/2018). The pre-purge sample identified 1,4-dioxane at 5.1 µg/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified 1,4-dioxane concentrations that slightly decreased from 1.6 µg/L (4 gallons), 1.2 µg/L (8 gallons), and 0.79 µg/L (13 gallons), but increased slightly to 1.2 µg/L (17 gallons).

4.5.3 BLM-32-543 Tentatively Identified Compounds

The highest detected concentrations of NBBS identified in this FLUTe zone during the two most recent years of sampling are 37 µg/L (11/30/2020) and 2200 µg/L (8/9/2021). Serial samples collected identified NBBS concentrations decreasing with each subsequent purge/sample event at 2200 µg/L (0 gallons), 1800 µg/L (4 gallons), 1600 µg/L (8 gallons), 1400 µg/L (13 gallons), and 960 µg/L (17 gallons).

The highest detected concentrations of 2,5-dimethyl-1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling are 6.1 µg/L (2/12/2020) and 10 µg/L (2/2/2021). Serial samples collected identified 2,5-dimethyl-1,4-dioxane concentrations at 12 µg/L (0 gallons) but this TIC was ND in the remaining serial samples.

The highest detected concentrations of N, N-dimethylformamide in this FLUTe zone during the two most recent years of sampling are 15 µg/L (6/8/2016) and 7.9 µg/L (2/7/2017) in WW-4-848. It was ND in the serial samples collected from this FLUTe zone.

4.6 BLM-32-571 Serial Sampling Results

NASA collected five sets of groundwater samples from FLUTe zone BLM-32-571 on May 16 through 23, 2022. The initial sample was collected prior to purging actions (0 gallons) followed by sample collection following purging to remove 4, 8, 13, and 17 gallons.

Table 4.1 presents the analytical results of the five serial sampling events for the COPCs. Figure 4.6 provides graphs of the analytical results of each COPC for each serial sampling event, including a graph of NDMA, a graph of 1,4-dioxane, and a graph of the TICs NBBS, 2,5-dimethyl-1,4-dioxane, and N, N-dimethylformamide.

4.6.1 BLM-32-571 NDMA

The highest detected concentrations of NDMA identified in this FLUTe zone during the two most recent years of sampling are 2.4 ng/L (5/5/2020) and 1.1 ng/L (2/2/2021). The pre-purge sample identified NDMA at 5.44 ng/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified NDMA concentrations that increased from 0.86 ng/L (4 gallons) to 1.04 ng/L (8 gallons), then stabilized at 0.5 ng/L (13 gallons), and 0.47 ng/L (17 gallons).

4.6.2 BLM-32-571 1,4-Dioxane

The only detected concentration of 1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling is 11 µg/L (8/7/2018). The pre-purge sample identified 1,4-dioxane at 5.1 µg/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified 1,4-dioxane concentrations that slightly decreased from 1.6 µg/L (4 gallons), 1.2 µg/L (8 gallons), and 0.79 µg/L (13 gallons), but increased slightly to 1.2 µg/L (17 gallons).

4.6.3 BLM-32-571 Tentatively Identified Compounds

The highest detected concentrations of NBBS identified in this FLUTe zone during the two most recent years of sampling are 470 µg/L (2/24/2016) and 200 µg/L (2/8/2017). Serial samples collected identified NBBS concentrations decreasing with each subsequent purge/sample event at 94 µg/L (0 gallons), 14 µg/L (4 gallons), and 7.4 µg/L (8 gallons) and was ND in the 13- and 17-gallon samples.

The single detected concentrations of 2,5-dimethyl-1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling is 8.7 µg/L (8/31/2016). Serial samples collected identified 2,5-dimethyl-1,4-dioxane concentrations at 12 µg/L (0 gallons) but this TIC was ND in the remaining serial samples.

N, N-dimethylformamide has not been detected in historical samples from this FLUTe zone and was ND in the serial samples collected from this FLUTe zone.

4.7 JER-2-684 Serial Sampling Results

NASA collected five sets of groundwater samples from FLUTe zone JER-2-684 on May 24 through 27, 2022. The initial sample was collected prior to purging actions (0 gallons) followed by sample collection following purging to remove 4, 8, 13, and 17 gallons.

Table 4.1 presents the analytical results of the five serial sampling events for the COPCs. Figure 4.7 provides graphs of the analytical results of each COPC for each serial sampling event, including a graph of NDMA, a graph of 1,4-dioxane, and a graph of the TICs NBBS, 2,5-dimethyl-1,4-dioxane, and N, N-dimethylformamide.

4.7.1 JER-2-684 NDMA

The highest detected concentrations of NDMA identified in this FLUTe zone during the two most recent years of sampling are 43 ng/L (7/21/2020) and 7.7 ng/L (10/13/2021). The pre-purge sample identified NDMA at 48.3 ng/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified NDMA concentrations that increased from 1.64 ng/L (4 gallons) to 1.74 ng/L (8 gallons), decreased to 0.49 ng/L (13 gallons), then increased to 2.3 ng/L (17 gallons).

4.7.2 JER-2-684 1,4-Dioxane

The highest detected concentrations of 1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling are 73 µg/L (7/21/2020) and 57 µg/L (1/14/2021). The pre-purge sample identified 1,4-dioxane at 30 µg/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified 1,4-dioxane concentrations that decreased for each purge/sample event at 4 µg/L (4 gallons), 3.8 µg/L (8 gallons), 0.36 µg/L (13 gallons) and 0.17 µg/L (17 gallons).

4.7.3 JER-2-684 Tentatively Identified Compounds

The highest detected concentrations of NBBS identified in this FLUTe zone during the two most recent years of sampling are 40 µg/L (10/27/2020) and 160 µg/L (10/13/2021). Serial samples collected identified NBBS concentrations decreasing with each subsequent purge/sample event at 420 µg/L (0 gallons), 240 µg/L (4 gallons), 210 µg/L (8 gallons), 160 µg/L (13 gallons), and 120 µg/L (17 gallons).

The highest detected concentrations of 2,5-dimethyl-1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling is 14 µg/L (10/27/2020) and 8.2 µg/L (1/14/2021). Serial samples collected identified 2,5-dimethyl-1,4-dioxane concentrations at 12 µg/L (0 gallons) but this TIC was ND in the remaining serial samples.

N, N-dimethylformamide was detected in one sample during the two most recent years of sampling at 5.6 µg/L (7/14/2017), but was ND in the serial samples collected from this FLUTe zone.

4.8 WW-5-909 Serial Sampling Results

NASA collected five sets of groundwater samples from FLUTe zone WW-5-909 on May 31 through June 6, 2022. The initial sample was collected prior to purging actions (0 gallons) followed by sample collection following purging to remove 4, 8, 13, and 17 gallons.

Table 4.1 presents the analytical results of the five serial sampling events for the COPCs. Figure 4.8 provides graphs of the analytical results of each COPC for each serial sampling event, including a graph of NDMA, a graph of 1,4-dioxane, and a graph of the TICs NBBS, 2,5-dimethyl-1,4-dioxane, and N, N-dimethylformamide.

4.8.1 WW-5-909 NDMA

The highest detected concentrations of NDMA identified in this FLUTe zone during the two most recent years of sampling are 5 ng/L (1/16/2020) to 6.5 ng/L (4/13/2021). The pre-purge sample identified a low concentration of NDMA at 1.46 ng/L, then increased to 3.08 ng/L (4 gallons) and decreased steadily to 2.37 ng/L (8 gallons), 1.81 ng/L (13 gallons), and 1.56 ng/L (17 gallons).

4.8.2 WW-5-909 1,4-Dioxane

The highest detected concentrations of 1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling are 22 µg/L (7/19/2018) and 18 µg/L (10/12/2018). The pre-purge sample identified 1,4-dioxane at 14 µg/L, but is not considered indicative of formation water. Serial samples collected following purging activities identified 1,4-dioxane concentrations that decreased for each purge/sample event to 3.7 µg/L (4 gallons), 3.3 µg/L (8 gallons), 3.2 µg/L (13 gallons) and 0.43 µg/L (17 gallons).

4.8.3 WW-5-909 Tentatively Identified Compounds

The highest detected concentrations of NBBS identified in this FLUTe zone during the two most recent years of sampling are 720 µg/L (10/22/2020) and 1100 µg/L (10/20/2021). Serial samples collected identified NBBS concentrations increasing from 720 µg/L (0 gallons) to 920 µg/L (4 gallons), then decreasing to 590 µg/L (8 gallons), 500 µg/L (13 gallons) and increasing to 580 µg/L (17 gallons).

The highest detected concentrations of 2,5-dimethyl-1,4-dioxane identified in this FLUTe zone during the two most recent years of sampling is 30 µg/L (7/19/2018) and 4.6 µg/L (10/24/2019). Serial samples collected did not identify 2,5-dimethyl-1,4-dioxane in the remaining serial samples.

N, N-dimethylformamide was ND in historical samples over the last two years that this zone was sampled and was ND in the serial samples collected from this FLUTe zone.

4.9 Historical NDMA Concentrations Comparison

NASA compared historical NDMA concentrations with the concentrations identified during serial sampling. NASA selected the most recent two years of NDMA analytical results from each FLUTe zone evaluated as part of this investigation. NDMA concentrations from the pre-purge samples (0 gallons) are not considered representative of formation groundwater and were not included in this comparison. Results of these comparisons are described in the following sections.

4.9.1 WW-4-423

Figure 4.9 shows two graphs: the first is the historical NDMA concentrations identified over the last two years of sampling completed prior to this investigation, and the second is the NDMA concentrations from the 4-, 8-, 13-, and 17-gallon purge samples. Historical NDMA in this zone ranged from 0.99 to 0.31 ng/L, while samples from this investigation identified an NDMA range of 7.51 to 2.11 ng/L. While in the same order of magnitude as historical concentrations, NDMA has increased in samples collected during this investigation.

4.9.2 WW-4-589

Figure 4.10 shows the historical NDMA graph and the serial sampling NDMA graph. Historical NDMA in this zone ranged from 7 to 0.4 ng/L, while samples from this investigation identified an NDMA range of 3.72 to 0.58 ng/L. Historic and serial sampling NDMA concentrations are remarkably consistent in this FLUTe zone in groundwater samples.

4.9.3 WW-4-848

Figure 4.11 shows the historical NDMA graph and the serial sampling NDMA graph. Historical NDMA in this zone ranged from 1 to <0.23 ng/L (below reporting limit), while samples from this investigation identified an NDMA range of 0.91 to <0.46 ng/L (below reporting limit). Historic and serial sampling NDMA concentrations are remarkably consistent in this FLUTe zone in groundwater samples.

4.9.4 WW-4-948

Figure 4.12 shows the historical NDMA graph and the serial sampling NDMA graph. Historical NDMA in this zone ranged from 3.6 to 2 ng/L, while samples from this did not identify NDMA at concentrations above the reporting limit, at <0.49 to <0.47 ng/L. Historic NDMA concentrations are noticeably higher than NDMA concentrations identified during this investigation.

4.9.5 BLM-32-543

Figure 4.13 shows the historical NDMA graph and the serial sampling NDMA graph. Historical NDMA in this zone ranged from 3.4 to 1.5 ng/L, while samples from this investigation identified an NDMA range of 1.68 ng/L to <0.47 ng/L (below the reporting limit). Historic NDMA concentrations are noticeably higher than NDMA concentrations identified during this investigation.

4.9.6 BLM-32-571

Figure 4.14 shows the historical NDMA graph and the serial sampling NDMA graph. Historical NDMA in this zone ranged from 2.4 to <0.22 ng/L, while samples from this investigation identified an NDMA range of 1.04 ng/L to 0.5 ng/L. Historic NDMA concentrations are inconsistent with more fluctuations in concentrations, while NDMA concentrations identified during this investigation are consistently at or below 1 ng/L.

4.9.7 JER-2-684

Figure 4.15 shows the historical NDMA graph and the serial sampling NDMA graph. Historical NDMA in this zone ranged from 7.7 to <0.23 ng/L, while samples from this investigation identified an NDMA range of 2.3 ng/L to <0.49 ng/L. Historic NDMA concentrations are inconsistent with more fluctuations in concentrations, while NDMA concentrations identified during this investigation are consistently at or below 2.5 ng/L.

4.9.8 WW-5-909

Figure 4.16 shows the historical NDMA graph and the serial sampling NDMA graph. Historical NDMA in this zone ranged from 6.5 to 1.7 ng/L, while samples from this investigation identified an NDMA range of 3.08 ng/L to 1.56 ng/L. Historic NDMA concentrations are inconsistent with more fluctuations in concentrations, while NDMA concentrations identified during this investigation are consistently at or below 3 ng/L.

4.10 Tentatively Identified Compounds

NASA compared concentrations of NDMA with concentrations of the three TICs, 2,5-dimethyl-1,4-dioxane, NBBS, and N, N-dimethyl-formamide for each sample event at each FLUTe zone. Analytical results of TICs for each sample are shown in Table 4.1, and graphs of TIC concentrations are shown on

Figure 4.1 through Figure 4.8. 2,5-Dimethyl-1,4-dioxane was detected in 11 of the 40 samples, NBBS in 33 of 40, and N, N-dimethyl-formamide in two of 40 samples.

The TIC NBBS was identified in 82.5% of samples, so results of comparison with WSTF COC concentrations is more reliable than with the remaining two TICs. One notable difference in NBBS concentrations and concentrations of NDMA and 1,4-dioxane is that in the upper three FLUTe zones in WW-4, the pre-purge (0-gallon) NBBS concentrations were much lower than subsequent samples collected from these zones, while NDMA and 1.4-dioxane concentrations generally declined with each subsequent purge/sample event. Correlation between NBBS and WSTF COC concentrations is not apparent. The age of FLUTe liners appears to have a significant effect on NBBS concentrations, with NBBS at significantly higher concentrations in BLM-32, JER-2, and WW-5 than were identified in any of the WW-4 samples, indicating leaching of NBBS is increasing over time in FLUTe systems. No other apparent conclusions can be drawn from this comparison.

The low occurrence of 2,5-dimethyl-1,4-dioxane, identified in 27.5% of samples, and N, N-dimethyl-formamide, identified in 5% of samples, introduces uncertainty when evaluating these concentrations with WSTF COCs. N, N-dimethyl-formamide was not compared with WSTF COCs. Concentrations of 2,5-dimethyl-1,4-dioxane were identified in all pre-purge (0-gallon) samples (except at WW-5-909), and in the 4-gallon and 8-gallon samples from WW-4-423 and WW-4-589. Pre-purge concentrations were much higher than those from purged samples in WW-4 zones, and somewhat correlate to 1,4-dioxane concentration decreases in those samples. However, the low occurrence rate introduces uncertainty to any comparison with WSTF COCs.

4.11 Quality Control Samples

Unlike the Phase 1 investigation, NDMA was ND in the field blank samples collected for the low-level analytical method. Duplicate sample results closely matched the corresponding primary sample results in most samples collected and analyzed. Six duplicate samples (of 60 total samples) were flagged “QD” to indicate that the precision for a field duplicate was outside standard limits.

Additionally, one sample, the 13-gallon from WW-4-423, was flagged “SP” indicating that either the spike recovery or the relative percent difference for spike duplicates was outside standard limits.

NASA evaluated the higher of the primary or duplicate sample NDMA concentration in all instances. The effect of the field duplicate and spiked sample precision outside standard limits is considered minimal, and these data are appropriate to support the objective of this investigation.

Data flags for the 1,4-dioxane results indicate similar results as with the NDMA. The occurrence of the “QD” flags was slightly higher than with NDMA, with twelve of 60 samples flagged. In all cases, NASA evaluated the higher of the two (primary or duplicate) sample concentration during this investigation. The effect of the field duplicate sample precision outside standard limits is considered minimal, and these data are appropriate to support the objective of this investigation.

5.0 Uncertainties

NDMA concentrations in groundwater samples collected during this investigation of well WW-4 are not likely subject to uncertainty when considering detections of NDMA in the accompanying QC samples. The identified data quality issues with NDMA samples are limited to duplicate and spike sample precision being outside standard limits. In all cases NASA used the higher of the primary or duplicate sample result to evaluate the effect of increased purge volumes on NDMA results. Of the 40 samples collected from the eight FLUTe zones, six of these samples were flagged, representing 15% of the total samples. Likewise 1,4-dioxane samples flagged “QD” represent 20% of the total samples.

Fluctuations in COPC concentrations may be attributed to the execution of serial purging and sampling of FLUTe zones over multiple days because of previously discussed project constraints. In some instances, analytical results indicate that when a subsequent purge/sample event was not completed on the same day as the previous purge/sample cycle, there was an increase in COPC concentrations when compared with the previous purge/sample COPC concentrations.

6.0 Conclusions

This FLUTe data representativeness evaluation compared a time series of sampling event concentrations from eight FLUTe zones in wells WW-4, BLM-32, JER-2, and WW-5. This investigation included four FLUTe zones from a new liner system installed in WW-4, and included four zones from wells in which FLUTe liners have been installed and sampled over several years. Serial sampling was performed by collecting samples representing pre-purge water in the FLUTe system and samples collected following purging of 1, 2, 3, and 4 sample system volumes. Analytical results from the serial sampling events were also compared with COPC concentrations identified during scheduled groundwater sampling performed in accordance with the GMP. The evaluation shows the following:

- Serial sampling activities conducted during this investigation have identified potential issues with established WSTF FLUTe sampling procedures that may affect sample quality. NASA revised these procedures to assure samples represent formation groundwater by requiring sample collection immediately after purging the minimum volume required for each zone. In all cases a minimum of four gallons will be purged from all FLUTe zones.
- NDMA concentrations through the serial sampling events at the eight FLUTe zones were consistent with historical concentrations in groundwater samples collected from the Water FLUTe system. Based on the evaluation of NDMA detections presented in this report, NASA concludes that NDMA concentrations in groundwater samples collected from the Water FLUTe system may be representative of groundwater, though uncertainty remains due to the variable nature of detections from Water FLUTe systems.
- NDMA concentrations compared with concentrations of 1,4-dioxane and the three TICs evaluated herein does not indicate the presence of 1,4-dioxane and the three TICs in groundwater have a causal effect on NDMA concentrations. There was no obvious correlation between concentrations of NDMA and other constituents.
- The age of each FLUTe liner influences the occurrence of NBBS. Older FLUTe liners may be leaching NBBS at increasing rates with time.

The purpose of this investigation was to determine if the detections of constituents of concern at the eight FLUTe zones will decrease with increased purging prior to sampling. The greatest reduction in NDMA concentrations occurred following purging of the first sampling system volume and did not appreciably decrease with additional purging. Therefore, NASA concludes that significant additional purging of Water FLUTe systems is not likely to impact the detection of the COPCs evaluated in this investigation.

