

WATER QUALITY MONITORING PLAN

**WHITE ROCK FIELD
ADAMS COUNTY COLORADO
CITY OF AURORA**

Invicta 3-65-28 Oil and Gas Application DA ~~2371-00~~ Case Number ~~2023-6050-00~~

Revision Date: August 15, 2024

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1.0 WATER QUALITY MONITORING DETERMINATION

CDH Consulting LLC (CDH) is providing this Water Quality Monitoring Plan for GMT Exploration Company, LLC (GMT) for oil and gas exploration and production drilling locations in the White Rock Field in Aurora, Adams County, Colorado. Site-specific location information is provided in Section 3.0 in this report. Section 3.0 also addresses specific water sampling required per city of Aurora.

Section 1.0 and 2.0 of this Water Quality Monitoring Plan is provided to describe and provide a means to implement water source sampling required by the Colorado Energy and Carbon Management Commission (ECMC) formerly known as the Colorado Oil and Gas Conservation Commission (COGCC). The plan is also designed to address local municipality requirements.

1.1 Initial Water Source Research

The Colorado Division of Water Resources (DWR) Permitted Water Well database is used to identify permitted water sources within a one-half mile radius of the proposed drilling locations. An identified subset of the permitted water sources is required to be sampled prior to and within twelve months of the drilling start date and at subsequent time periods depending on the applicable regulation at the time of the oil and gas well drilling permit approval. A map indicating the listed water well locations associated with the proposed drilling pad locations are provided in site specific Appendix A. The completion and viability of each of these locations will be investigated. A preliminary summary of well data and the records reviewed are provided in the site-specific information within the attached appendices.

The following pad location is included as part of the plan.

| DRILLING PAD NAME | LATITUDE | LONGITUDE | ECMC APPLICABLE RULE | SECTION |
|------------------------|----------|------------|----------------------------|---------|
| Invicta 3-65 28 Pad | 39.76477 | -104.66814 | 615 | 3.0 |

The site-specific location and water well sampling list will be developed for each drilling pad and included under Section 3.0 in this plan. Up to four water sources (typically water wells) within a half-mile radius of the middle of the planned well drilling location for each of the multi-well pads will be sampled per this water quality monitoring plan.

If more than four Available Water Sources are present within a half-mile radius of a proposed Oil and Gas Well, Multi-Well Site, or Class II UIC Well, up to four sampling locations will be selected based on the following criteria:

- Proximity. Available Water Sources closest to the proposed Oil and Gas Well, Multi-Well Site, or Class II UIC Well are required.

- Type of Water Source. Well-maintained domestic water wells are required over other Available Water Sources.
- Orientation of Sampling Locations. To the extent Groundwater flow direction is known or reasonably can be inferred, sample locations from both down-gradient and up-gradient are preferred over cross-gradient locations. Where Groundwater flow direction is uncertain, sample locations should be chosen in a radial pattern from a proposed Oil and Gas Well, Multi-Well Site, or Class II UIC Well.
- Multiple Identified Aquifers Available. Where multiple defined Aquifers are present, sampling the deepest and shallowest identified Aquifers is required.
- Condition of Water Source. Water Sources that are determined to be improperly maintained, nonoperational, or have other physical impediments to sampling that would not allow for a representative sample to be safely collected or would require specialized sampling equipment (e.g., Shut-In Wells, wells with confined space issues, wells with no tap or pump, non-functioning wells, intermittent springs) will not be sampled.

Based on the priority evaluation above, a good faith effort to contact each identified owner will be completed in a timely manner. The owners of identified domestic water source(s) will be interviewed regarding the history and condition of their water source. To the extent possible, the installation date, completion aquifer, well depth, well diameter, operating history, pretreatment, unusual odor, color, and/or other pertinent information and general quality and use history, such as periods of no water or limited water pressure will be recorded. If an owner cannot be reached or does not respond to contact attempts, a variance will be requested to be alleviated of the sampling requirement for that water source. Obtaining a representative water sample from the prioritized wells that are determined to be accessible will be attempted and completed providing suitable well operation exists.

If existing water data including appropriate analytical constituents and procedures is available for an identified well that has been collected within 18 months preceding the scheduled initial sampling event these data may be used to satisfy the initial sampling requirement  or well pads having overlapping areas, a sampled well may be used to satisfy the requirements for multiple drilling pads

1.2 WATER SOURCE ACCESS

Access agreements to identified domestic water sources will be coordinated with the owner(s). Requests for signed access to sample the owner's well and publish the resulting data will be sent to the identified landowner for signature. Sampling of wells will be contingent upon obtaining written authorization. A mutually agreed upon time to access the water source(s) will be arranged and coordinated with the owner(s) to visit their property and access their water source(s) for sampling purposes.

1.3 UNAVAILABLE MONITORING LOCATIONS

If no water wells are available to conduct water monitoring within one-half mile of the drilling pad location, then a request will be provided via a Form 4 to the ECOM requesting a variance from the sampling requirement.

Per the local government entity code, if a suitable sampling location is not identified then a groundwater monitoring well installation may be required. GMT proposes to address this requirement through measures described in the site-specific description (Section 3.0) for each individual drilling location.

2.0 SAMPLING AND FREQUENCY

Initial baseline water samples will be collected from each accessible well identified as described in Section 1.0, and where access has been provided. Subsequent samples will be collected in accordance with the regulatory required schedules.

2.1 SAMPLING AND ANALYSIS SCHEDULE

The initial baseline water samples will be collected within twelve-months prior to initial drilling at the drilling locations or prior to the re-stimulation of a new well that no samples were collected and analyzed for during the previous twelve-month period.

Post stimulation samples will be collected from the same water sources collected during the initial baseline sampling six to 12 months following well completion. A second subsequent sampling event will be conducted between 60- and 72-months following completion of the well, or the last well on a multi-well drilling pad.

Under Rule 615 additional subsequent samples will be collected every 5 years (57 to 63-month interval) for the life of the Well. Additionally, a post abandonment sample will be collected 6 to 12 months after the oil and gas well has been plugged and abandoned. Wells that are drilled and abandoned without ever producing hydrocarbons are exempt from subsequent monitoring sampling under ECMC Rule 615.d.(2).

If local municipalities require additional sampling, the schedules are described under each location specific section of this plan.

2.2 SAMPLING AND ANALYSIS PROCEDURES

Water source sampling will be conducted per the guidelines of the ECMC Model Sampling and Analysis Plan (SAP) Version 2, April 2020 and current industry standards. The ECMC Model SAP is included as an Appendix B. Sampling will be conducted by GMT or a qualified independent consultant if requested by the well owner. Costs associated with the water quality testing and analysis will be assumed by GMT.

Water quality will be measured during purging using appropriate calibrated field instrumentation in accordance with the SAP and initial water quality testing analysis will be conducted per the attached Table 1 and Table 2 in accordance with the methods detailed in the SAP.

Subsequent sampling will be conducted at each water source previously sampled. Subsequent water quality sampling analysis will be conducted per the attached Table 3 per the methods detailed in the SAP.

- Field parameters will be documented during sampling procedures as outlined in the SAP. Additional observations will be documented such as condition of the water well, and any observed potential pollutant sources. The water source location will be documented using a GPS with sub-meter resolution.
- Field observations will include odor, water color, sediment, bubbles and effervescence and presence or absence of hydrogen sulfide (H₂S) gas.

- An additional sample will be collected and held for additional analysis. If detection of free gas or dissolved methane at a concentration level greater than 1 milligram per liter (mg/L) is detected in a water source, the sample will be further analyzed for the parameters listed in Table 2 and in accordance with the methods listed in the SAP. Analysis will include the determination of the gas type using gas compositional analysis and stable isotope analysis of the methane (carbon and hydrogen). If detection of free gas or methane is greater than 10 mg/L or increases by 5 mg/L between sampling periods, the ECMC, local municipality and well owner will be notified immediately.
- If BTEX and/or TPH is detected during water source sampling, ECMC local municipality and well owner will be notified immediately.
- If local municipalities require additional analytes, the schedules are described under each location specific section of this plan.

2.3 Data and Report Preparation

Individual water source reports will be provided to well owners, and the ECMC within 3 months of sample collection and will include the following:

- A summary of the field parameters/observations;
- A summary table with the laboratory analytical results of Table 1 or Table 3 (initial or subsequent), as applicable;
- A summary table of laboratory analytical results listed in Table 2 (as applicable);
- The surveyed water sample locations; and
- A description of the field sampling methods and laboratory analytical methods utilized

The above information will be provided in an electronic data deliverable in an ECMC approved format.

The sampling results and analytical data will be provided to local authorities within 30 days of receipt of laboratory analytical results.

3.0 SITE SPECIFIC PLANS INVICTA 3-65 28 PAD

Specific sampling plans will be updated in this section as additional drilling locations are identified. Local authority requirements will be included in this section. The plan for well testing in this section is described to comply with The Aurora Oil & Gas Manual section 135.4 (c) for the Invicta Pad location and ECMC rules described in Section 1.0 and 2.0.

3.1 INVICTA 3-65 28 PAD

A review of Colorado Division of Water Resources records indicates there could be two registered water wells within one-half mile of the Invicta Pad drilling location. A location just west of the pad indicates it is an abandoned borehole that was 15 feet deep. One other well is described at an abandoned uninhabitable residence located approximately one-half mile to the north.

3.2 Existing Domestic Supply Wells Within One-half Mile

Per Aurora Oil and Gas Manual, and ECMC requirements, operator must obtain initial baseline samples from all available domestic water sources within a one-half (1/2) mile distance from the edge of the Oil and Gas Location.

Two water sample records in the ECMC database were collected in 2021 from a water source located one-half mile north of the pad. The residential structure associated with this location is uninhabitable. The data from these samples is provided in Appendix C. The completion record for this well indicates it is 960 feet deep. DNR records reviewed in 2024 indicate this well has been abandoned and sampling will not be attempted.

The other water well record within one-half mile is for an abandoned borehole and sampling is not feasible.

3.3 Monitoring Well Installations on Oil and Gas Location

The City of Aurora Oil and Gas Manual describes installing a single monitoring well to be used for sampling of water from five different aquifers at the drilling pad location. CDH recommends an individual well installation in each interval rather than attempting to screen over multiple intervals in a single borehole and installation of individual monitoring wells is planned. The bedrock fresh water aquifers mapped in this area of the Denver Basin include the Denver, Upper and Lower Arapahoe and Fox Hills. A limited shallow saturated alluvial/weathered bedrock interval may also exist. In the Denver Basin, groundwater flows downgradient from the Palmer Divide toward streams in all directions. Using surface topography as the guidance, groundwater flow at the pad location is to the east toward an unnamed drainage that leads to Box Elder Creek.