7.0 Recommendations

Based on the regulatory criteria and decision rule provided in the NMED-approved abbreviated work plan (NASA, 2021d), the results of the Phase 2 investigation summarized in Section 4.0 and the conclusions drawn from those results summarized in Section 6.0, NASA recommends continued use of FLUTe systems for collection of groundwater samples from wells with multiple screened intervals. Results of this investigation has prompted NASA to revise sampling procedures to assure samples represent formation groundwater by requiring sample collection immediately after purging the minimum volume from each zone. NASA recommends continued evaluation of WSTF COCs in groundwater samples collected from FLUTe systems to determine if the procedural changes affect COC concentrations.

Additionally, NASA recommends the minimum purge volumes remain unchanged from the current requirements of four gallons from wells BLM-32, JER-1, JER-2, ST-7, WW-4, and WW-5, and four and a half gallons from wells PL-11 and ST-6. COPC concentrations do not appreciably reduce following additional purging activities, but were minimally reduced in wells BLM-32, JER-2 and WW-5 by purging two cycles prior to sampling (8 gallons). Evaluation of future COC concentrations in samples collected using the revised procedures will provide additional information that will support changes to the established purge volumes.

NASA submitted the *NASA WSTF Westbay Well Reconfiguration Work Plan for Westbay Wells PL-7, PL-8, PL-10, ST-5, and WW-3* on April 29, 2021 (NASA, 2021b). NASA proposed to replace the Westbay systems in these wells with purgeable, multiport Water FLUTe sampling systems to improve the quality of groundwater samples collected for chemical analysis. The basis is that NDMA concentrations in this study are consistent with historical concentrations in groundwater samples collected from the Water FLUTe system. Alternatives to the Water FLUTe system for permanent purgeable sampling systems in general are under consideration, though NASA does not recommend any currently available options over the Water FLUTe system for existing multi-zone monitoring wells.

8.0 References

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Figures

Figure 2.1 **FLUTe Phase 2 Well Location Map**

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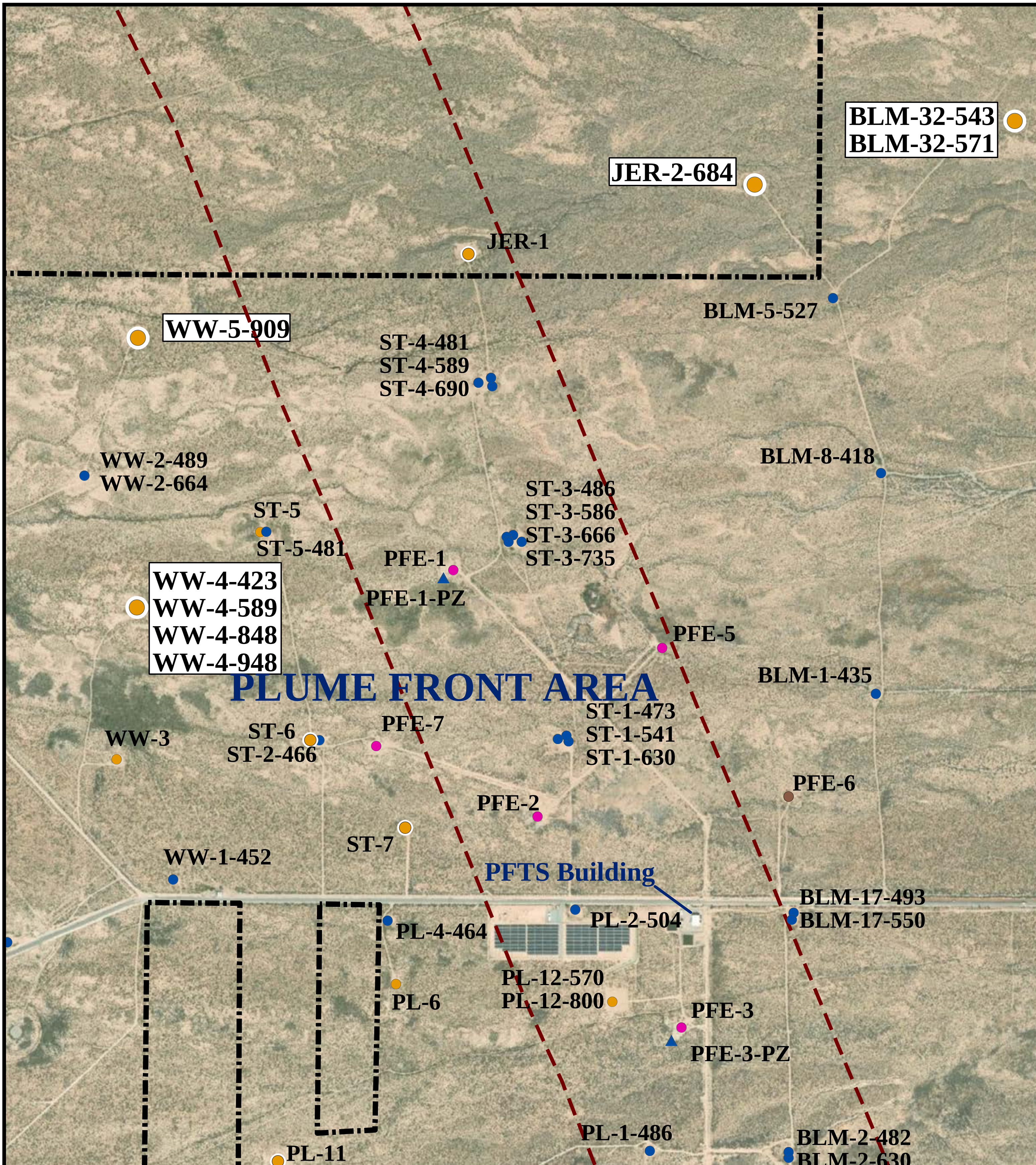
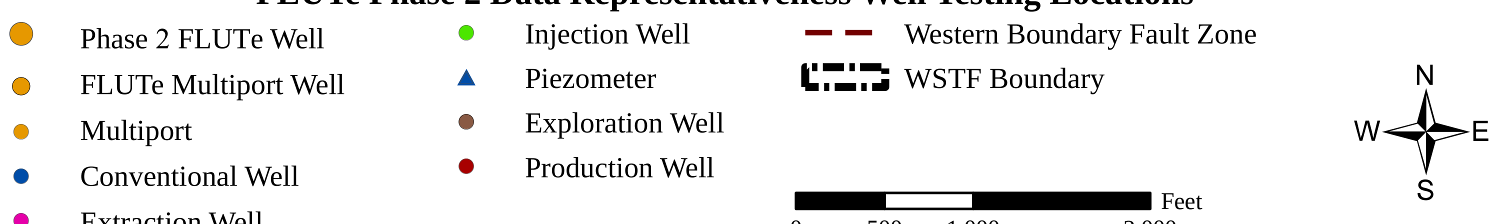


FLUTe Phase 2 Data Representativeness Well Testing Locations



April 2023

Figure 3.1 **WW-4 Water FLUTe Installation Diagram**

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WW-4 WATER FLUTe INSTALLATION DIAGRAM

Brass Cap: 4,443.19' (AMSL)
Borehole Diameter: 17 ½" 0-117'; 12 ¼" 117'-1,020'
Surface Casing: Nominal 14" (13 ½" Inside Diameter [ID]) Carbon Steel to 117'
Casing and Screen: Nominal 5" (4 ¾" ID) Schedule (SCH) 80 PVC

Coordinates: 554,772.88' N; 1,512,065.14' E
Original Development Start Date: 04/18/01
Original Development End Date: 04/25/01
Redevelopment Start Date: 09/29/15
Redevelopment End Date: 10/02/15
FLUTe Well Installation Date: 11/09/15

Water FLUTe Sampling Zones:
419'-429'
589'-599'
848'-858'
948'-958'

Not to Scale
All measurements in ft-bgs
unless otherwise noted
Coordinates are NM State Plane (NAD 83 in ft)

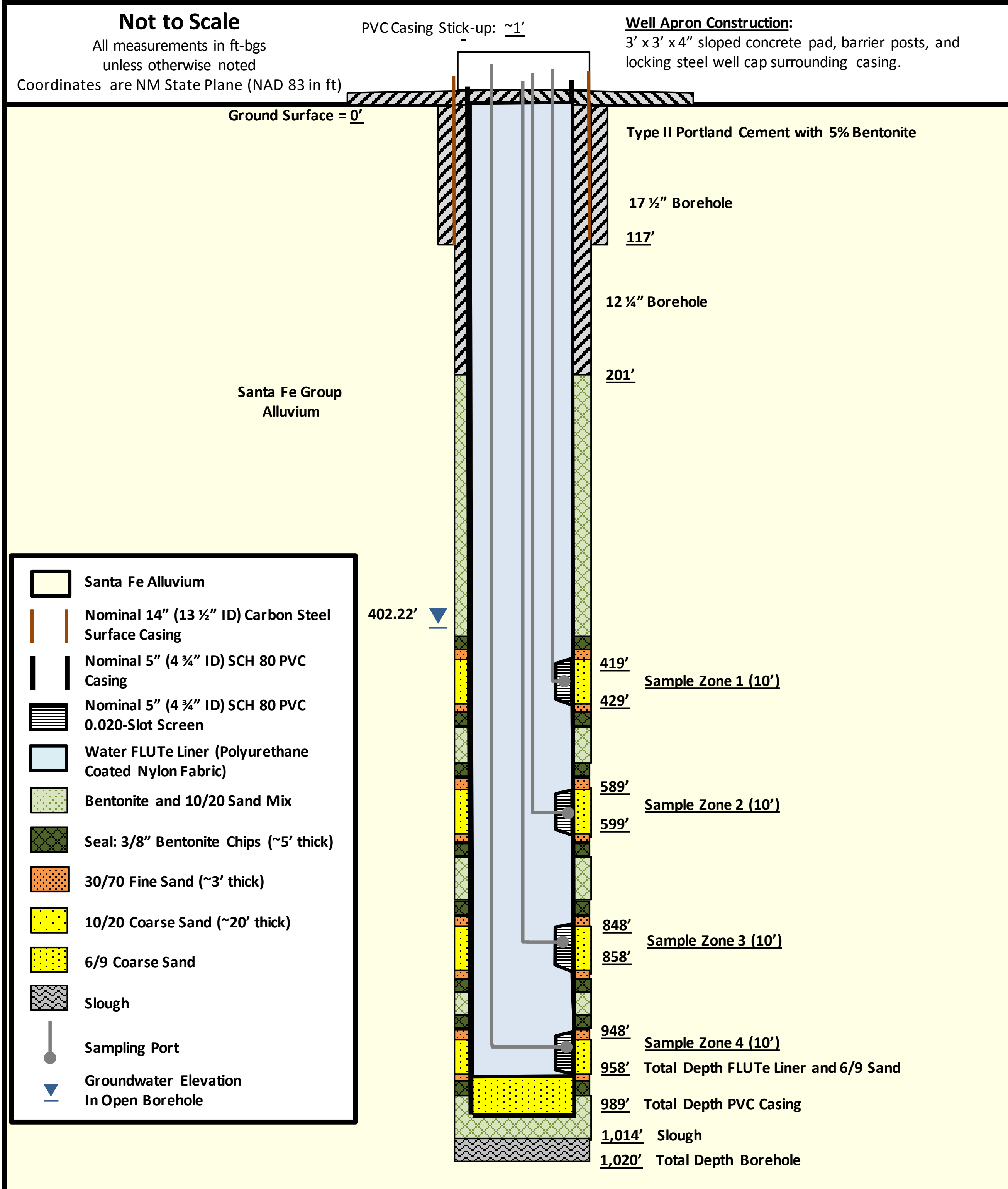

Figure 3.2 **BLM-32 Water FLUTe Installation Diagram**

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BLM-32 Water FLUTe INSTALLATION DIAGRAM

Brass Cap : 4,597.18' (AMSL)
Coordinates: 558,870.47' N; 1,519,464.23' E
Borehole Diameter: 8 ¾" = 0' - 376';
4 ½" = 376' - 750'
Surface Casing: 5 ¼" carbon steel to 376' bgs

Original Development Start Date: 06/07/97
Original Development End Date: 06/08/97
FLUTe Well Installation Date: 08/13/15

Water Flute Sampling Zones:
543'-563'
571'-591'
632'-647'

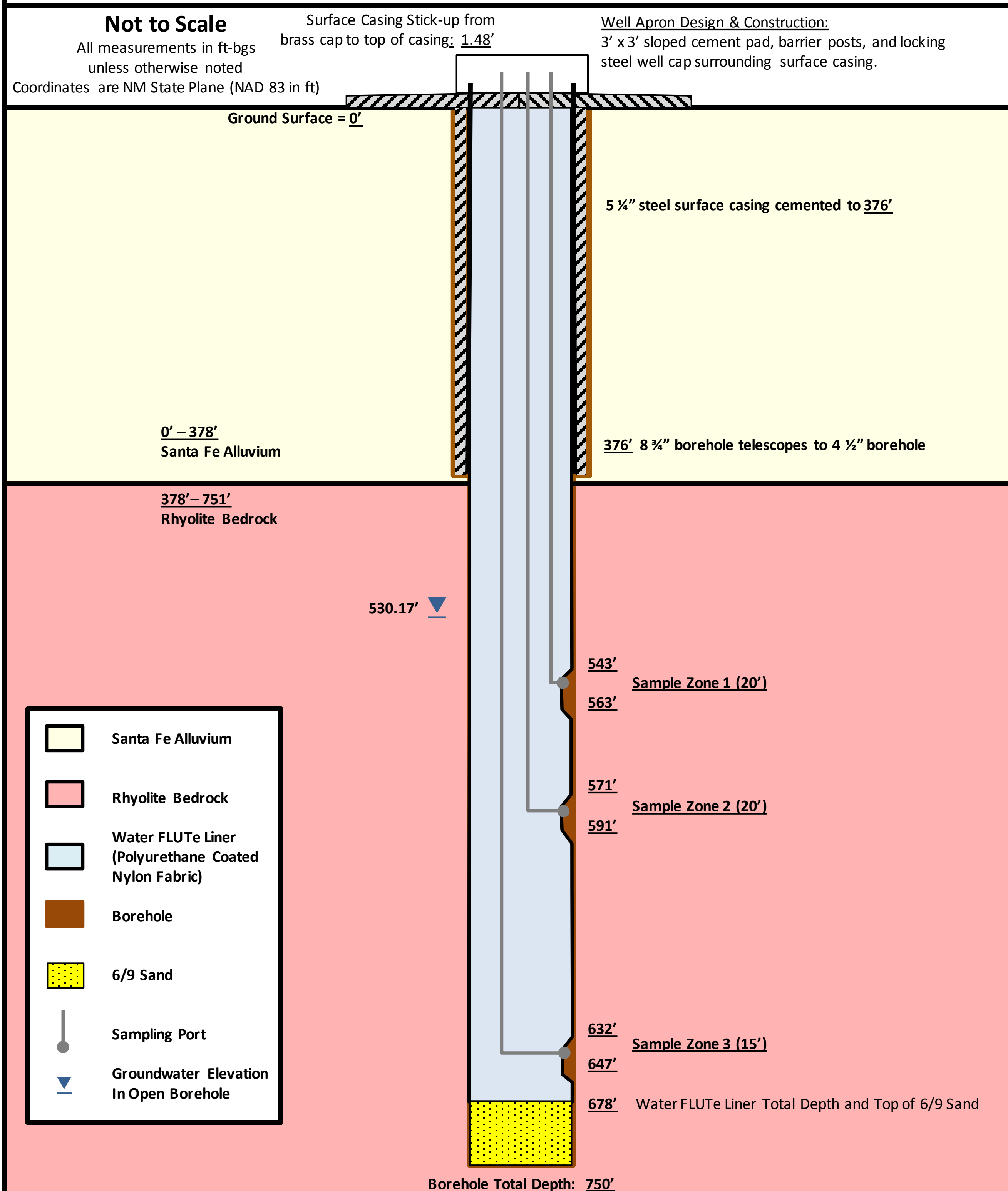

Figure 3.3 JER-2 Water FLUTe Installation Diagram

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JER-2 Water FLUTe Well Installation Diagram

Brass Cap: 4,546.32 ft amsl
Coordinates: 558,336.64 N; 1,517,273.62 E
Borehole Diameter: 12.25”
Casing and Screen: Nominal 6” SDR-17 PVC
Surface Casing: 14” Steel to 69’

Original Development Start Date: 12/7/03
Original Development End Date: 12/23/03
Redevelopment Dates: 10/8/16-10/19/16
FLUTe Well Installation Date: 1/5/17-1/6/17

Water FLUTe Sampling Zones:
503.5’- 513.5’
583.5’-593.5’
683.5’-693.5’