Following review of an initial submittal and based on comments received from City of Aurora the following approach will be implemented:

- Evaluate water well aquifers for depth intervals and viability as a water source. Install an individual monitoring well with screen placed into each viable aquifer identified. Preliminary information indicates the following estimated monitoring well installation depths:

- Shallow Alluvium, Estimated depth 40 feet if present,
 - Dawson aquifer, not believed to be present but review logs for determination
 - Denver aquifer 750 feet
 - Upper Arapahoe aquifer 1000 feet
 - Lower Arapahoe aquifer 1300 feet
 - Fox Hill Aquifer 1900 feet
- The deepest expected monitoring well will be installed first and/or the surface casing borehole will be drilled, and a geophysical log will be created within the borehole to identify water source intervals. The geophysical log will be provided to the City of Aurora describing the aquifer layers are sufficiently identified and monitoring wells will be installed to monitor these intervals.
 - Monitoring well installations will be completed in accordance with the Colorado Division of Water Resources requirements.
 - Monitoring well locations will be on the east side of the Invicta Pad, downgradient of the oil and gas well boreholes and located greater than 350 feet from City of Aurora infrastructure.
 - Preliminary monitoring well bore diagrams are provided as Figure 1 and Figure 2.
 - Actual drilled locations will be surveyed to sub-meter resolution and GPS coordinates will be provided to the City of Aurora with the well bore records.

3.4 Initial Sampling of Monitoring Wells

Each installed monitoring well will be sampled prior to subsurface oil and gas activity at the pad location and within 12 months prior to initiating oil and gas activity. The list of analytes for the initial samples listed in the Aurora Oil and Gas Manual and meeting ECMC requirements are provided in Table 1. The Table 1 list includes analytes where specific methods are under development. GMT will consult with the City of Aurora if analytical methods are currently not available for particular analytes prior to sampling. Table 2 lists additional parameters which will be analyzed dependent upon methane concentrations observed in the samples exceeding 1 mg/L per the ECMC and Aurora requirements.

3.5 Ongoing Monitoring

In accordance with ECMC Rule 615 as a monitoring hole and a water well within ½ mile have been abandoned no sampling will be required.

The following sampling events from the monitoring locations for the Invicta Pad will be implemented to comply with City of Aurora requirements:

- Prior to the re-stimulation of an existing Well for which no samples were collected and tested during the previous twelve (12) months.
- Water samples from installed monitoring wells will be sampled annually for the Denver Basin Aquifers and quarterly for the alluvial aquifer pending results of the borehole logging and

monitoring well installations, and as agreed to in consultation with, and approved by the City of Aurora.

- Continue this sampling approach for one year following drilling then re-assess the frequency with consultation of the City of Aurora.

Ongoing water quality testing will be conducted for the analytes listed in Table 3. Sampling will be conducted in accordance with Section 2.0 and the ECMC Model Sampling and Analysis Plan (Appendix B).

One water sample will be collected from each aquifer accessed by the on-location monitoring wells after all final reclamation of all oil and gas facilities on the Invicta Pad Location. The samples will be analyzed for the constituents in Tables 1 and Table 2 (dependent upon Table 1 results), and the results will be reported to the City of Aurora and ECMC.

3.6 Reporting

Reporting of field and laboratory results will be provided to the City of Aurora and the water source owners within 30 days of receipt of laboratory analytical results and will be provided to ECMC per Section 2.3 of this plan. Results indicating specific petroleum hydrocarbons or gases will require additional reporting as indicated in Section 2.2.