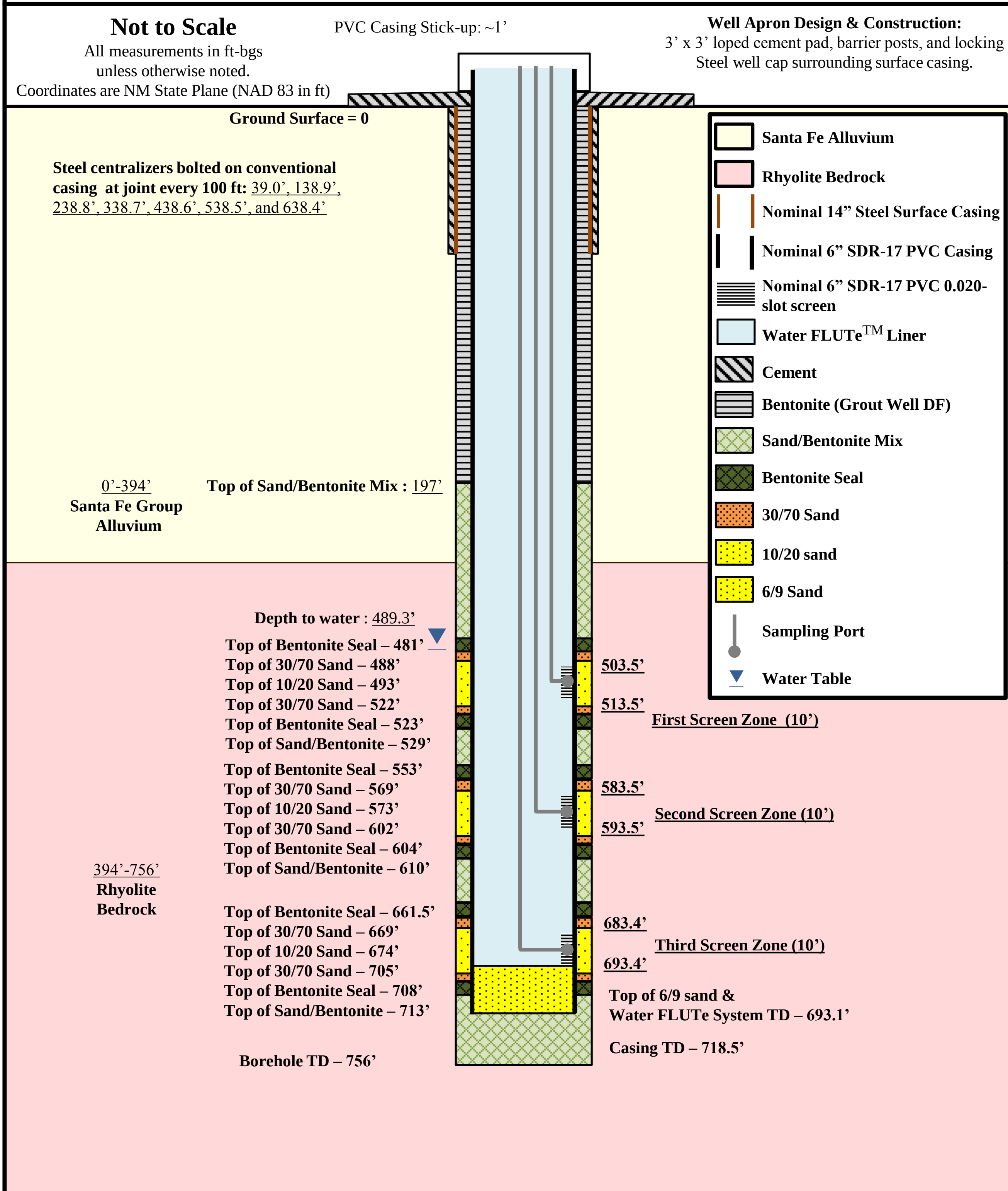


Figure 3.4 WW-5 Water FLUTe Installation Diagram

(SEE NEXT PAGE)

WW-5 WATER FLUTe INSTALLATION DIAGRAM

Brass Cap: 4,444.59' (AMSL)
Borehole Diameter: 17 ½" 0-116'; 12 ¼" 116'-1,020'
Surface Casing: Nominal 14" (13 ½" Inside Diameter [ID]) Carbon Steel to 116'
Casing and Screen: Nominal 5" (4 ¾" ID) Schedule (SCH) 80 PVC

Coordinates: 557,042.74' N; 1,512,073.89' E
Original Development Start Date: 09/27/01
Original Development End Date: 10/06/01
Redevelopment Start Date: 09/26/15
Redevelopment End Date: 09/29/15
FLUTe Well Installation Date: 11/10/15

Water FLUTe Sampling Zones:
459'-469'
579'-589'
809'-819'
909'-919'

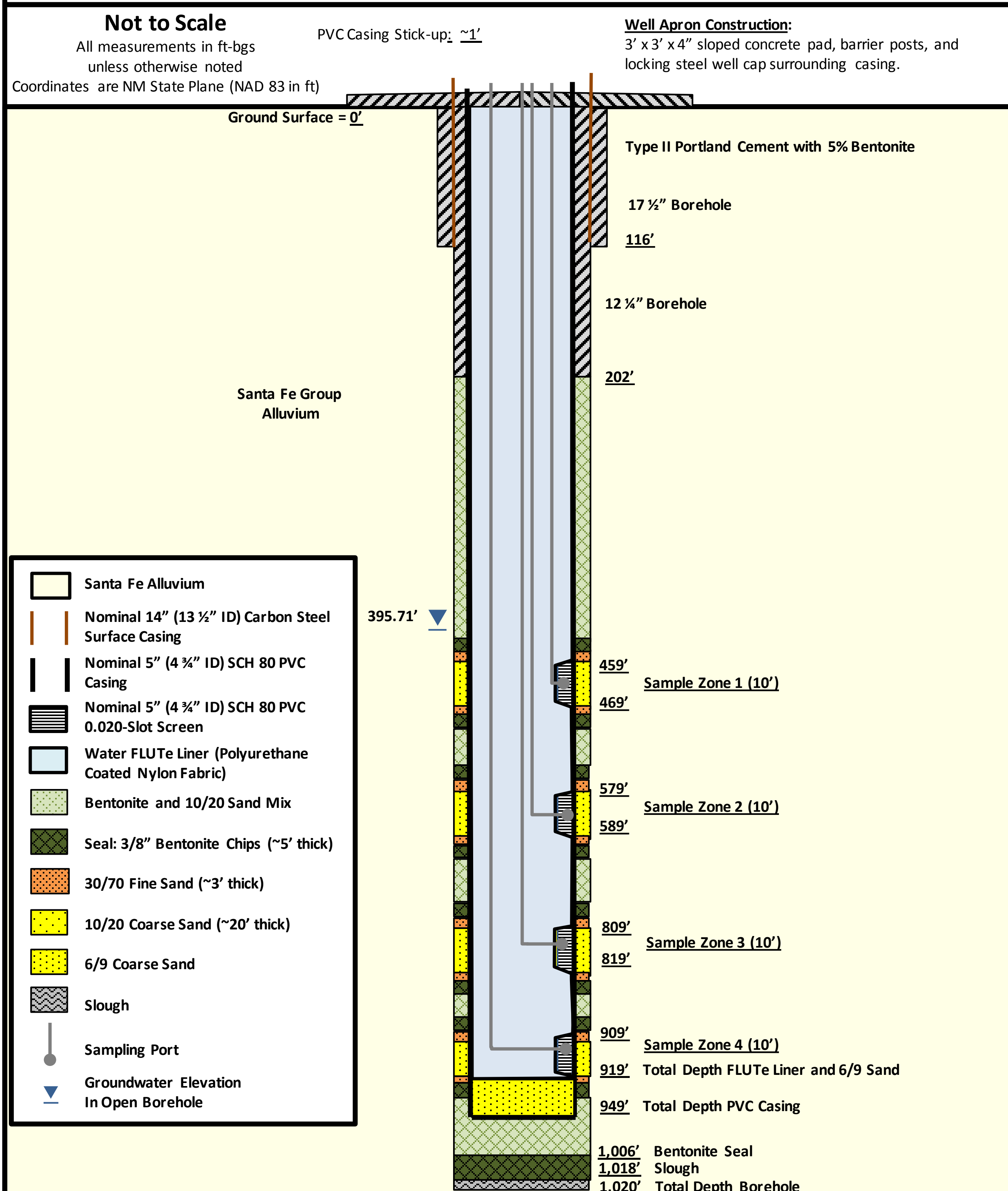
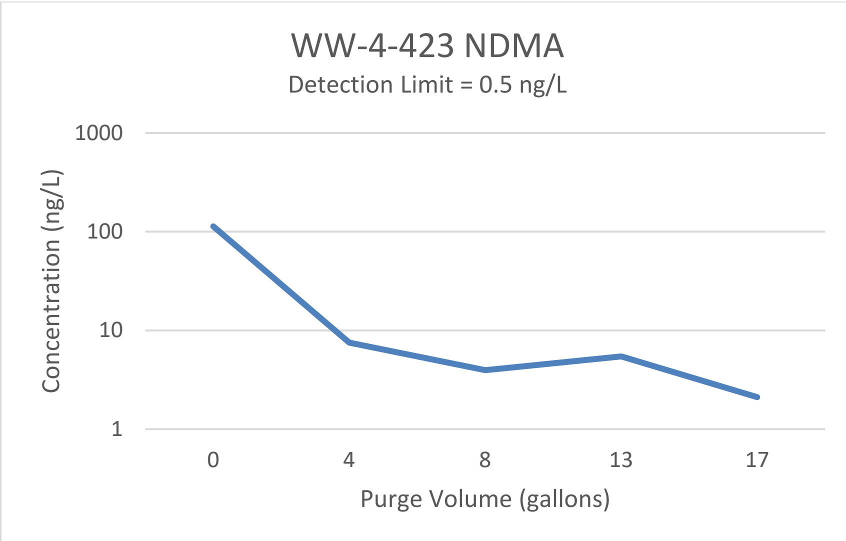
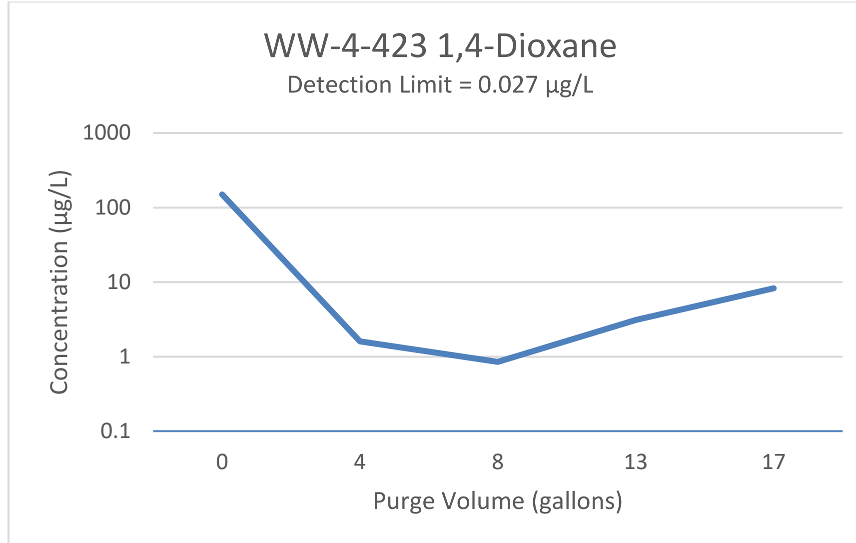


Figure 4.1 **WW-4-423 FLUTe Sampling Events Results**





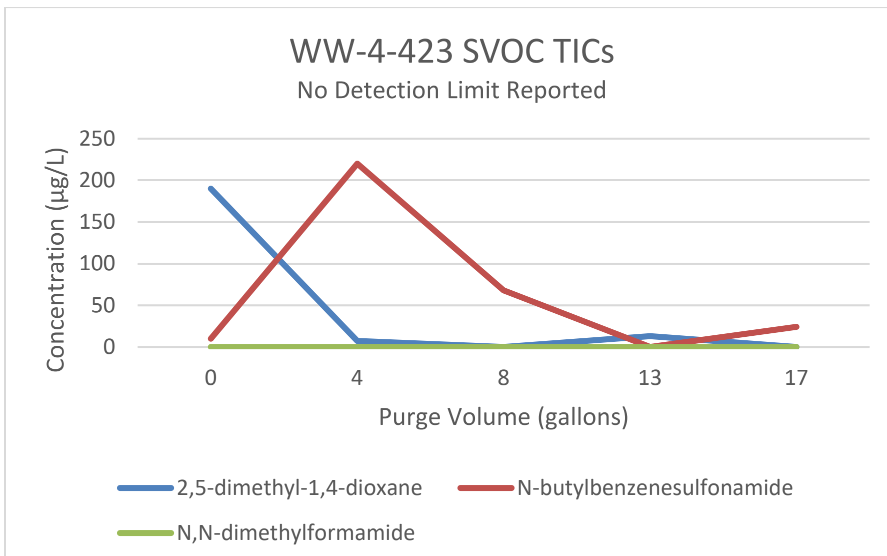
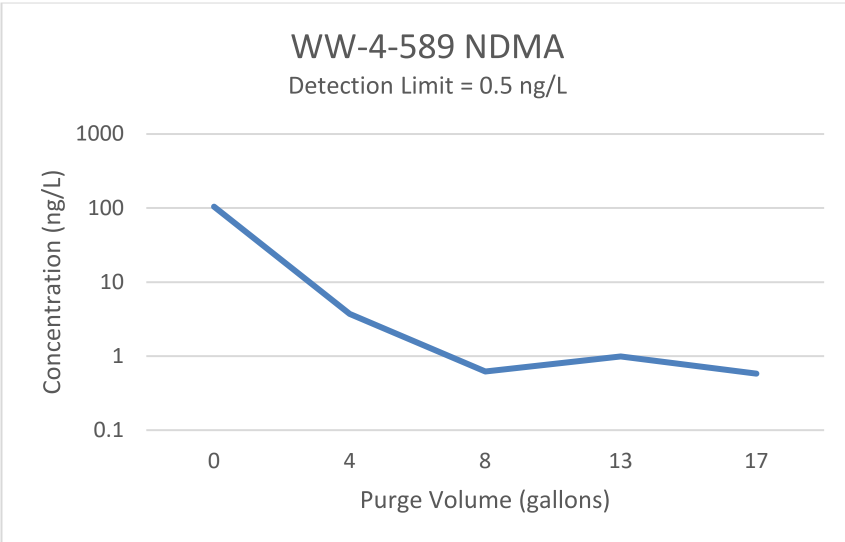
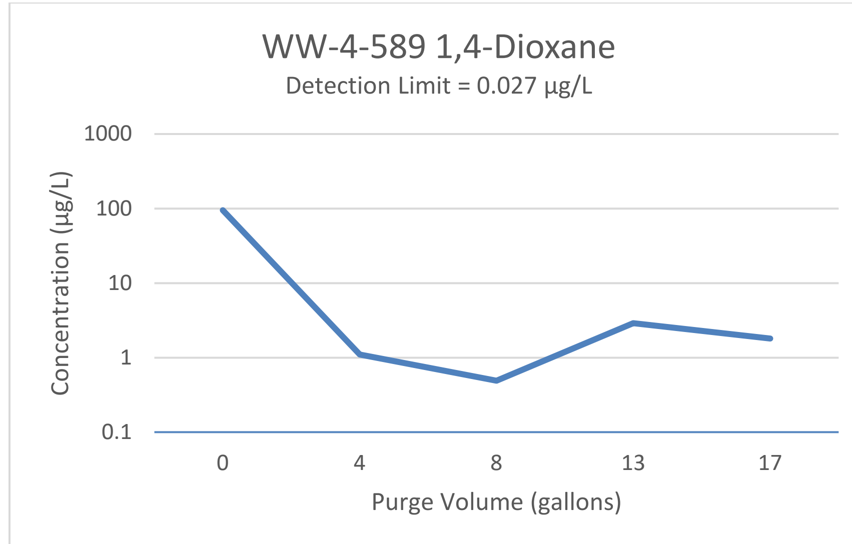


Figure 4.2 **WW-4-589 FLUTe Sampling Events Results**





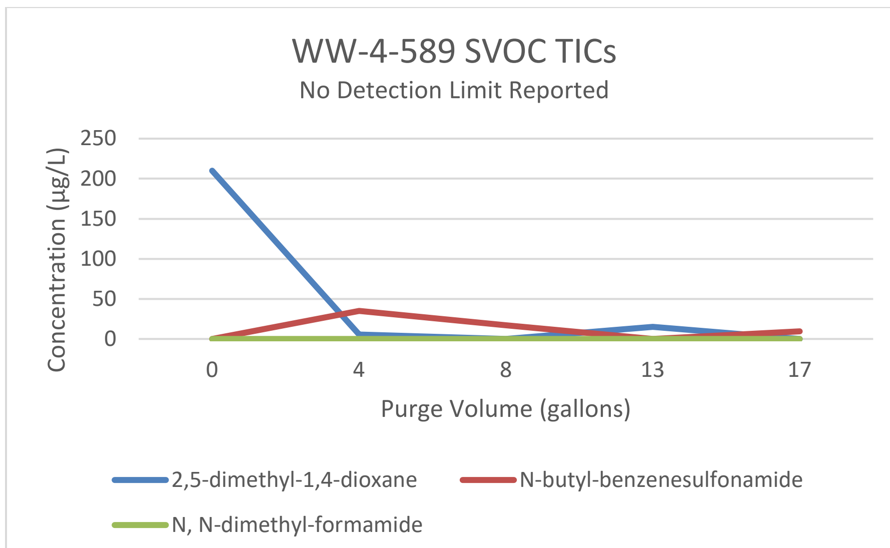
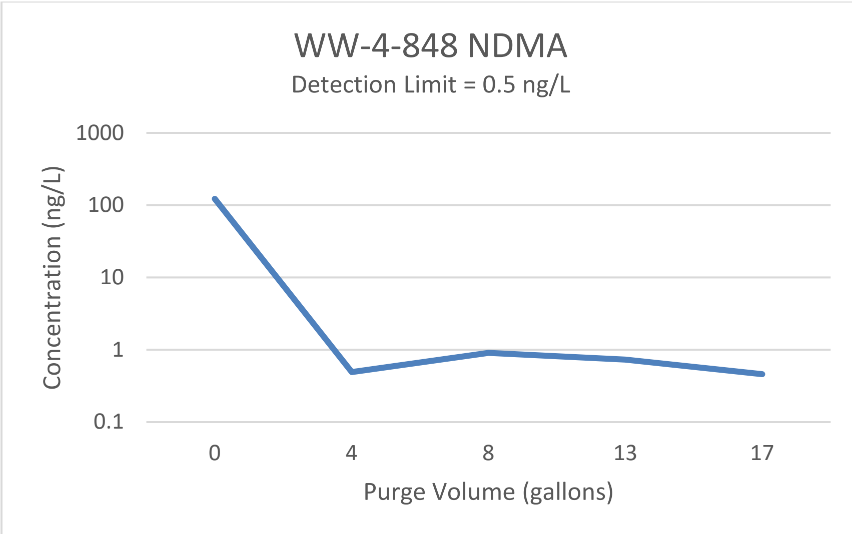
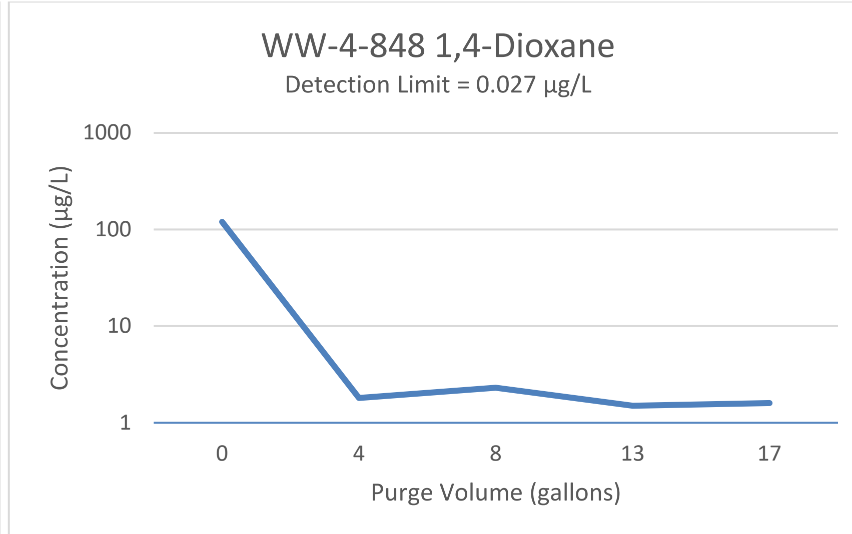