4.0 REFERENCES

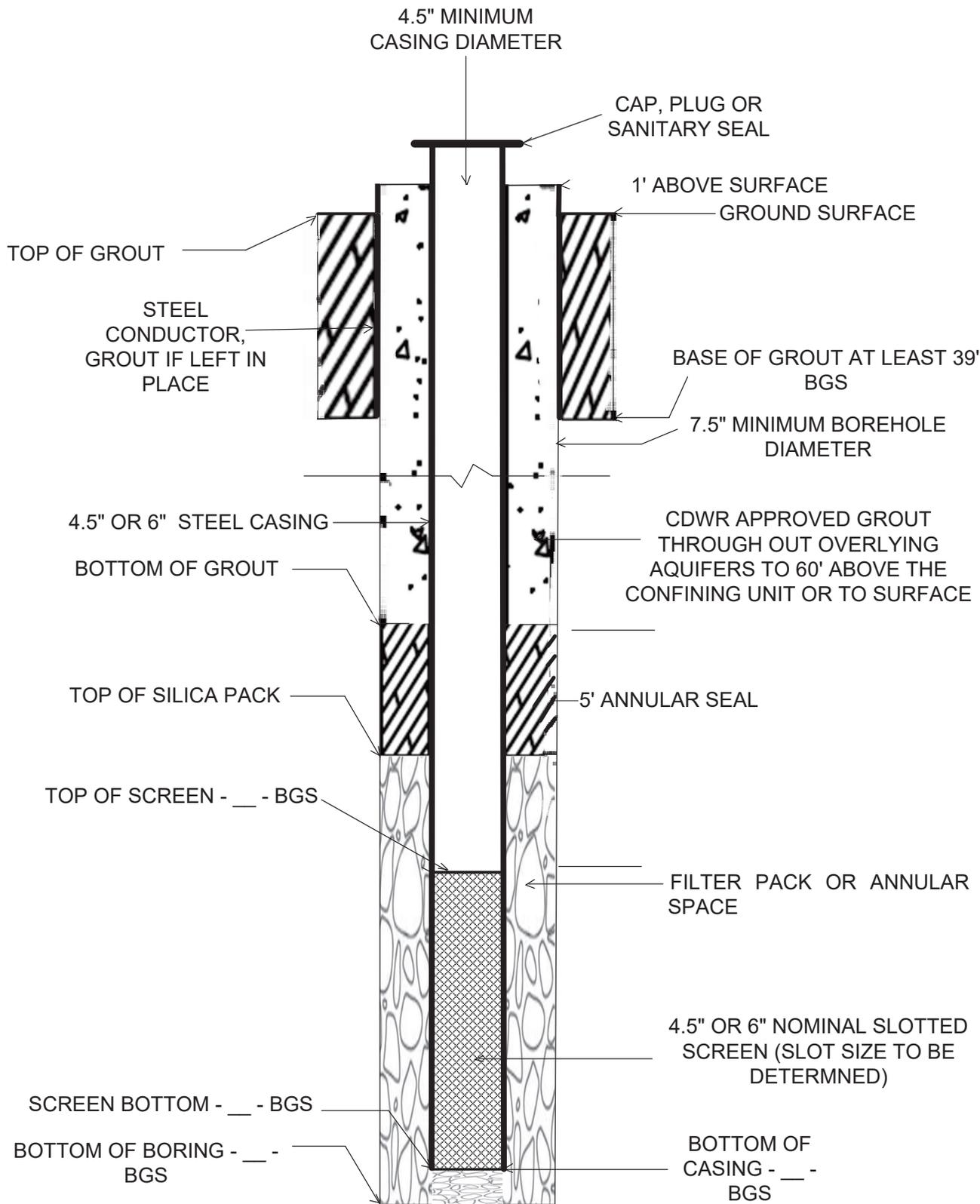
Board of Examiners of Water Well Construction and Pump Installation Contractors RULES AND REGULATIONS FOR WATER WELL CONSTRUCTION, PUMP INSTALLATION, CISTERN INSTALLATION, AND MONITORING AND OBSERVATION HOLE/WELL CONSTRUCTION 2 CCR 402-2

ECMC(COGCC) Rules SAFETY AND FACILITY OPERATIONS REGULATIONS, 600 SERIES, 615.
GROUNDWATER BASELINE SAMPLING AND MONITORING

Aurora City Code Chapter 135, OIL AND GAS MANUAL, July 17, 2021

Groundwater Availability of the Denver Basin Aquifer System, Colorado. Professional Paper 1770, U.S. Geological Survey, 2011

FIGURES



*BGS=BELOW GROUND SURFACE
 CDWR=COLORADO DIVISION OF WATER RESOURCES

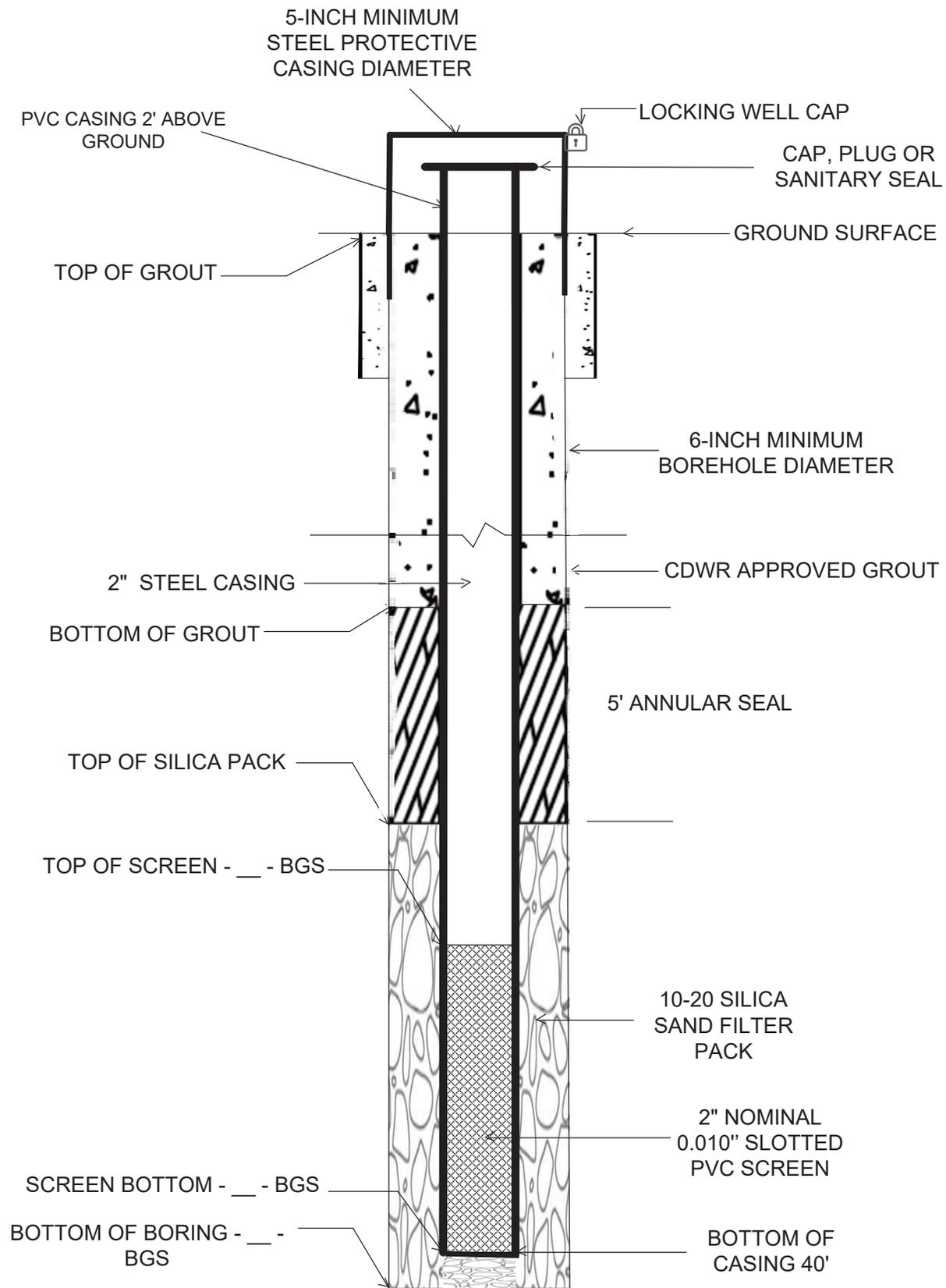
* Installation to comply with CDWR Rules 2 CCR 402-2

TOTAL ESTIMATED DEPTH OF EACH OF FOUR WELLS:
 o DENVER AQUIFER 750'
 o UPPER ARAPAHOE 1000'
 o LOWER ARAPAHOE AQUIFER 1300'
 o FOX HILL AQUIFER 1900'
 *ACTUAL DEPTH AND SCREENED INTERVALS WILL DEPEND ON GEOPHYSICAL LOG OF INITIAL BORING



PRELIMINARY MONITORING WELL BORE DIAGRAM
 GMT EXPLORATION COMPANY
 INVICTA 3-65 28 PAD
 N ½, SECTION 28, T3S, R65W, 6th P.M.,
 ADAMS COUNTY, COLORADO

FIGURE 1



*BGS=BELOW GROUND SURFACE
 CDWR=COLORADO DEVISION OF WATER RESOURCES

* Installation to comply with CDWR Rules 2 CCR 402-2

TOTAL ESTIMATED DEPTH:

o SHALLOW ALLUVIUM ESTIMATED DEPTH OF 40'

*ACTUAL DEPTH AND SCREENED INTERVALS WILL DEPEND ON GEOPHYSICAL LOG OF INITIAL BORING

TABLES

Table 1
Initial Water Well Sample Analytical List
Invicta 3-65 28 Pad
Aurora, Adams County Colorado
GMT Exploration Company, LLC

Analytes

| Aurora Table 135-4-1 Inorganic Chemicals. | Table 135-4-3 Synthetic Organic Compounds (SOCs). | Table 135-4-4 Radionuclides. |
|---|---|--|
| Antimony | Alachlor | Combined radium-226 and radium-228 |
| Arsenic | Aldicarb1 | Gross alpha particle activity (including radium-226 but excluding radon and uranium) |
| Asbestos | Aldicarb sulfoxide | Beta particle and photon radioactivity |
| Barium | Aldicarb sulfone | Uranium |
| Beryllium | Atrazine | Table 135-4-5 Secondary Maximum Contaminant Levels. |
| Cadmium | Carbofuran | Aluminum |
| Chromium | Chlordane | Chloride |
| Cyanide (as free Cyanide) | Dibromochloropropane | Color |
| Fluoride | 2,4-D | Copper |
| Mercury | Ethylene dibromide | Corrosivity |
| Nitrate | Heptachlor | Fluoride |
| Nitrite | Heptachlor epoxide | Foaming agents (surfactants) |
| Total Nitrate and Nitrite | Lindane | Iron |
| Selenium | Methoxychlor | Manganese |
| Thallium | Polychlorinated biphenyls | Odor |
| Table 135-4-2 Organic Chemicals. | Pentachlorophenol | pH |
| Propane | Toxaphene | Silver |
| BTEX as Benzene, Toluene, Ethylbenzene and Xylenes | 2,4,5-TP (Silvex) | Sulfate |
| Total Petroleum Hydrocarbons (TPH) as TPH extractable (C10 to C36) and and TPH volatile (C6 to C10) | Benzopyrene | Total dissolved solids (TDS) |
| Vinyl chloride | Dalapon | Zinc |
| Benzene | Di(2-ethylhexyl)adipate | |
| Carbon tetrachloride | Di(2-ethylhexyl)phthalate | |
| 1,2-Dichloroethane | Dinoseb | |
| Trichloroethylene | Diquat | |
| Para-Dichlorobenzene | Endothall | |
| 1,1-Dichloroethylene | Endrin | |
| 1,1,1-Trichloroethane | Glyphosate | |
| cis-1,2 Dichloroethylene | Hexachlorobenzene | |
| 1,2-Dichloropropane | Hexachlorocyclopentadiene | |
| Ethylbenzene | Oxamyl (Vydate) | |
| Monochlorobenzene | Picloram | |
| o-Dichlorobenzene | Simazine | |
| Styrene | 2,3,7,8-TCDD (Dioxin) | |
| Tetrachloroethylene | Perfluorooctanoic Acid (PFOA) | |
| Toluene | Perfluorooctane Sulfonate (PFOS) | |
| Trans-1,2 Dichloroethylene | | |
| Xylenes (total) | | |
| Dichloromethane(methylene chloride) | | |
| 1,2,4-Trichlorobenzene | | |
| 1,1,2-Trichloroethane | | |
| Table 135-4-6 Other Parameters. | | |
| GENERAL WATER QUALITY | | |
| Alkalinity, Conductivity & TDS, pH, Dissolved Organic Carbon (or Total Organic Carbon), Bacteria*, and Hydrogen | | |
| MAJOR IONS | | |
| Bromide, Magnesium, Potassium, Sodium, and Nitrate + Nitrite as N | | |
| METALS | | |
| Boron, Lead, Selenium, Strontium | | |
| DISSOLVED GASES | | |
| Methane, Ethane, Propane | | |
| OTHER | | |
| Water Level, Stable isotopes of water (Oxygen, Hydrogen, Carbon), Phosphorus | | |