Figure 4.3 **WW-4-848 FLUTe Sampling Events Results**





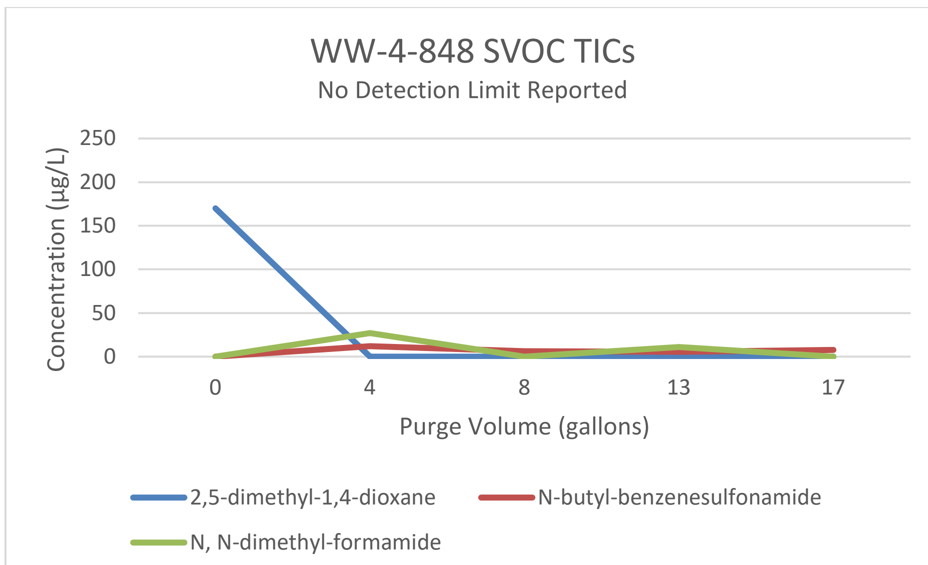
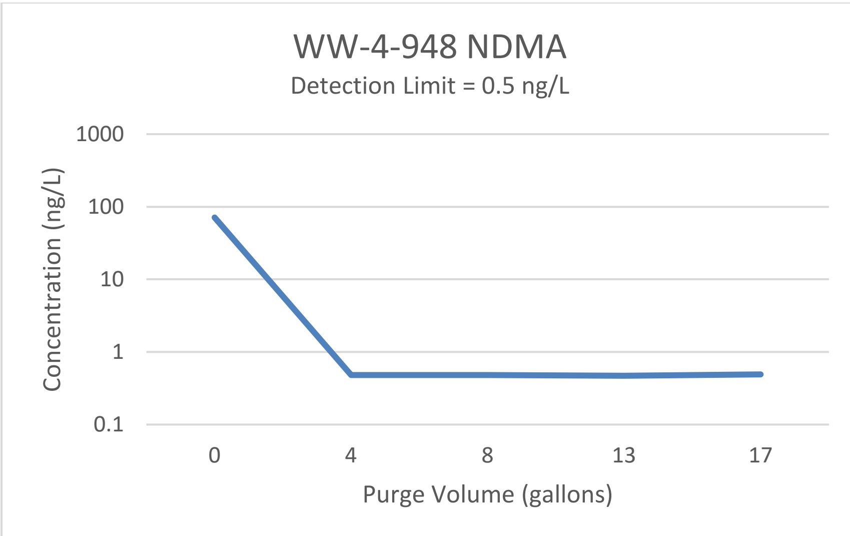
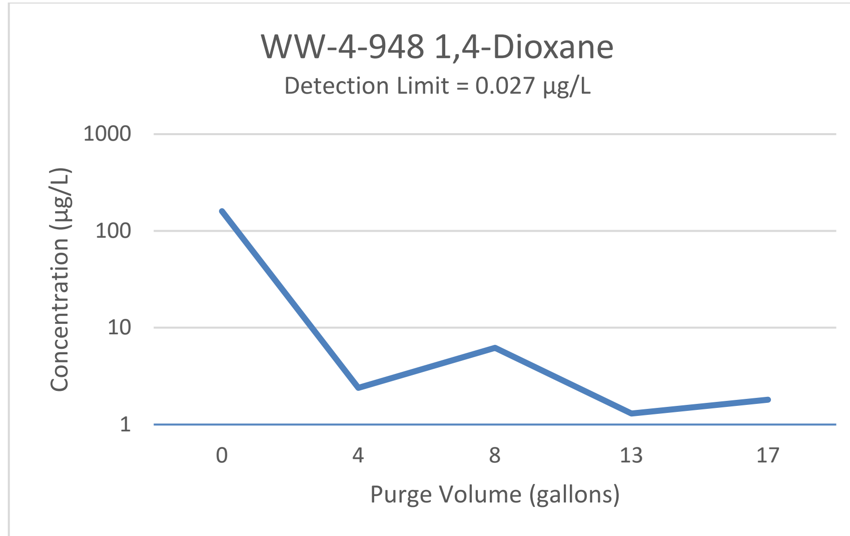


Figure 4.4 **WW-4-948 FLUTe Sampling Events Results**





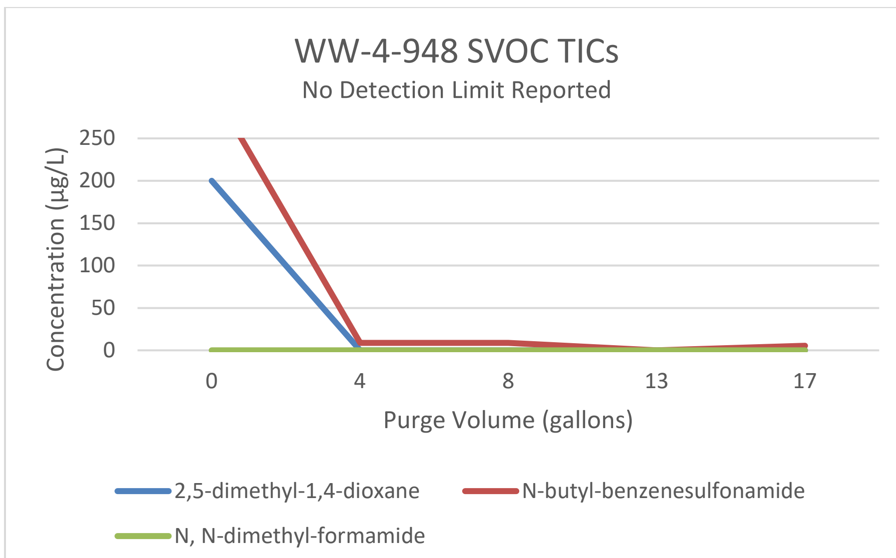
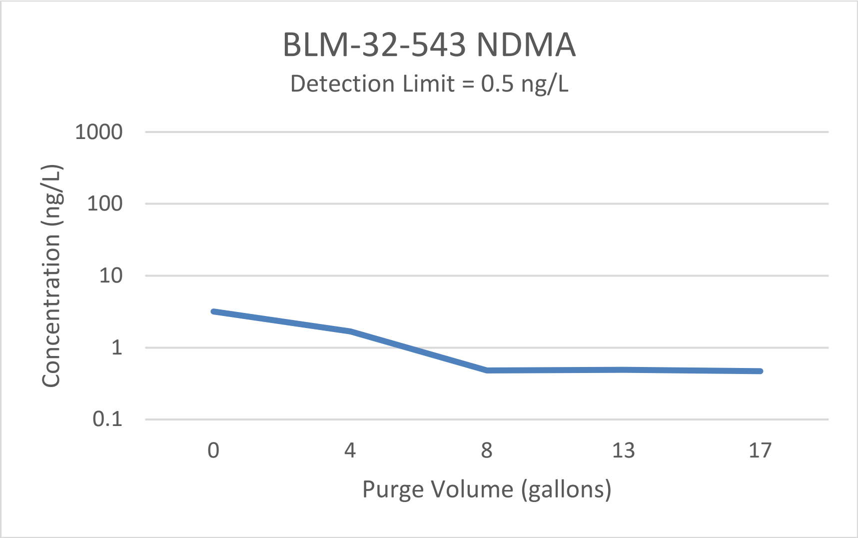
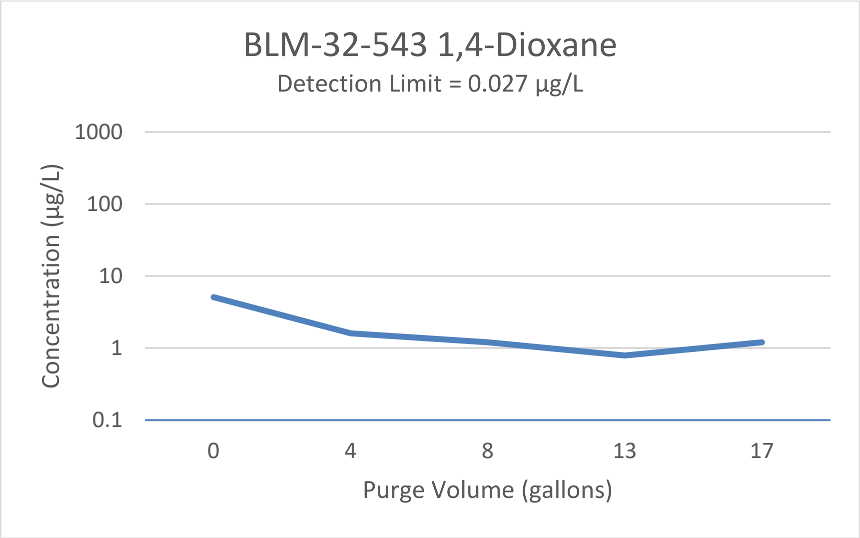


Figure 4.5 **BLM-32-543 FLUTe Sampling Events Results**





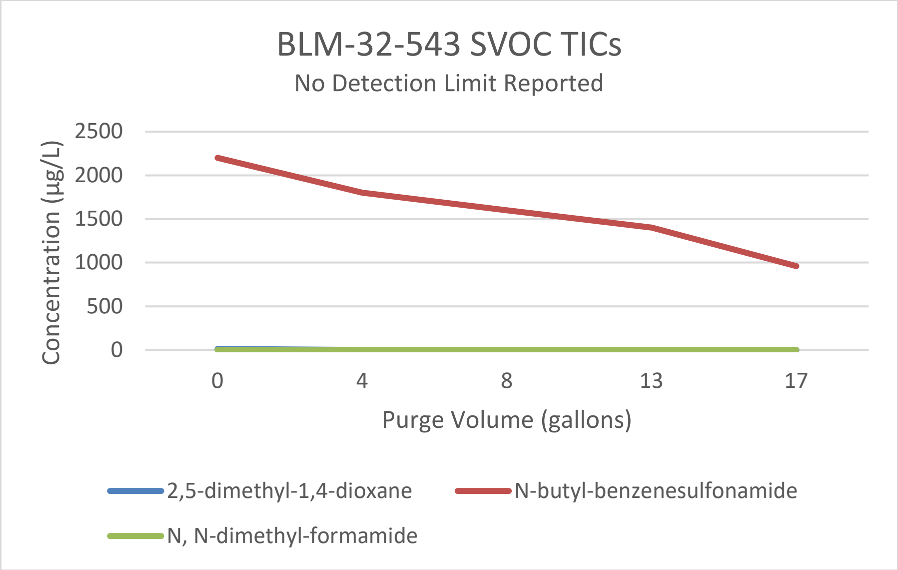


Figure 4.6 **BLM-32-571 FLUTe Sampling Events Results**

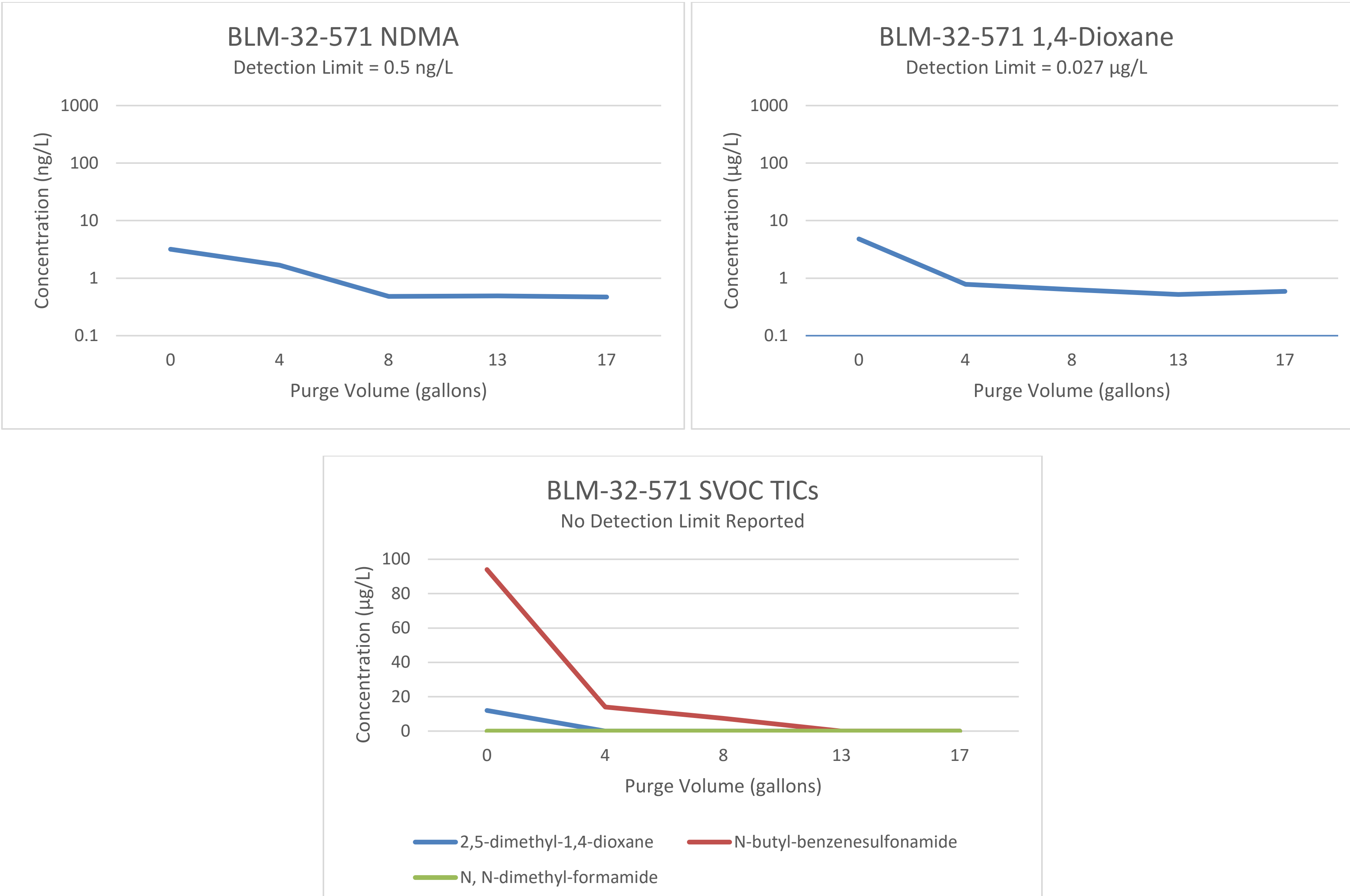
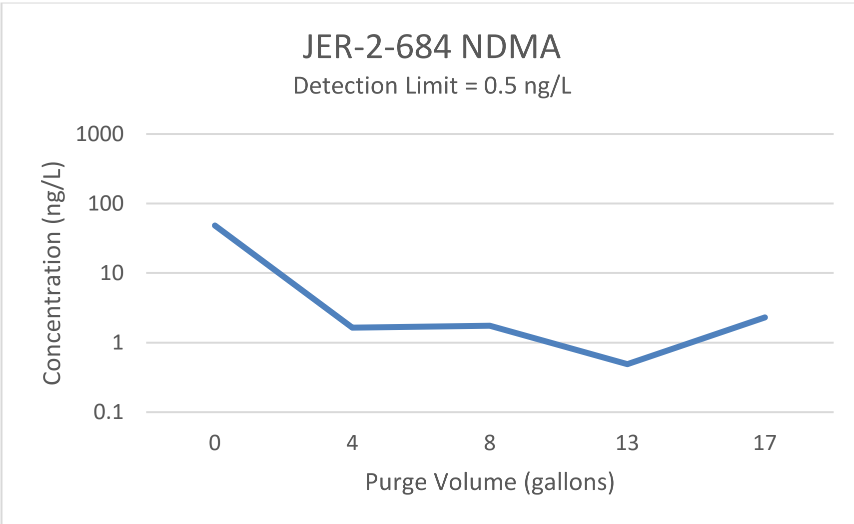
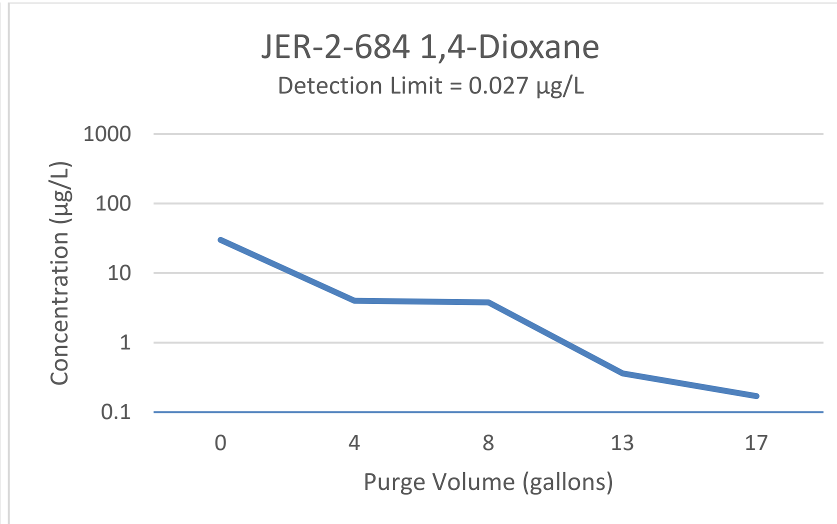


Figure 4.7 **JER-2-684 FLUTe Sampling Events Results**





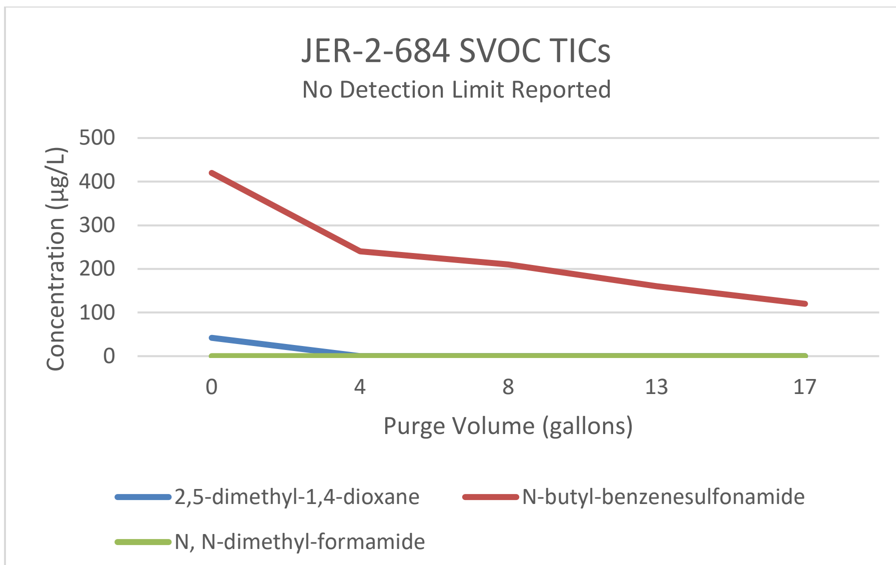


Figure 4.8 **WW-5-909 FLUTe Sampling Events Results**

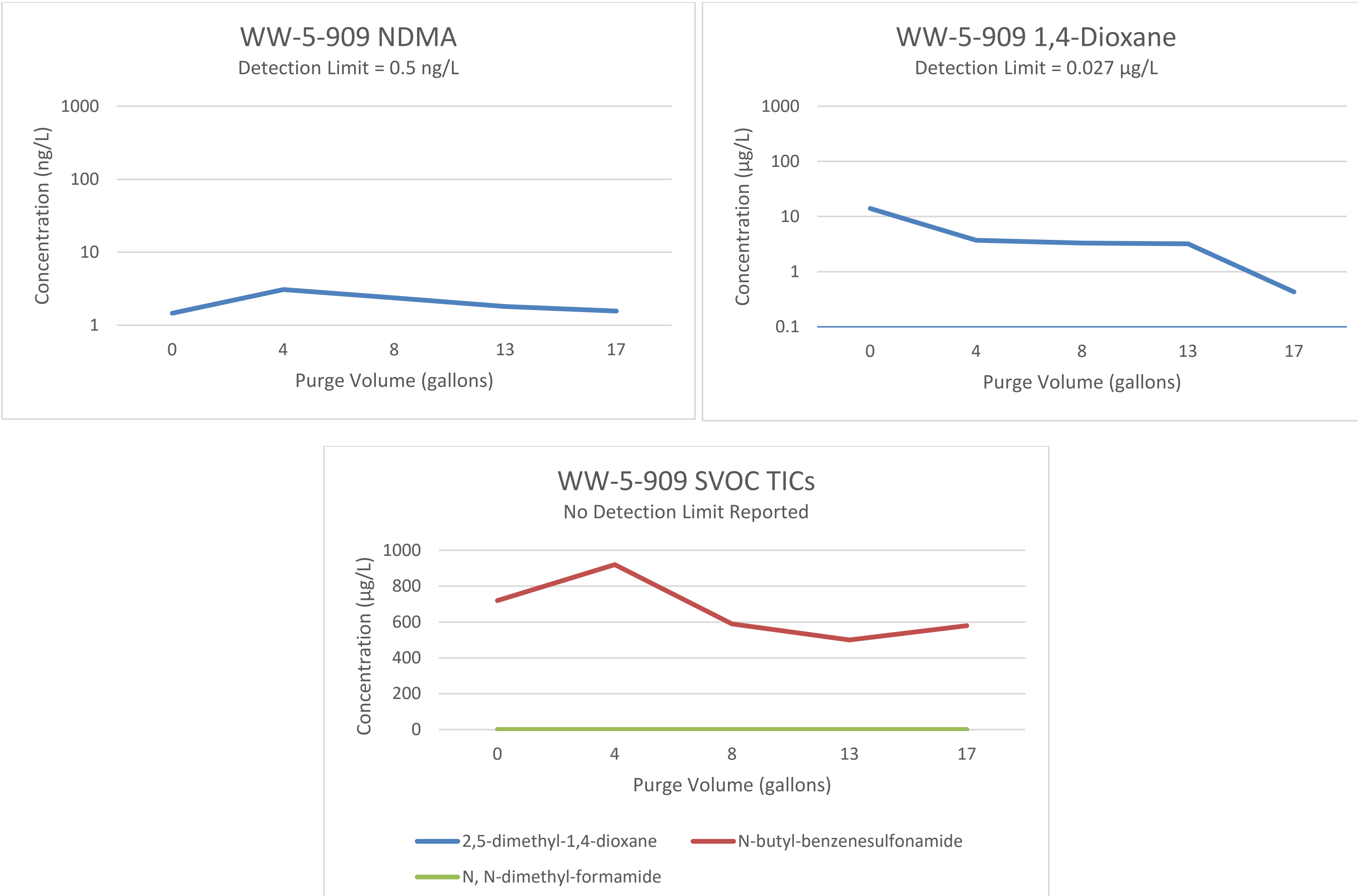


Figure 4.9 **WW-4-423 Historical NDMA**

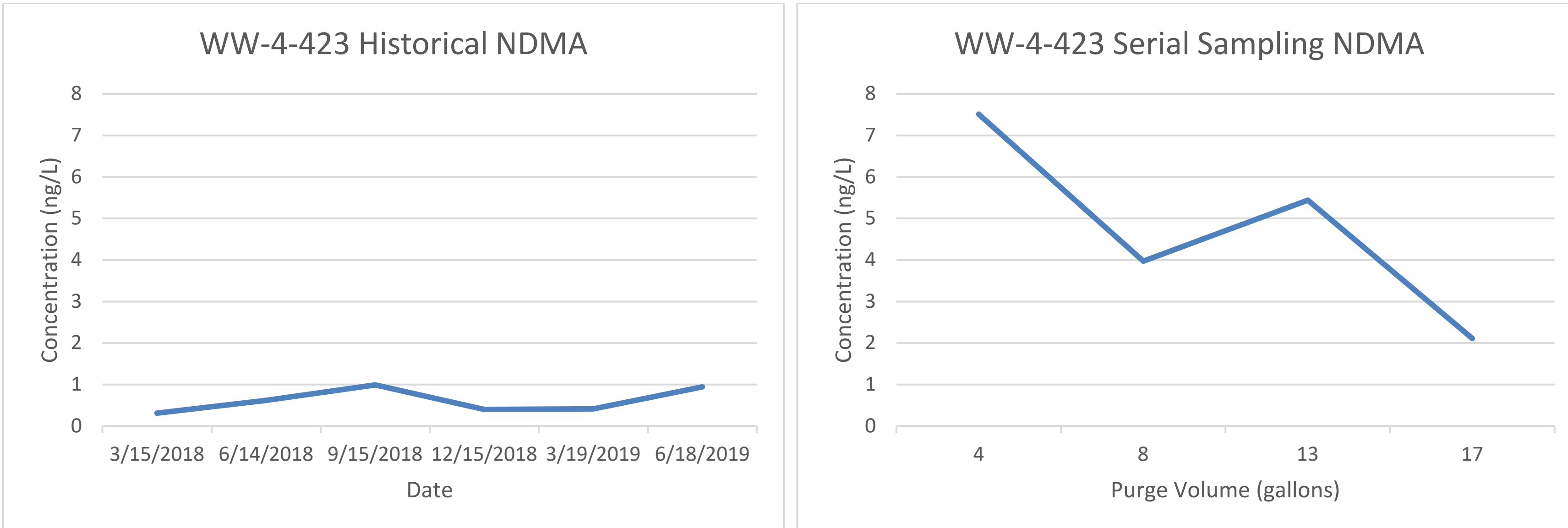


Figure 4.10 **WW-4-589 Historical NMDA**

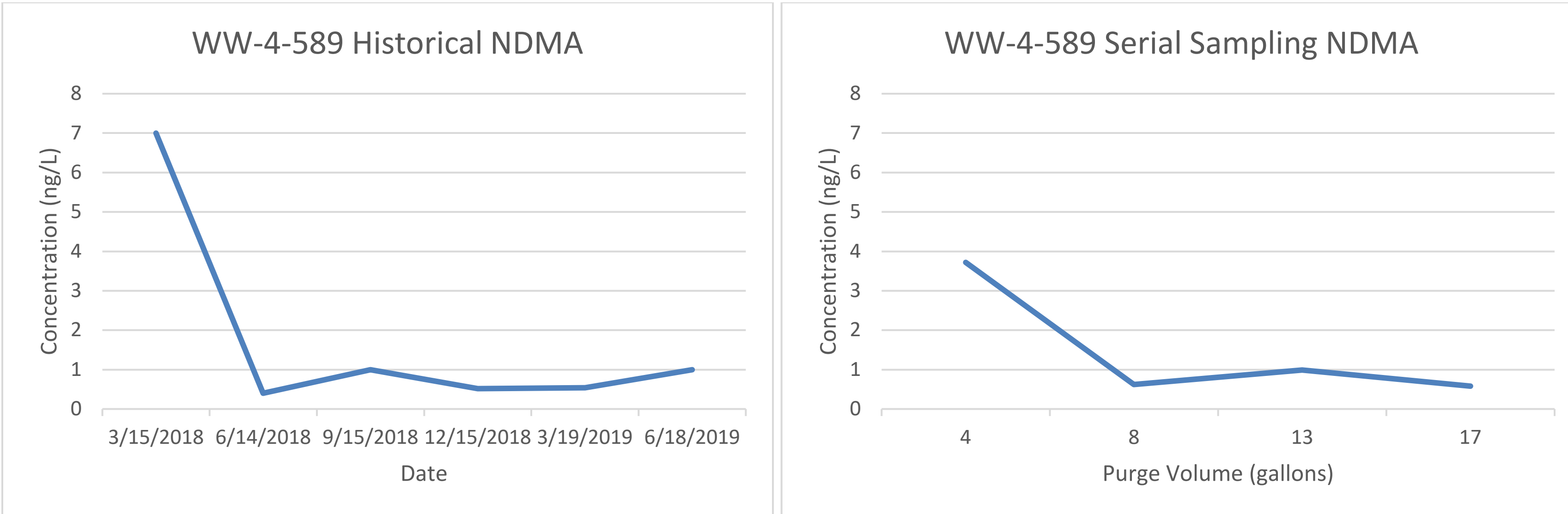
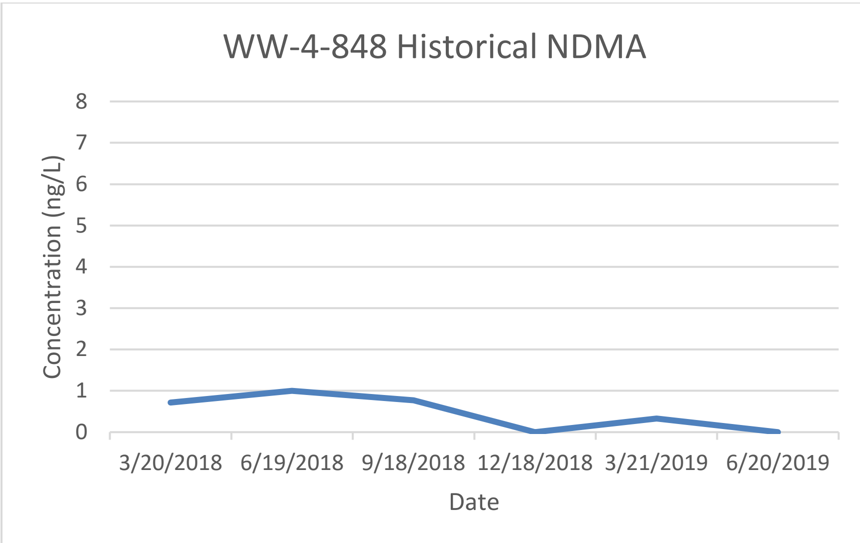


Figure 4.11 **WW-4-848 Historical NDMA**



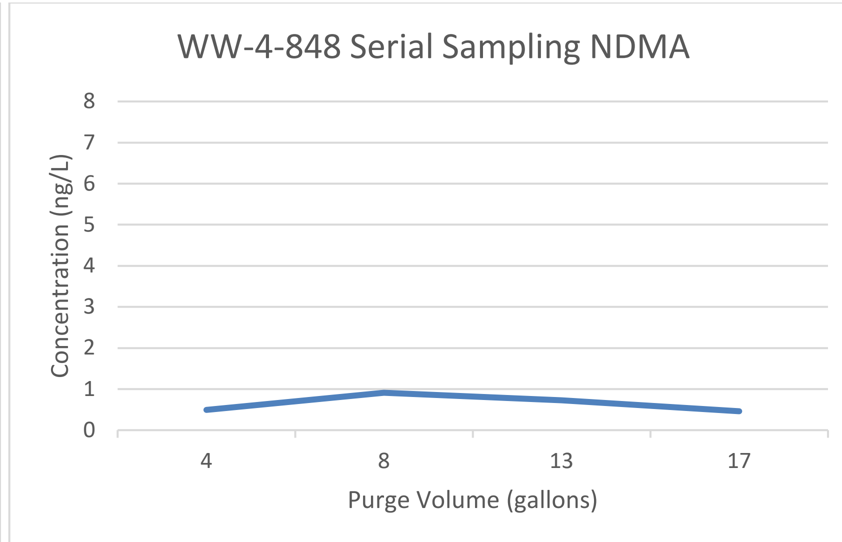
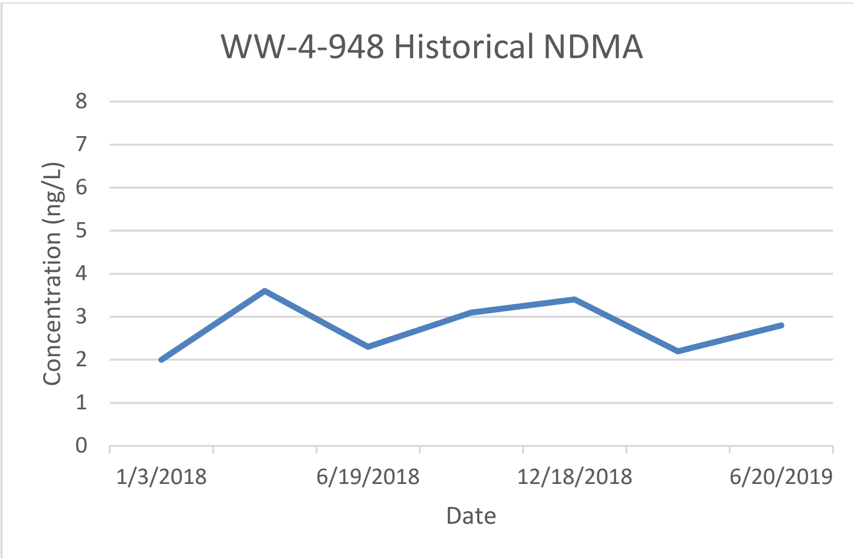


Figure 4.12 **WW-4-948 Historical NDMA**



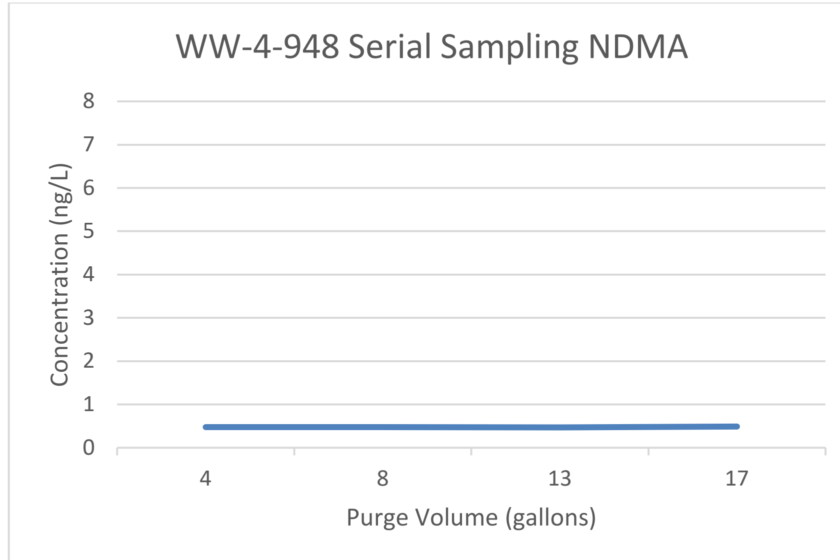
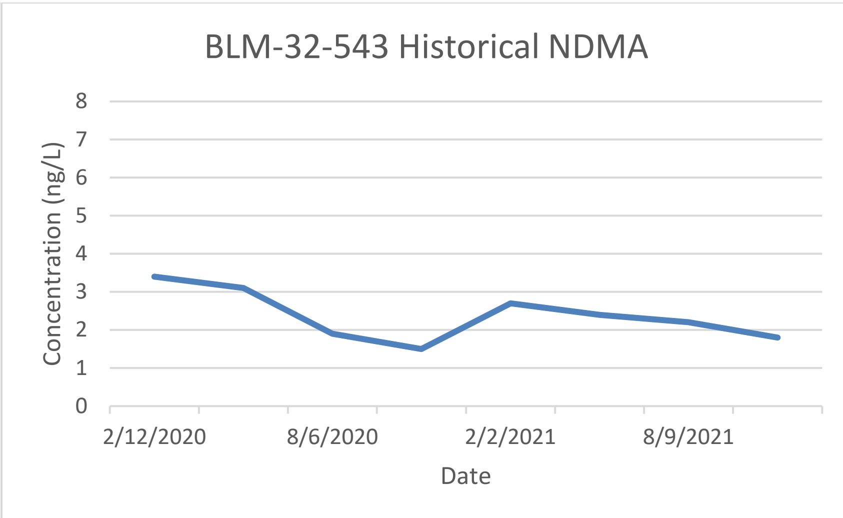