*Presence of Bacterial Activity Reaction Tests (iron related, sulfur reducing, slime forming)

Table 2
Gas Composition and Isotopic Analysis (When Required)
Invicta 3-65 28 Pad
Aurora, Adams County Colorado
GMT Eploration Company, LLC

| Analytes | Analytes |
|-----------------------|-----------------------------|
| oxygen | helium |
| hydrogen | propene |
| argon | Iso-butane |
| nitrogen | n-butane |
| Carbon dioxide | Iso-pentane |
| methane | n-pentane |
| ethane | hexanes |
| ethene | Specific gravity |
| propane | British thermal units (BTU) |
| | |
| | |
| δD of C1 | $\delta^{13}C$ of nC4 |
| $\delta^{13}C$ of C1 | $\delta^{13}C$ of iC5 |
| $\delta^{13}C$ of C2 | $\delta^{13}C$ of nC5 |
| $\delta^{13}C$ of C3 | $\delta^{13}C$ of CO2 |
| $\delta^{13}C$ of iC4 | |

Table 3
Subsequent Water Well Sample Analyte List
Invicta 3-65 28 Pad
Aurora, Adams County Colorado
GMT Eploration Company, LLC

Analytes

[Table 135-4-7 General Sampling Parameters.](#)

| |
|---|
| GENERAL WATER QUALITY Alkalinity, Conductivity & Total Dissolved Solids (TDS), pH, Dissolved Organic Carbon (or Total Organic Carbon), Bacteria, and Hydrogen Sul |
| MAJOR IONS Bromide, Chloride, Fluoride, Magnesium, Potassium, Sodium, Sulfate, and Nitrate + Nitrite as N |
| METALS Arsenic, Barium, Boron, Chromium, Copper, Iron, Lead, Manganese, Selenium, Strontium, Mercury, Uranium, and Radium |
| DISSOLVED GASES and VOLATILE ORGANIC COMPOUNDS Methane, Ethane, Propane, BTEX as Benzene, Toluene, Ethylbenzene and Xylenes, Total Petroleum Hydrocarbons (TPH) |
| OTHER Water Level, Stable isotopes of water (Oxygen, Hydrogen, Carbon), Phosphorus |
| Add for COGCC List Calcium, iron, magnesium |

Table 4
Water Well Permits Within One-half Mile of Drilling Location
Invicta 3-65 28 Pad
Aurora, Adams County Colorado
GMT Eploration Company, LLC

| Location Relative to Pad | Permit # | Comment | Owner | Well Depth (feet) | Quarter | Quarter | Section | Township | Range | Lattitude | Longitude |
|--------------------------|----------|---|--------------------------|-------------------|---------|---------|---------|----------|-------|-----------|------------|
| 1/2 mile north | 148547 | well sampled 2021, at uinhabitable former reisdence, well abandoned | Aurora tech ctr holdings | 960 | SW | SE | 21 | 3S | 65W | 39.77101 | 104.66642 |
| 0.3 mile Southwest | 24544-MH | Borehole, abandoned | Metro Wastewater | 15 (dry) | SE | NW | 28 | 3S | 65W | 39.763601 | -104.67119 |

notes:

Registered water wells within 1/2 mile of the Invicta Pad listed above

Lattitude and Longitude spotted from section lines typically

**APPENDIX A:
INVICTA PAD SITE SPECIFIC INFORMATION –SITE LOCATION
FIGURE**



Borehole in DWR database

Water well in DWR Database (abandoned)

Monitoring wells will be located greater than 350 feet from existing critical city infrastructure see detailed updated plats

2000' OFFSET FROM WORKING PAD SURFACE

REV: 01 07-17-23 K.C.. (REMOVE BUILDINGS)

| # | FEATURE | BEARING | DISTANCE |
|---|------------------|---------|----------|
| 1 | E. 38th AVE | NORTH | 1089'± |
| 2 | TOWER | NORTH | 1221'± |
| 3 | POWER LINE | NORTH | 1276'± |
| 4 | PIPELINE | SOUTH | 185'± |
| 5 | POWER LINE | EAST | 1994'± |
| 6 | RIVERINE - R4SBA | SE | 793'± |
| 7 | RIVERINE - R4SBC | SW | 1486'± |
| 8 | WATER WELL | SW | 640'± |

Reference Point: CENTER OF INVICTA PAD
 Lat: 39.764777°
 Long: -104.668144°
 1589' FNL 2440' FEL
 Ungraded Ground Elev. 5634.2'
 PDOP: 1.5

NOTES:
 • Bearings & distances shown are from the nearest edge of working pad surface.

LEGEND:

| | | | |
|--|----------------------|--|-----------------|
| | OIL & GAS LOCATION | | POWER LINE |
| | WORKING PAD SURFACE | | PIPELINE |
| | PROPOSED ACCESS ROAD | | WATER WELL |
| | DRAINAGE | | REFERENCE POINT |
| | ROAD | | |



UELS, LLC
 Corporate Office * 85 South 200 East
 Vernal, UT 84078 * (435) 789-1017



GMT EXPLORATION COMPANY, LLC

INVICTA 3-65 28 PAD
 N 1/2, SECTION 28, T3S, R65W, 6th P.M.
 ADAMS COUNTY, COLORADO

| | | | |
|--------------------|----------------|----------|--------------|
| SURVEYED BY | DALLAS NIELSEN | 01-26-23 | SCALE |
| DRAWN BY | K.C. | 06-29-23 | 1" = 500' |

LOCATION DRAWING

**APPENDIX B:
ECMC (COGCC) MODEL SAMPLING AND ANALYSIS PLAN**



COLORADO

**Oil & Gas Conservation
Commission**

Department of Natural Resources

Model Sampling and Analysis Plan

Rules 609 and 318A.f

Colorado Oil and Gas Conservation Commission

Version 2

April 2020



2019 Review and Revisions by
Apex Companies, LLC & COGCC staff

REVISION HISTORY

| Effective Date | Reviewer/Approver | Description (Review or Nature of Revisions) |
|----------------|---|---|
| May 1, 2013 | COGCC | Version 1 SAP approval and implementation |
| August 2019 | H. Shideman (Apex) / P. Gintautas (COGCC) A. Koepsell (COGCC) | Version 2 SAP review and updates |

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1.0 – INTRODUCTION

The Colorado Oil and Gas Conservation Commission (COGCC) has prepared this model sampling and analysis plan (SAP) for parties who engage in sampling and analysis activities for Rule 609 - Statewide Groundwater Sampling and Monitoring (609), and Rule 318A.f – Groundwater Baseline Sampling and Monitoring in the Greater Wattenberg Area (GWA) which originally was rule 318A.e(4) approved during rulemaking in 2013 (COGCC Order 1R-116). This SAP document will be modified as necessary based on new procedures, protocols, and other information that need to be incorporated to meet the objectives of the rules. Rule 318A.f is the present rule number applicable in the GWA area after a clean-up rulemaking in 2014 and this rule number change became effective in 2014 (COGCC Order 1R-120).

As stated in Cause No. 1R Docket No. 1211-RM-03 Order 1R-116 Statewide Water Sampling and Monitoring (new Rule 609 and amended Rule 318A.e.(4), the statement of basis and purpose for these rules are:

"The purpose of the new and amended water sampling rules is to gather baseline water quality data prior to oil and gas development occurring in a particular area, and to gather additional data after drilling and completion operations. The water quality data generated under the rules will be publicly available on the Commission's web site. Acquiring this data and making it publicly available will inform relevant stakeholders, including public officials, of baseline groundwater quality, and may aid in early detection of any adverse impacts related to oil and gas activity. Similarly, the sampling program may identify existing groundwater contaminants, which can then be properly treated."

The timing and frequency of the sampling is described in the rules themselves and will not be described in detail in this SAP.

Sampling must be conducted in a way that employs "best practice protocols" designed for the collection of samples that are representative of groundwater at the site. Methods and techniques used in the analysis of the groundwater samples must be capable of providing both accurate and precise measurements from representative aliquots of groundwater for analysis. It is important to use well documented analytical processes so that different laboratories are capable of producing comparable accurate data. The goal of any environmental sampling program is to ensure precision, accuracy, representativeness, comparability, and completeness of the data. These principals must be carried forward for sampling and analysis efforts designed to meet requirements of rule 609 and rule 318A.f. Equally important is the assurance that the methods and processes of analysis will yield reproducible results at reporting thresholds that are adequate to evaluate potential changes in water quality.

The groundwater sampling and analysis procedures outlined in the SAP are designed to provide consistency in sampling and analytical techniques. The use of the original laboratory's electronic data deliverable (EDD) files in the COGCC format is also an essential part of ensuring that the data are accurately captured for later evaluation. The upload process allows efficient data handling and transfer and can eliminate the need to check for data transcription errors that are an inevitable result of manual data entry. Documentation of sample location and condition of an available water source (AWS) and its current use, along with field observations about the water sample, such as effervescence, reported taste, and odor, are also important. The field observations acquired at each site must be recorded and submitted into the COENV database in addition to the laboratory generated analytical data.

2.0 - PRE-SAMPLING ACTIVITIES

Water sources will be selected based on the definition in the COGCC 100 Series Definitions and further refined based on criteria contained in 609 and 318A.f. Water sources within the areas where sampling is required can be identified using the COGCC GIS Online interactive map as outlined in the COGCC guidance to operators (COGCC, 2015). An oil and gas operator (Operator) must make good faith efforts to identify the owner of the water source

and obtain permission for site access, including the acknowledgement that the sample data will be accessible to the public through the COGCC website.