Figure 4.13 **BLM-32-543 Historical NDMA**



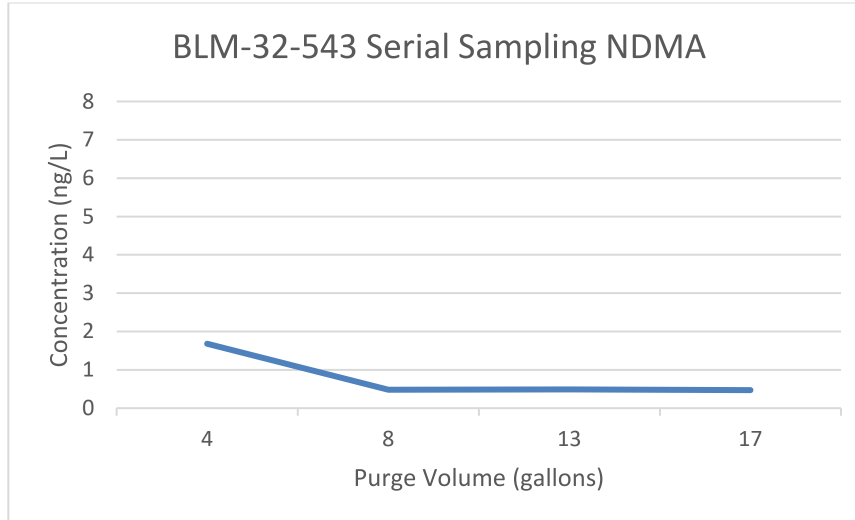


Figure 4.14 **BLM-32-571 Historical NDMA**

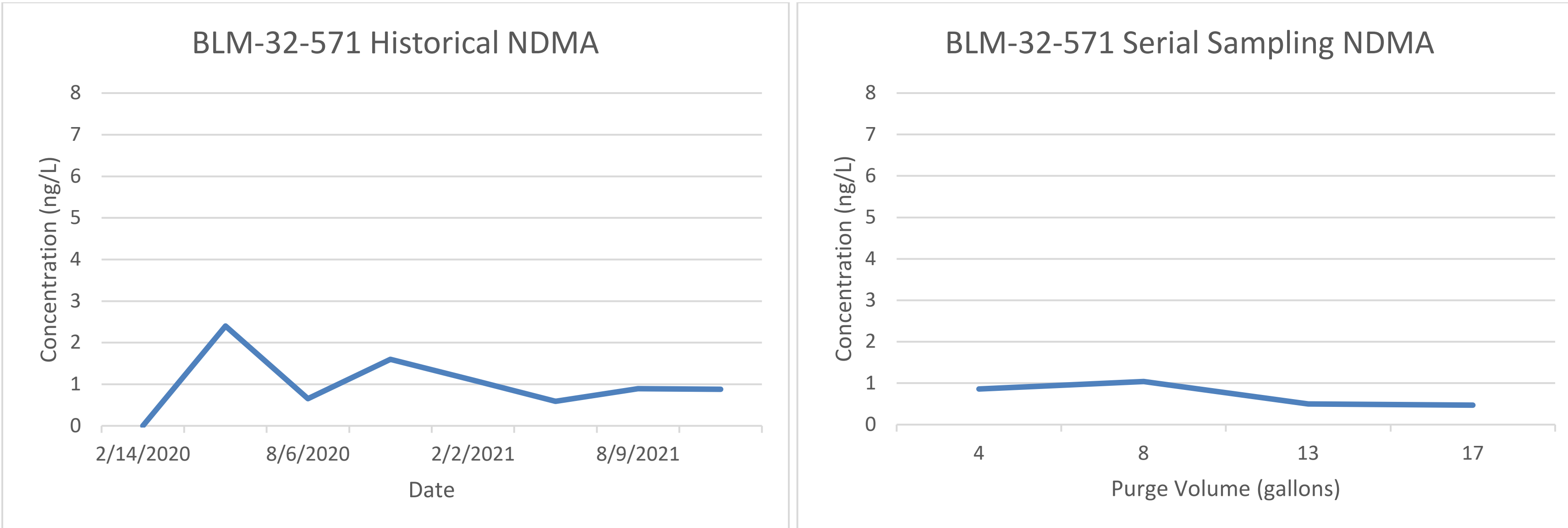
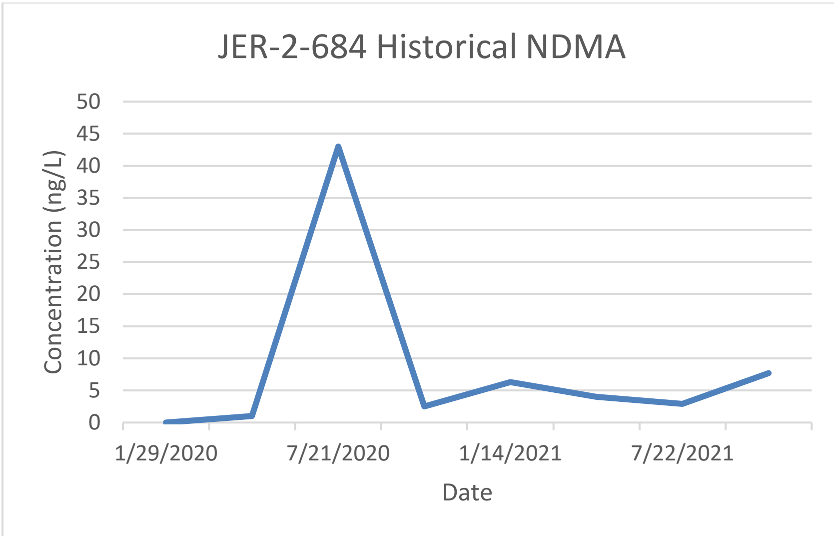


Figure 4.15 **JER-2-684 Historical NMDA**



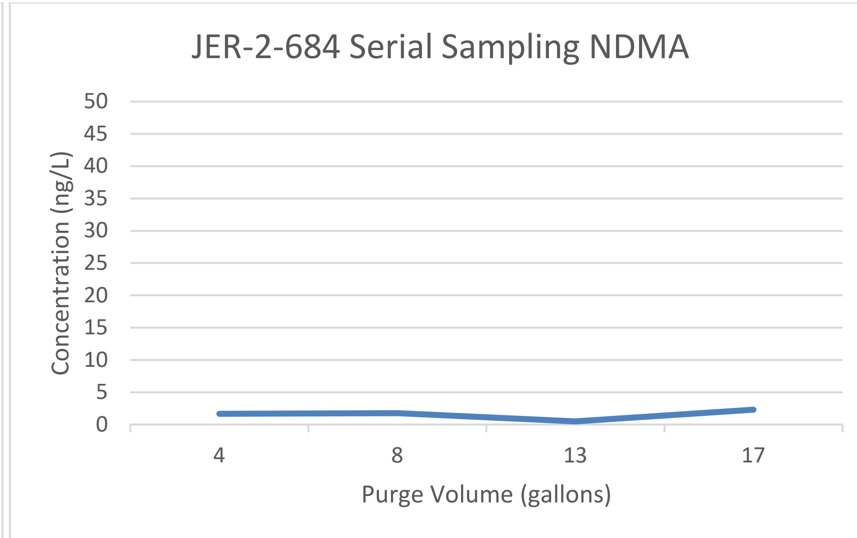
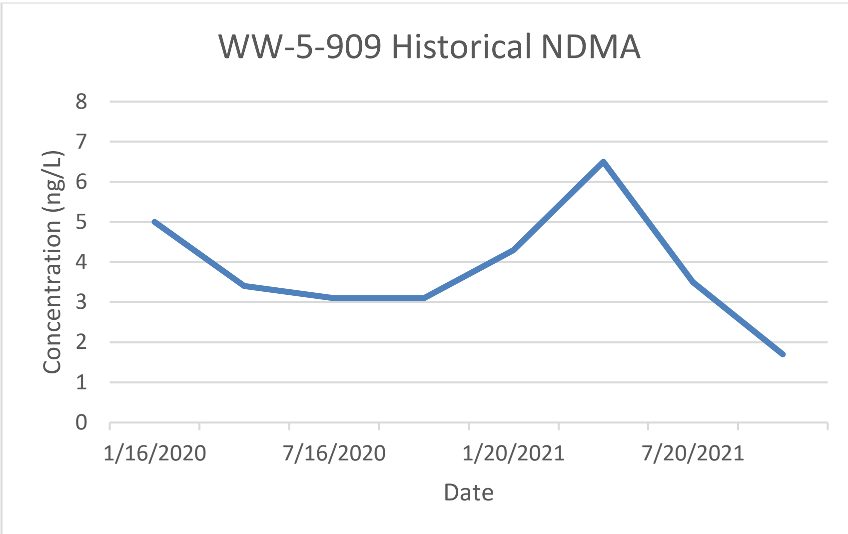
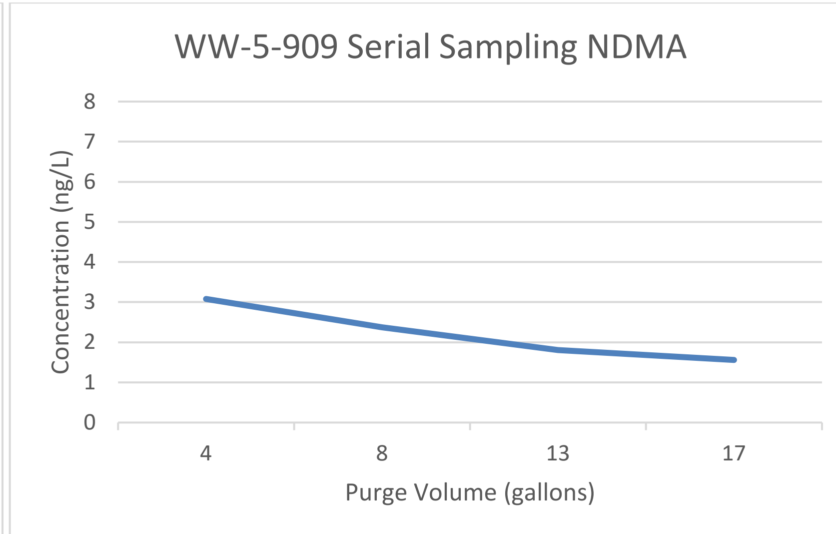


Figure 4.16 **WW-5-909 Historical NDMA**





Tables

Table 3.1 Phase 2 Investigation Sample Inventory

FLUTe Zone	Date of Sample	Time Sampled		Cumulative Purge Volume (gal)	Initial Field Parameters	LL-NDMA[1] (QA)[4]	1,4-Dioxane by SVOC SIM[2] (QA)[4]	SVOC[3] (QA)[4]
		Start	End					
WW-4-423	05/09/22	08:04	08:31	0	X	X (D)	X (TB, FB)	X (FB, D)
	05/09/22	13:30	14:45	4	X	X (D) (D)	X (D)	X (D)
	05/10/22	09:48	09:52	8	X	X (D)	X (D)	X
	05/11/22	06:47	07:13	13	X	X (D)	X (MS/MSD)	X (D)
	05/11/22	13:33	14:36	17	X	X (D)	X (D)	X
WW-4-589	05/09/22	08:12	08:39	0	X	X (FB)	X (FB)	X (FB)
	05/09/22	13:48	14:50	4	X	X (D)	X (D)	X (D)
	05/10/22	10:14	10:18	8	X	X (D)	X (MS/MSD)	X
	05/11/22	07:02	07:23	13	X	X (D)	X (D)	X (D)
	05/11/22	13:44	14:47	17	X	X	X (D)	X (D)
WW-4-848	05/12/22	07:05	07:10	0	X	X (FB)	X (FB)	X (FB)
	05/12/22	10:07	10:48	4	X	X (D)	X (MS/MSD)	X (D)
	05/13/22	07:10	07:43	8	X	X (D)	X (D)	X
	05/13/22	12:50	13:45	13	X	X (D)	X (D)	X (D)
	05/16/22	09:50	09:54	17	X	X (D)	X (D)	X (D)
WW-4-948	05/12/22	07:17	07:22	0	X	X (FB)	X (FB)	X (FB)
	05/12/22	10:18	10:59	4	X	X (D)	X (D)	X (D)
	05/13/22	07:21	07:48	8	X	X (D)	X (MS/MSD)	X
	05/13/22	13:16	13:55	13	X	X (D)	X (D)	X (D)
	05/16/22	09:36	10:08	17	X	X (D)	X (D)	X (D)
BLM-32-543	05/16/22	14:00	14:05	0	X	X (FB)	X (TB, FB)	X (FB)
	05/17/22	13:40	14:21	4	X	X (D)	X (D)	X (D)
	05/18/22	13:26	14:03	8	X	X (D)	X (D)	X
	05/19/22	13:16	14:21	13	X	X (D)	X (MS/MSD)	X (D)
	05/23/22	13:21	13:48	17	X	X (D)	X (D)	X

FLUTe Zone	Date of Sample	Time Sampled		Cumulative Purge Volume (gal)	Initial Field Parameters	LL-NDMA[1] (QA)[4]	1,4-Dioxane by SVOC SIM[2] (QA)[4]	SVOC[3] (QA)[4]
		Start	End					
BLM-32-571	05/16/22	14:20	14:25	0	X	X (FB)	X (FB)	X (FB)
	05/17/22	13:50	14:30	4	X	X (D)	X (MS/MSD)	X (D)
	05/18/22	13:46	14:18	8	X	X (D)	X (D)	X
	05/19/22	13:36	14:10	13	X	X (D)	X (D)	X (D)
	05/23/22	13:36	13:58	17	X	X (D)	X (D)	X (D)
JER-2-684	05/24/22	07:30	07:35	0	X	X (FB, D)	X (TB, FB)	X
	05/24/22	13:21	13:52	4	X	X (D)	X (D)	X (D)
	05/25/22	13:31	14:23	8	X	X (D)	X (D)	X
	05/26/22	13:01	13:45	13	X	X (D)	X (MS/MSD)	X (D)
	05/27/22	13:00	13:30	17	X	X	X (D)	X (D)
WW-5-909	05/31/22	09:00	09:05	0	X	X (FB)	X (TB, FB)	X (FB)
	05/31/22	13:01	13:34	4	X	X (D)	X (D)	X (D)
	06/01/22	12:55	12:59	8	X	X (D)	X (D)	X
	06/02/22	12:52	13:49	13	X	X (D)	X (MS/MSD)	X (D)
	06/06/22	13:16	13:20	17	X	X	X (D)	X (D)

NOTE:
1 – X indicates analyses of N-Nitrosodimethylamine using the NMED approved low-level analytical method (Southwest Research Institute TAP 01-0403-015).
2 – X indicates analyses of 1,4-dioxane using SW-846 Method 8270D with Selective Ion Monitoring.
3 – X indicates analyses of semi-volatile organic compounds using SW-846 Method 8270D.
4 – Quality Assurance samples: TB = trip blank, D = duplicate, FB = field blank, MS/MSD = matrix spike/matrix spike duplicate.

Table 4.1 Phase 2 Investigation Serial Sample Results

FLUTe Zone	Cumulative Purge Volume (gal)	LL-NDMA[1] (ng/L)	1,4-Dioxane[2] (µg/L)	2,5-dimethyl-1,4-dioxane[3] (µg/L)	N-butyl-benzene-sulfonamide[3] (µg/L)	N, N-dimethyl-formamide[3] (µg/L)
WW-4-423	0	113.34	150	190	10	ND
	4	7.51	1.6	7.4	220	ND
	8	3.97	0.85	ND	68	ND
	13	5.44	3.1	13	ND	ND
	17	2.11	8.3	ND	24	ND
WW-4-589	0	104.32	95	210	ND	ND
	4	3.72	1.1	5.7	35	ND
	8	0.62	0.49	ND	17	ND
	13	0.99	2.9	15	ND	ND
	17	0.58	1.8	ND	9.4	ND
WW-4-848	0	122.43	120	170	ND	ND
	4	0.49	1.8	ND	12	27
	8	0.91	2.3	ND	6.4	ND
	13	0.73	1.5	ND	5.6	11
	17	0.46	1.6	ND	7.8	ND
WW-4-948	0	71.1	160	200	310	ND
	4	0.48	2.4	ND	8.8	ND
	8	0.48	6.2	ND	8.9	ND
	13	0.47	1.3	ND	ND	ND
	17	0.49	1.8	ND	5.5	ND
BLM-32-543	0	3.18	5.1	12	2200	ND
	4	1.68	1.6	ND	1800	ND
	8	0.48	1.2	ND	1600	ND
	13	0.49	0.79	ND	1400	ND
	17	0.47	1.2	ND	960	ND

FLUTe Zone	Cumulative Purge Volume (gal)	LL-NDMA[1] (ng/L)	1,4-Dioxane[2] (µg/L)	2,5-dimethyl-1,4-dioxane[3] (µg/L)	N-butyl-benzene-sulfonamide[3] (µg/L)	N, N-dimethyl-formamide[3] (µg/L)
BLM-32-571	0	0.86	0.78	ND	14	ND
	4	1.04	0.63	ND	7.4	ND
	8	0.5	0.52	ND	0	ND
	13	0.47	0.59	ND	0	ND
	17	48.3	30	42	420	ND
JER-2-684	0	1.64	4	ND	240	ND
	4	1.74	3.8	ND	210	ND
	8	0.49	0.36	ND	160	ND
	13	2.3	0.17	ND	120	ND
	17	1.46	14	ND	720	ND
WW-5-909	0	3.08	3.7	ND	920	ND
	4	2.37	3.3	ND	590	ND
	8	1.81	3.2	ND	500	ND
	13	1.56	0.43	ND	580	ND
	17	104.32	95	210	ND	ND

1 – Analyses of N-Nitrosodimethylamine using the NMED approved low-level analytical method (Southwest Research Institute TAP 01-0403-015).
2 – Analyses of 1,4-dioxane using SW-846 Method 8270D with Selective Ion Monitoring.
3 – Analyses of semi-volatile organic compounds using SW-846 Method 8270D. These three constituents are Tentatively Identified Compounds (TIC) defined as “Indicates that the analyte was tentatively identified by a GC/MS library search and the amount reported is an estimated value.” Neither the method detection limit nor the reporting limit are listed for TICs.
ng/L – nanograms per liter.
µg/L – micrograms per liter.

Appendix A
Field Logbooks

2-22-22
Tue

PROJECT WW-4 Flute Liner Install

Notebook No. MFP #2
Continued from page —

0700 - K. Williams & S. Rees escort FLUTe crew to WW-4.
FLUTe · Ian Sharp, Michael Sharp.

0730 - unloading reel at well.
H&S briefing - see file copy
- Torres & Halverson at site to tag DTW.
DTW - 407.65' btoc, 22½" casing stickup.

0800 - M&B to Well J to get unchlorinated water for liner installation.
Plumbers - supervisor Victor Meza 575.644.9556
Joe DeLeon 575.932.8115

0830 - Setting up to install. S. Rees goes back to office to get Trent Cassidy.

0920 - S. Rees & T. Cassidy arrive at WW-4
0940 - B. Barrick & photographer arrive. (Alex)

1000 - Liner installation begins. Initially, add ~20' of water "slug" to drive liner installation, to water level in well.

1036 - B. Barrick + Alex leave site.

1145 - Liner installed to water level in well. Installed water line to 120' for water introduction during installation. Reel #1 (Liner) installed

1150 - Lunch.
1230 - Resume ops.

1300 - Obtained 500 gal water from Well J.
Returned to WW-4, making connection between Liner (reel #1) and tubing (reel #2).
1500 - Installing tubing.
1700 - Liner landed. Stop for the day.

Continued from page 5

Read and Understood By

Signed	Date	Signed	Date
[signature]	2-22-22	[signature]	2-23-22

2-23-22
Wed.

PROJECT WW-4 Flute Liner Installation

Notebook No. MFP 2

Continued from page 4

0700 - K. Williams escorts FLUTe crew (Ian + Michael Sharp) to WW-4
0715 - H+S briefing - see file copy.
0720 - T. Torres + D. Halvorsen arrive w/ Dewar and Quick-connect fittings. H+S briefed
0730 - Phillip Bolan arrives - H+S briefed.
Weather 45°-65° F, clear, high winds forecast for the afternoon.
Plan for Today.
- Complete surface installation
- Test pump each of 4 sampling zones.
0915 K. Williams off site to office to grab BaroTroll 2 info on set parameters for Transducers.
0927 FLUTe personnel checking transducer functionality.
0943 Techs backing N_2 trailer up to well head, setting up for purging.
K. Williams back on site. Wind is picking up quite a bit.
0950 - Williams back on site.
1005 - Begin test purge. All 4 ports purge pressure = 225 psi N_2.
1015 - Slow purge on all 4 ports - bumped pressure to 250 psi
Port 1 initial purge = 3/4 gal.
Port 2 " " = 3/4 gal
Port 3 " " = 3/4 gal
Port 4 " " = 3/4 gal
1026 K. Williams met Trent Casidy at gate, both on site now.
1045 2nd purge cycle complete ~3/4 gal each once again. Tested good!
Picking up, will be calibrating transducers next.
1115 WW-4 FLUTe liner installed and tested.
Clean up site, secure equipment.
Technicians + P. Bolan leave site.

1200 Site cleaned and secured. FLUTe crew and Williams leave site.

2-23-22
KW

Continued from page

Read and Understood By

[signature] Signed 2-23-22 Date [signature] Signed 2/23/22 Date

PROJECT WW-4-423 FLUTe

Dan Halvorsen & Tony Torrez present. Weather is clear and cool. This zone will be sampled and purged using a FLUTe System. Samples will be collected using a dedicated discharge hose. Purge pressure set at 225 psi and sample pressure set at 203 psi. Bubbler flowmeter set at 3 psi and stable at 5.5 psi. 15 minute recovery between sampling events. Car Dog 62 in use.

Parameters		2) Parameters (4 gallons)	Meter ID	Transducer
Time	2205090800	2205091328 B	PH/COND = 91	PSI = 52.24
pH	= 7.51	8.52	TURB = 21	TEMP = 24.68
Temp	= 28.6	31.2	" STD = 9.13	DPLN = 120.5
Cond	= 1055	1095	" RDG = 9.10	
Turb	= 8.66	198	" LOT = 200445	
pH Pre	= 7.03-10.02	7.01-10.02	" EXP = 5/22	
pH Post	= 7.01-10.01	7.00-10.02		

(0 gallons Purged) Samples

Sample #	Analysis	Preserve	Container	LOT	LAB
2205090630B	NDMA LL (TB)	Ice	(1) 1L Amber	100301	SRI
——0804B	" " "	"	"	"	"
——0805B	" " (FB)	"	"	"	"
——0806B	1,4 Dioxane 8270D SIM	"	(1) 250 ml Amber		ALS
——0807B	" " (FB)	"	"		"
——0830B	SVOCs by 8270D	"	(2) 1L Amber		"
——0831B	" " (Dup)	"	"		"

(4 gallons Purged) Samples

Sample #	Analysis	Preserve	Container	LOT	LAB
2205091330B	NDMA LL	Ice	(1) 1L Amber	100301	SRI
——1331B	" " (Dup)	"	"	"	"
——1332B	1,4-Dioxane	"	(1) 250 ml Amber		ALS
——1410B	" " (Dup)	"	"		"
——1411B	SVOCs by 8270D	"	(1) 1L Amber		"
——1445B	" " (Dup)				

This zone produced dark water, dark green/Blk in color.

NOTE: HAD to get unchlorinated water from Well to add to the liner. Initial Bubbler reading was only 1 psi so water was added to increase to 5.5 psi.

Continued from page

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[signature] Signed 5-9-2022 Date A-4 [signature] Signed 5-10-22 Date

ROJECT WW-4-~~846~~ 423 EAN-0020 FLUTe

Dan Halvorsen & Tony Torrez Present. Weather is clear and cool. This zone will urged and sampled using a FLUTe system. Samples will be collected using a dedicated discharge hose. Purge pressure set at 225 psi and sample pressure at 203 psi. Bubbler set at 3 psi and stable at 5.5 psi. 15 minute recovery between sampling events. Cardoy G2 in use.

Parameters

Time = 2205100920B
pH = 8.22
Temp = 21.2
Cond = 1113
Turb = 2.64
pH Pre = 7.01-10.02
pH Post = 7.01-10.01

Transducer

psi = 52.70
Temp = 24.92
Depth = 121.55

Meter ID

pH/Cond = 91
Turb = 21
STD = 9.13
RDG = 9.10
Lot = 200445
Exp = 5/22

Samples (8 gallons)

Sample #	Analysis	Preserve	Container	Lot	Lab
2205100948B	NDMA LL	Ice	(1) 1L Amber	100301	SRI
—0949B	" " ~~(FB)~~ Dup	"	"	"	"
—0950B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
—0951B	" " ~~(FB)~~ Dup	"	"	"	"
—0952B	SVOA 8270D	"	(1) 1L Amber	"	"
~~"~~	~~" (FB)~~ Dup	~~"~~	~~"~~	~~"~~	~~"~~

Parameters

Time = 2205110645B
pH = 7.84
Temp = 17.3
Cond = 1107
Turb = 2.22
pH Pre =
pH Post =

Samples (13 gallons)

Sample #	Analysis	Preserve	Container	Lot	Lab
2205110647B	NDMA LL	Ice	(1) 1L Amber	100301	SRI
—0648B	" MS/MSDup	"	"	"	"
—0710B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
—0711B	" " Dup	"	"		"

Continued from page (6)

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Notebook No. D32 [1st] 125 B

Continued from page ______

ROJECT WW-41-423

Samples (13 gallons) cont.

ample #	Analysis	Preserve	Container	Lot	Lab
205[11]to0712B	SVOA 8270 D	Ice	(1) 1L Amber	N/A	ALS
—— 0713B	" " (Dup)	"	"	"	"

arameters

ame = 220511to1330B

= 8.48

emp = 26.5

ond = 1116

urB = 2.17

Pre = 6.99-10.02

Post = 6.99-10.01

Samples (17 gallons)

ample #	Analysis	Preserve	Container	Lot	Lab
205[11]to1333B	NDMA LL	Ice	(1) 1L Amber	100301	SRL
—— 1334B	" " (Dup)	"	"	"	"
—— 1405B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
—— 1435B	SVOA 8270D	"	(1) 1L Amber	"	"
—— 1436B	" " (Dup)	"	"	"	"

NOTE: on 5-10-2022 a total of 13 gallons were purged. After purging 13 gallons there wasn't enough time to collect samples for the 13 gallon Target zone. Samples will be collected for 13 and 17 gallon target on 5-11-2022

Continued from page

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A-6

Signed [signature] Date 5-12-22

ROJECT WW-4-589 ENV-0020 FLUTe

Notebook No. D32 #125 B

Continued from page

Dan Halvorsen & Tony Torrez present. Weather is clear and cool. This zone will be purged and sampled using a FLUTe System. Samples will be collected using dedicated discharge hose. Purge pressure set at 225 psi and sample pressure set at 203 psi. Bubbler set at 3 psi and stable at 5.5 psi. 15 minute recovery between sampling events. Carboy G2 in use.

Parameters (#1)		(2) Parameters (4 gallons)	Meter I.D.	Transducer
Time	= 220509 0810 B	2209 1345 B	PH/COND = 91	psi = 52.70
pH	= 7.49	8.38	TURB = 21	Temp = 24.92
Temp	= 28.3	28.5	STD = 9.13	Depth = 121.55
Cond	= 883	1108	RDG = 9.10	
Turb	= 4.06	2.57	LOT = 200445	
Pre	= 7.03-10.02	7.01-10.03	Exp = 5/22	
Post	= 7.01-10.01	7.01-10.01		

SAMPLES (0 gallons purged)

Sample #	Analysis	Pressure	Container	Lot	Lab
220509 0812 B	NDMA LL	Ice	(1) 1L Amber	100301	SGS
—— 0813 B	" " (FB)	"	"	"	"
—— 0814 B	1,4 Dioxane	"	(1) 250 ml Amber		ALS
—— 0815 B	" " (FB)	"	"		"
—— 0838 B	Svoa & 8270 D	"	(1) 1L Amber		"
—— 0839 B	" " (FB)	"	"		"

SAMPLES (4 gallons purged)

Sample #	Analysis	Pressure	Container	Lot	Lab
220509 1348 B	NDMA LL	Ice	(1) 1L Amber	100301	SGS
—— 1349 B	" " (Dup)	"	"	"	"
—— 1350 B	1,4 Dioxane	"	(1) 250 ml Amber		ALS
—— 1420 B	" " (Dup)	"	"		"
—— 1421 B	Svoa 8270 D	"	(1) 1L Amber		"
—— 1450 B	" " (Dup)	"	"		"

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PROJECT WW-4-589 GNV-0020 FLUTe

Dan Haworth & Tony Torrez present. Weather is Clear and Cool. This Zone will be purged and sampled using a FLUTe system. Samples will be collected using a dedicated discharge hose. Purge pressure set at 225 psi and Sample pressure at 203 psi. Bubbler set at 3 psi on Flowmeter and stable at 7 psi. 15 minute recovery between sampling events.

Parameters
Time = 2205100930B
pH = 8.75
Temp = 23.2
Cond = 1089
Turb = 2.47
pH Pre = 7.01-10.00
pH Post = 7.02-10.00

Transducer
PSI = ~~52.70~~ 40.06
Temp = ~~24.92~~ 25.10
Depth = 93.30

Meter ID
pH/Cond = 91
Turb = 21
STD = 9.13
DO6 = 910
LOT = 200445
Exp = 5/22

SAMPLES (8 gallons)

Sample #	Analysis	Preservative	Container	LOT	LAB
2205101014B	NDMA LL	Ice	(1) L Amber	100301	SRL
1015B	" " MS/MSD	"	"	"	"
1016B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
1017B	" " (Dup)	"	"	"	"
1018B	SVOC 8270D	"	(1) L Amber	"	"
~~"~~	~~" (Dup)~~	~~"~~	~~"~~	~~"~~	~~"~~

Parameters
Time = 2205110658B
pH = 7.92
Temp = 18.8
Cond = 1101
Turb = 41.23
pH Pre = 7.02-10.01
pH Post = 7.02-10.01

SAMPLES (13 gallons)

Sample #	Analysis	Preservative	Container	LOT	LAB
2205110702B	NDMA LL	Ice	(1) L Amber	100301	SRL
0703B	" " (Dup)	"	"	"	"
0720B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
0721B	" " (Dup)	"	"		"

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PROJECT WW-4-589 (Cont.)

Notebook No. D32 #125 B

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SAMPLES (13 gallons) Cont.

Sample #	Analysis	Preserve	Container	Lot	LAB
220511-0722B	SVOA 8270D	Ice	(1) 1L Amber	N/A	ALS
——— 0723B	" " (Dup)	"	"		"

Parameters

Time = 220511-1340B
pH = 8.43
Temp = 27.1
Cond = 1104
Turb = 3.71
pH Pre = 7.01-10.02
pH Post = 7.00-10.01

SAMPLES (17 gallons)

Sample #	Analysis	Preserve	Container	Lot	LAB
220511-1344B	NDMA LL	Ice	(1) 1L Amber	100301	EPI
——— 1345B	" " (Dup)	"	"	"	"
——— 1445B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
——— 1446B	SVOA 8270D	"	(1) 1L Amber	"	"
——— 1447B	" " (Dup)	"	"	"	"

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PROJECT WW-4-848 FLUTe ENV-0020

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Dan Halversen & Tony Torrez present. Weather is Clear, HoT and Extremely windy. This zone will be purged and sampled using a FLUTe system. Samples will be collected using a dedicated discharge hose. Purge pressure set at 225 psi and Sample Pressure at 203 psi. Bubbler Flowmeter set at 3 psi and stable at 3.5 psi. 15 minute recovery between sample events. Carboy G in use.

Parameters	Meter ID	Transducer
Time = 220512 0700 B	PH/COND = 91	PSI = 53.14
PH = 7.62	TURB = 21	Temp = 24.61
Temp = 19.3	STD = 9.13	Depth = 122.58
COND = 1084	RDG = 9.16	
TURB = 11.0	LOT = 200445	
PHPre = 7.02-10.03	Exp = 5/22	
PHPost = 7.01-10.02		

SAMPLES (0 gallons Purged)

Sample #	Analysis	Preserve	Container	Lot	LAB
2205120705 B	NDMA LL	Ice	(1) 1L Amber	100301	SRI
——— 0706 B	" " (FB)	"	"	"	"
——— 0707 B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
——— 0708 B	" " (FB)	"	"	"	"
——— 0709 B	Svoa 8270D	"	(1) 1L Amber	"	"
——— 0710 B	" " (FB)	"	"	"	"

Parameters

Time = 220512 1005 B
PH = 8.63
Temp = 22.8
COND = 961
TURB = 1.82
PHPre = 7.01-10.03
PHPost = 7.01-10.01

SAMPLES (4 gallons Purged)

Sample #	Analysis	Preserve	Container	Lot	LAB
2205121007 B	NDMA LL	Ice	(1) 1L Amber	100301	SRI
——— 1044 B	" " (ms/msDup)	"	"	"	"
——— 1045 B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
——— 1046 B	" " (Dup)	"	"		

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ROJECT WW-41- 848 (Cont)

Notebook No. D32 #125 B

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~~...n Halvorsen + Tony Torrez~~ SAMPLES (4 gallons Purged) Cont.

...mple #	Analysis	Preserve	Container	LOT	LAB
...0512 1047 B	Svoc by 8270 D	Ice	(1) 1L Amber	N/A	ALS
—— 1048 B	" " (Dup)	"	"	"	"

...rameters

...ime = 2205130708B
...H = 8.92
...emp = 15.1
...ond = 937
...urB = 1.26
...Pre = 7.01-10.03
...Post = 7.01-10.01

SAMPLES (8 gallons Purged)

...mple #	Analysis	Preserve	Container	LOT	LAB
2205130710 B	NDMA LL	Ice	(1) 1L Amber	100 301	SRL
—— 0740 B	" " (Dup)	"	"	"	"
—— 0741 B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
—— 0742 B	" " (Dup)	"	"	"	"
—— 0743 B	Svoc by 8270 D	"	(1) 1L Amber	"	"

Parameters

Time = 2205 1250 B
pH = 8.89
Temp = 17.3
Cond = 940
Turb = 1.18
...Pre = 7.00-10.02
...Post = 6.99-10.01

SAMPLES (13 gallons Purged)

Sample #	Analysis	Preserve	Container	LOT	LAB
2205131250 B	NDMA LL	Ice	(1) 1L Amber	100 301	SRL
—— 1251 B	" " (Dup)	"	"	"	"
—— 1252 B	1,4- Dioxane	"	(1) 250 ml Amber	N/A	ALS
—— 1253 B	" " (Dup)	"	"	"	"
—— 1254 B	Svoc by 8270 D	"	(1) 1L Amber	"	"
—— 1345 B	" " (Dup)	"	"		"

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ROJECT LW-4-848 (Cont.)

Parameters 5/16/22 Al Montes & Tony Torrez present.

Time = 220516 0912B
pH = 8.83
Temp = 18.1°c
Cond = 838 µs/cm
NTU = 2.20
pH cal = 7.01/9.99 (22.9°c)
pH post = 6.96/9.98

Samples (17 gallons Purged)

Sample #	Analysis	Preserve	Container	LOT	LAB
220516 0915B	NDMA LL	Ice	(1) 1L Amber	100301	SRL
— 0950B	" " (Dup)	"	"	"	"
— 0951B	1,4-Dioxane	"	(1) 250 ml amber	N/A	ALS
— 0953B	Svoc by 8270	"	(1) 1L amber	"	"
— 0954B	" " (Dup)	"	"	"	"
— 0952B	1,4-Dioxane (Dup)	"	(1) 250 ml amber	"	"

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PROJECT WW-4-948 FLUTe ENV-0020

Notebook No. D32*125 B

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Dan Halvorsen & Tony Torrez present. Weather is Cloudy and cool. This zone will be purged and sampled using a FLUTe System. Samples will be collected using a dedicated discharge hose. Purge pressure set at 225 psi and sample pressure at 203 psi. Bubbler flowmeter set at 3 psi and stable at 7 psi. 15 minute recovery between sample events. Carboy G2 in use.

Parameters	Meter I.D	Transducer
Time = 2205120715B	PH/COND = 91	Psi = 53.76
pH = 7.19	TURB = 21	Temp = 24.61
Temp = 18.7	STD = 9.13	Depth = 124.01
Cond = 1120	RDG = 9.16	
Turb = 8.99	LOT = 200445	
pH Pre = 7.01-10.02	EXP = 5/12	
pH Post = 7.01-10.02		

SAMPLES (0 gallons Purged)

Sample #	Analysis	Preserve	Container	Lot	Lab
2205120717B	NDMA LL	Ice	(1) 1L Amber	100301	SRL
——— 0718B	" " (FB)	"	"	"	"
——— 0719B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
——— 0720B	" " (FB)	"	"	"	"
——— 0721B	SVOC 8270D	"	(1) 1L Amber	"	"
——— 0722B	" " (FB)	"	"	"	"

Parameters

Time = 2205121016B
pH = 8.58
Temp = 21.7
Cond = 1168
Turb = 1.94
pH Pre = 7.01-10.02
pH Post = 7.00-10.01

SAMPLES (4 gallons)

Sample #	Analysis	Preserve	Container	Lot	Lab
2205121018B	NDMA LL	Ice	(1) 1L Amber	100301	SRL
——— 1055B	" " (Dup)	"	"	"	"
——— 1056B	1,4 Dioxane	"	(1) 250 ml Amber	N/A	ALS
——— 1057B	" " (Dup)	"	"		"

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T.D. 5.16.22 — Signed

5.16.22 — Date

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5-16-22 — Date

PROJECT WW-4-948 (Cont)

SAMPLES (4 gallons) Cont.

Samples #	Analysis	Preserve	Container	LOT	LAB
2205121058 B	SVOA 8270 D	Ice	(1) 1L Amber	N/A	ALS
——1059 B	" " (Dup)	"	"	"	"

Parameters
Time = 2205130719 B
pH = 8.76
Temp = 15.0
Cond = 1073
Turb = 3.44
pH Pre = 7.01-10.01
pH Post = 7.02-10.02

SAMPLES (8 gallons Purged)

Sample #	Analysis	Preserve	Container	LOT	LAB
2205130721 B	NDMA LL	Ice	(1) 1L Amber	100301	SRI
——0745 B	" " (ms/ms Dup)	"	"	"	"
——0746 B	1,4-Dioxane	"	(1) 250 ml Amber	N/A	ALS
——0747 B	" " (Dup)	"	"	"	"
——0748 B	SVOA 8270 D	"	(1) 1L Amber	"	"

Parameters
Time = 2205131313 B
pH = 8.72
Temp = 16.2
Cond = 1069
Turb = 2.77
pH Pre = 6.99-10.02
pH Post = 6.98-10.01

SAMPLES (13 gallons Purged)

Sample #	Analysis	Preserve	Container	LOT	LAB
2205131316 B	NDMA LL	Ice	(1) 1L Amber	100301	SRI
——1317 B	" " (Dup)	"	"	"	"
——1318 B	1,4 Dioxane	"	(1) 250 ml Amber	N/A	ALS
——1319 B	" " (Dup)	"	"	"	"
——1320 B	SVOA 8270 D	"	(1) 1L Amber	"	"
——1355 B	" " (Dup)	"	"		"

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Lori Wunch Signed 5-16-22 Date

PROJECT WW-4-948 (Cont)

Notebook No. D32 #125 B

Continued from page

Parameters

5/16/22 Tony Torrez & AL Montes present.

Time	=	220516 0935B
pH	=	8.72
Temp	=	22.8°c
Cond	=	1191 µs/cm
Turb	=	2.46
pH Pre	=	6.95/9.98 (23.0°c)
pH Post	=	6.94/9.99

SAMPLES (17 gallons Purged)

Sample #	Analysis	Preserve	Container	Lot	LAB
220516 0936B	NDMA LL	ICE	(1) 1LT Amber	N/A	SRL
— 0937B	" " (Dup)	"	"	"	"
— 1005B	1,4-Dioxane	"	(2) 250ml Amber	"	ALS
— 1006B	" " (Dup)	"	"	"	"
— 1007B	SVOC 8270D	"	"	"	"
— 1008B	" " (Dup)	"	"	"	"

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Lori Wunderle Signed 5-16-22 Date

Blm-32-543 ENV. 110

PROJECT Phase 2 Flute Representativeness Study

Notebook No. D32#125B

Continued from page

Al Montes & Tony Torrez present. The weather is clear & Hot. This zone will be purged & sampled using the flute sampling system. Samples collected from a dedicated Teflon Tube. Purge pressure & Sample pressure Bubbler set @ 3psi & stable @ 7.5psi. 15 mins of recovery between cycles. 1.5 liters per purge

~~Par~~ Parameters

pH 8.53
Temp 25.1°c
Cond 1108
Turb ~~3.6~~ 21.4 ntu's
pH pre 7.09/10.01 (38.1°c)
pH post 7.05/10.03
220516 1359B

Meter ID's
pH/cond 91
Turb # 21
" std = 9.13
" Rdg = 9.15
" Lot# = 200445
" Exp = 5/22

Ø gallon Samples

Sample #	Analysis	Preserv	Lot #	Cont	Lab
220516 1350B	LLNDMA (TB)	Ice	100301	(1) 1L Amber	SRI
220516 1400B	"	"	"	"	"
— 1401B	" (FB)	"	"	"	"
— 1402B	SVOA Sims	"	N/A	"	ALS
— 1403B	" (FB)	"	"	"	"
— 1404B	8270	"	"	"	"
— 1405B	" (FB)	"	"	"	"

4 gallon Samples

Sample #	Sample #	Analysis	Preserv	Cont	Lab
220517 1335B	220517 1340B	LLNDMA	Ice	(1) 1L Amber	SRI
pH 8.43	— 1341B	" ~~[illegible]~~ (Dup)	"	(2) 1L Amber	SRI
Temp 25.9	— 1400B	SVOA/Dioxin sims	"	(1) 250ml Amber	ALS
Cond 1077	— 1401B	" (Dup)	"	"	"
Turb 7.08 ntus	— 1420B	8270	"	(1) 1L Amber	"
pH pre 6.98/9.96 (38.1)	— 1421B	" (Dup)	"	"	"
pH post 6.99/10.01					

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Blm-32-543

PROJECT Phase 2 Flute Representativeness Sampling

Notebook No. D32# 125 LB

Continued from page 15

8 gallons Sampling.

PARAMETERS	SAMPLE #	ANALYSIS	PRESERV	LOT #	CONT	LAB
220518 1325B						
pH 8.47	220518 1326B	LLNDMA	ICE		(1) 1L T Amber	SRJ
Temp 26.8°c	— 1400B	" (Dup)	"		"	"
Cond 1084 µs/cm	— 1401B	SUDA Sims	"		"	A/S
Turb 0.82 NTU's	— 1402B	" (Dup)	"		"	"
pH pre 7.14/10.01(38.1)	— 1403B	8270	"		"	"
pH post 7.09/10.00						

13 gallon Samples

PARAMETERS	SAMPLE #	ANALYSIS	PRESERV	CONT	LAB
220519 1315B					
pH 8.61	220519 1316B	LLNDMA	ICE	(1) 1L T Amber	SRJ
Temp 26.1	— 1350B	" (MS)	"	"	"
Cond 1067	— 1351B	" (Dup/MS)	"	"	"
Turb 0.42 NTU's	— 1352B	SUDA Sims	"	(1) 250ml Amber	ALS
pH pre 7.02/9.95 (35.7)	— 1353B	" (Dup)	"	"	"
pH post 7.02/9.97	— 1420B	8270	"	(1) 1L T Amber	"
	— 1421B	" (Dup)	"	"	"

5-23-22 Tim Kowdy + Tony Torrez present

17 gallon Samples

PARAMETERS	SAMPLE #	ANALYSIS	PRESERV	CONT	LAB
220523 1320B	220523 1321B	LLNDMA	ICE	(1) 1L T Amber	SRJ
pH 8.68	— 1345B	" (Dup)	"	"	"
Temp 26.1°c	— 1346B	SUDA Sims	"	(1) 250ml Amber	A/S
Cond 1079	— 1347B	8270	"	(1) 1L T Amber	"
Turb 0.59 NTU's	— 1348B	" (Dup)	"	"	"
pH pre 7.05/10.07(33.8°c)					
pH post 7.04/10.07					

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ROJECT Flute Representativeness Sampling Study ENV.110

Notebook No. D32#/25B

Continued from page ________

Al Montes & Tony Torrez present. The weather is clear & Hot. This zone will be purged & sampled using a Flute sampling system. Samples collected from a dedicated Teflon Tube. Purge pressure 281 & Sample pressure 252. Bubbler set @ 3psi & stage @ 7.5psi. 15 mins of recovery between purges. 1.5 liters per purge

Parameters

Time	220516 1419
Temp	26.2
Cond	1116 µs/cm
Turb	3.61 NTU's
pH pre	6.96/9.98 (39.4°c)
pH post	6.95/9.97
~~Time~~ pH	8.56

Meter ID's

pH/Cond	91
# Turb #	21
" STD =	9.13 NTU's
" Rdg =	9.15 NTU's
" Lot #	200445
Exp	5/22

Samples Ø gallons

Sample #	Analysis	Preserv	Lot #	Cont	Lab
220516 1420B	LLNDMA	Ice	100301	(1) 1 Lt Amber	SRL
— 1421B	" (FB)	"	"	"	"
— 1422B	SVOA SIMS	"	N/A	"	ALS
— 1423B	" (FB)	"	"	"	"
— 1424B	8270	"	"	"	"
— 1425B	" (FB)	"	"	"	"

Param's

pH	8.06
Temp	23.5°c
Cond	1033 µs/cm
Turb	1.36 NTU's
pH pre	7.01/10.00 (38.9)
pH post	6.99/10.01
220517 1349B	

4 gallon samples

Sample #	Analysis	Preserv	Lot #	Cont	Lab
220517 1350B	LLNDMA	Ice	10301	(1) 1 Lt Amber	SRL
— 1410B	" (MS ~~MS Dup~~)	"	"	(2) "	"
— 1431B	SVOA SIMS	"	N/A	(1) 250ml Amber	ALS
— 1432B	" (Dup)	"	"	"	"
— 1433B	8270	"	"	(1) 1 Lt Amber	"
— 1434B	" (Dup)	"	"	"	"
— 1430B	LLNDMA (MS Dup)	"	100301	"	"

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B/m-32-571

Notebook No. D32#125B 19

PROJECT Flute Representativeness Sampling - Env. 110 Draft Continued from page 18

Param's — 8 gallon Samples

220518 1345B	Sample#	Analysis	Preserv	Cont	Lab
pH 8.63	220518 1346B	1,4 NDMA	Ice	(1) 1L Amber	SRI
Temp 26.2°c	— 1415B	" (Dup)	"	"	"
Cond 1054 µs/cm	— 1416B	5UOA Sims	"	"	A/S
Turb 0.46	— 1417B	" (Dup)	"	"	"
pH pre 7.05/1001(32.9)	— 1418B	8270	"	"	"
pH post 7.08/10.00					

Parameters — 13 gallon Samples

220519 1335B	Sample#	Analysis	Preserv	Cont	Lab
pH 8.65	220519 1336B	1,4 NDMA	Ice	(1) 1L Amber	SRI
Temp 25.9°c	— 1406B	" (Dup)	"	"	"
Cond 1041 µs/cm	— 1407B	5UOA Sims	"	(1) 250ml Amber	A/S
Turb 1.17	— 1408B	" (Dup)	"	"	"
pH pre 7.04/9.99/34.7	— 1409B	8270	"	(1) 1L Amber	A/S
pH post 7.08/9.97	— 1410B	" (Dup)	"	"	

5-23-22 Tim Kennedy & Tony Toller present

17 gallons Samples

Parameters	Sample#	Analysis	Preserv	Cont	Lab
220523 1335B	220523 1336B	1,4 NDMA	Ice/	(1) 1L Amber	SRI
~~pH~~ 8.51	— 1355B	" (Dup)	"	"	"
~~Temp~~ 25.1	— 1356B	5UOA Sims	"	(1) 250ml Amber	A/S
~~Cond~~ 1054	— 1357B	8270	"	(1) 1L Amber	"
~~Turb~~ 1.38	— 1358B	" (Dup)	"	"	"

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JER-2-684 DRAFT ENV 0110A

PROJECT FLUTE REPRESENTATIVENESS EVAL PHASE 2

Notebook No. DJZ #125 (JJ)

Continued from page

Tim Kondy & Tony Torrez present. The weather is overcast & cool. This zone will be purged & sampled using a FLUTE system & samples collected from a dedicated Teflon hose. Purge pressure set @ 265 & sample @ 244. Bubbler set @ 3psi & stable @ 7psi. 15 mins between purges.

*Check valve doesn't hold & water leaves the tubing.

0 gallon samples

Parameters	Sample#	Analysis	Presevd	Cont	Lab
220524 0725B	220524 0630B	LLNDMA (TB)	Ice	(1) 1LT Amber	SRI
pH 7.87	— 0730B	"	"	"	"
Temp 26.4	— 0731B	" (Dup)	"	~~(1) 250ml Amber~~ "	"
Cond 1171 µs/cm	— 0732B	SVOA Sim	"	(1) 250ml Amber	A/S
Turb 0.72 NTU's	— 0733B	" (Dup)	"	~~(1) 1LT Amber~~ "	"
pHpre 7.05/10.15 (13.0)	— 0734B	8270	"	(1) 1LT Amber	"
pHpost 7.07/10.15	— 0735B	" (Dup)	"	"	"

4 gallon samples

Parameters	Sample#	Analysis	Presevd.	Cont	Lab
220524 1320B	220524 1321B	LLNDMA	Ice	(1) 1LT Amber	SRI
pH 8.28	— 1322B	" (Dup)	"	"	"
Temp 26.5	— 1323B	SVOA Sim	"	(1) 250ml Amber	A/S
Cond 1183	— 1350B	" (Dup)	"	"	"
Turb 0.88	— 1351B	8270	"	(1) 1LT Amber	"
pHpre 7.01/9.96 (37.6)	— 1352B	" (Dup)	"	"	"
pHpost 7.05/9.96					

Meter ID's

pH/Cond #91 Turb #21 Std = 9.13 NTU's Rdg 9.15 NTU's Exp 5/22

Turb Lot# 200445

8 gallon samples

Parameters	Sample#	Analysis	Presevd	Cont	Lab
220525 1330B	220525 1331B	LLNDMA	Ice	(1) 1LT Amber	SRI
pH 8.13	— 1400B	" (Dup)	"	"	"
Temp 27.6 °c	— 1401B	SVOA Sims	"	(1) 250ml Amber	A/S
Cond 1218 µs/cm	— 1402B	" (Dup)	"	"	"
Turb 0.78 NTU's	— 1423B	8270	"	(1) 1LT Amber	"
pHpre 6.99/9.99 (30.0)					
pHpost 7.00/9.99					

** Gas breaking every cycle to get samples

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JEN 2-684 DRAFT ENV.0110A

PROJECT FLUTE REPRESENTATION EVAL PHASE 2

13 gallon samples

PARAMETERS	SAMPLE#	ANALYSIS	PRESERV	CONT	LAB
2205261300B	2205261301B	1CWDMA	ICE	(1) 1L T AMBER	SAI
pH 8.15	— 1302B	" (MS)	"	"	"
Temp 26.3 °c	— 1320B	" (Dup/MS)	"	"	"
COND 1165	— 1321B	SUDASIM	"	(1) 250ml Amber	A/S
Turb 0.44 NTU's	— 1322B	" (Dup)	"	"	"
pH pre 7.00/10.04 (4.0)	1323B	8270	"	(1) 1L T Amber	"
pH post 7.01/10.03	— 1345B	" (Dup)	"	"	"

17 gallon sampling

PARAMETERS	SAMPLE#	ANALYSIS	PRESERV	CONT	LAB
2205271045B	2205271300B	1CWDMA	ICE	(1) 1LT Amber	SAI
pH 8.09	— 1301B	" (Dup)	"	"	"
Temp ° 26.1	— 1302B	SUDASIMS	"	(1) 250ml/Amber	A/S
Cond = 1160	— 1303B	8270	"	(1) 1LT Amber	"
Turb = 0.52	— 1330B	" (Dup)	"	"	"
pH pre = 7.01 · 10.02					
pH post = 7.00 · 10.01					

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Tim Kondy & Tony Torrez present. The weather is clear & warm. This zone will be purged & sampled. Dedicated Teflon discharge tube used for sampling. Purge pressure 224psi & sample pressure 203. 15 mins recovery between purges.. Water was added to inside of flute since bubbler initial pressure was 2.5psi. After adding water bubbler set @ 3 & stable @ 5 psi. Carboy 6.1

Ø gallon sample

Parameters	Sample#	Analysis	Preserv	Cont	Lab
220531 0855B	220531 0830B	LLNDMA (TB)	Ice	(1) 1 LT Amber	SRI
pH 7.81	— 0900B	"	"	"	"
Temp 26.1	— 0901B	" (FB)	"	"	"
Cond 1473	— 0902B	SVOA SIMS	"	(1) 250ml amber	ALS
Turb 8.40	— 0903B	" (FB)	"	"	"
pH pre 7.01/10.01 (26.1)	— 0904B	8270	"	(1) 1 LT Amber	"
pH post 7.01/10.03	— 0905B	" (FB)	"	"	

4 gallon samples

Parameters	Sample#	Analysis	Preserv	Cont	Lab
220531 1300B	220531 1301B	LLNDMA	Ice	(1) 1 LT Amber	SRI
pH 7.78	— 1330B	" (Dup)	"	"	"
Temp 25.4°c	— 1331B	SVOA SIMS	"	(1) 250ml amber	ALS
Cond 1465 µs/cm	— 1332B	" (Dup)	"	"	"
Turb 6.54	— 1333B	8270	"	(1) 1 LT Amber	[illegible]
pH pre 6.99/10.05 (22.8)	— 1334B	" (Dup)	"	"	"
pH post 7.02/10.05					

Meter ID's pH/cond 91   Turb #21 std = 9.42   Rdg = 9.45 Exp 6/22
Lot# 200445

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PROJECT WW-5-909

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Parameters	8 gallon Sample				
220601 1250B					
	Sample #	Analysis	Preserv	Cont.	Lab
pH 7.81					
Temp 25.9°c	220601 1255B	(1) NDMA	Ice	(1) 1L Amber	SRI
Cond 1455 µs/cm	— 1256B	" (Dup)	"	"	"
Turb 4.67	— 1257B	SVOA Sims	"	(1) 250ml Amber	A/S
pH pre 7.00/10.03/38.1	— 1258B	" (Dup)	"	" (Dup)	"
pH post 7.01/10.00	— 1259B	8270	"	(1) 1L Amber	"

Dan Halvorsen, Matt Garcia & Tim Kondy present (6.2.2022)

13 gallon Samples

Parameters	Sample #	Analysis	Preserve	Container	LAB
Time 220602 1250B	220602 1252B	NDMA LL	Ice	(1) 1L amber	SRI
pH 7.84	— 1253B	" " (MS)	"	"	"
Temp 25.6	— 1254B	" " (MS Dup)	"	"	"
Cond 1426	— 1320B	1,4-Dioxane	"	(1) 250ml Amber	A/S
Turb 4.99	— 1321B	" " (Dup)	"	"	"
pH pre 7.00-10.01 (26.4)	— 1348B	SVOA 8270 D	"	(1) 1L amber	"
pH post 6.99-10.01	— 1349B	" " (Dup)	"	"	"

17 gallons Sample

Parameters	Sample #	Analysis	Preserv	Lot #	Lab
Time 220606 1315B	220606 1316B	LL NDMA	Ice/HT	(1) 1L Amber	SRI
pH 7.87	— 1317B	" (Dup)	"	"	"
Temp 24.0°c	— 1318B	SVOA Sim	"	(1) 250ml Amber	A/S
Cond 1430 µs/cm	— 1319B	8270	"	(1) 1L Amber	"
Turb 2.96	— 1320B	" (Dup)	"	"	"
pH pre 7.01/9.96 (40.8)					
pH post 7.03/9.95					

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