An Operator shall review Division of Water Resources (DWR) online permit records for water source construction, depth, casing diameter, reported static water level, and initial flow rate/yield prior to the water source sampling. During the initial sampling, the location of the water source must be surveyed in accordance with COGCC Rule 215. Confirmation of the location of the water source should be confirmed during subsequent sampling events.

Before or during the sampling, the landowner should be interviewed regarding current water source conditions and knowledge of any discrepancies between the DWR records and the current water source configuration. Data should also be collected on recent water source use(s) and water quality concerns such as observations or recent changes in appearance, taste, and odor.

3.0 - SAMPLE COLLECTION

All samples shall be collected by individuals experienced with water quality sampling and sent to a laboratory accredited by the National Environmental Laboratory Accreditation Program (NELAP) in general and, more importantly, for analytical procedures and analytes of concern in this SAP. Guidance for general sampling practices can be found in ASTM D4448-01 (Reapproved 2019) Standard Guide for Sampling Ground-Water Monitoring Wells, ASTM D5358-93 (2019) Standard Practice for Sampling with a Dipper or Pond Sampler, and/or ASTM D5088-15a (2015) Standard Practice for Decontamination of Field Equipment used at Waste Sites.

A complete set of samples should be obtained from each available water source, as specified in 609 and 318A.f, and at a minimum analyzed for the required analytes listed in Table 3-1.

The individual collecting the samples should wear new, disposable, powder free, nitrile gloves to prevent possible contamination of the samples. At a minimum, the gloves should be changed following the collection of each sample, or more frequently, as needed.

In order to prevent cross contamination of samples, disposable sampling equipment should be used whenever possible. Samples will be placed in clean laboratory-supplied, disposable polyethylene or glass bottles containing the appropriate preservative aliquot, as applicable. All non-disposable equipment (e.g., sampling pumps with non-disposable tubing, dippers, beakers, sample collection tubing, valve assemblies, etc.) and instruments that contact the samples must be decontaminated prior to use and between sample locations using the following ASTM D5088-15a procedures:

- 1) Remove gross contamination by dry brushing followed by a tap water rinse;
- 2) Wash with a laboratory grade detergent solution, such as Alconox® or equivalent;
- 3) Detergent solutions should be circulated through sampling pumps and non-disposable discharge tubing to decontaminate this equipment;
- 4) Rinse with tap water;
- 5) Rinse with distilled or deionized water;
- 6) Air dry; and
- 7) Decontaminated equipment should be stored in sealed containers such as zipper-lock plastic bags or boxes with tight lids to protect from airborne dust contamination during mobilization to the next site and prior to use.

Initial decontamination should be performed prior to arriving at a sampling location. All decontamination solutions should be collected, properly disposed, and documented in accordance with applicable federal, state, and local regulations.

Table 3-1 – Minimum Required Laboratory Analytes

| Analyte | Filter, Container, and Preservative | Lab Method, Holding Time, LLO |
|---|--|---|
| General Water Quality Parameters | | |
| pH | Unfiltered, Plastic, Unpreserved & 4°C | SM4500-H+ or SW846 9040C, < 15 minutes, NA |
| Specific Conductance (Conductivity) | | SM2510B or SW846 9050A, 28 days, NA |
| Solids, Total Dissolved (TDS) | | SM2540C, 7 days, 10 mg/L |
| Bicarbonate, Carbonate and Total Alkalinity (as CaCO ₃) | | SM2320B, 14 days, 10 mg/L |
| Major Anions | | |
| Bromide (Br) | Unfiltered, Plastic, Unpreserved & 4°C | EPA 300.0 or SW846 9056A, 28 days, 0.2 mg/L |
| Chloride (Cl) | | EPA 300.0 or SW846 9056A, 28 days, 0.1 mg/L |
| Fluoride (F) | | EPA 300.0 or SW846 9056A, 28 days, 0.2 mg/L |
| Sulfate (SO ₄ ²⁻) | | EPA 300.0 or SW846 9056A, 28 days, 5 mg/L |
| Phosphorus (P) | | EPA 365.1 or SM4500-PA, NA, 0.05 mg/L |
| Nitrate as N (NO ₃) | | EPA 300.0 or SW846 9056A, 48 hours, 0.1 mg/L |
| Nitrite as N (NO ₂) | | EPA 300.0 or SW846 9056A, 48 hours, 0.1 mg/L |
| Nitrate & Nitrite as N | | By summation of results of NO ₃ and NO ₂ analyses by 300.0 or 9056A (above) |
| Nitrate & Nitrite as N | Unfiltered, Plastic, preserved with H ₂ SO ₄ & 4°C unless analyzed in 24 hours of collection | SM4500-NO ₃ F or EPA353.3, 28 days, 0.1 mg/L |
| Major Cations (dissolved) | | |
| Calcium (Ca) | Filtered (0.45µm) at lab, Plastic, HNO ₃ Preserved to pH<2 at lab & 4°C May also be filtered in the field and then immediately preserved to pH<2 | EPA 200.7/200.8 or SW846 6010D/SW846 6020A, 180 days, 1 mg/L |
| Iron (Fe) | | EPA 200.7/200.8 or SW846 6010D/SW846 6020A, 180 days, 0.1 mg/L |
| Magnesium (Mg) | | EPA 200.7/200.8 or SW846 6010D/SW846 6020A, 180 days, 1 mg/L |
| Manganese (Mn) | | EPA 200.7/200.8 or SW846 6010D/SW846 6020A, 180 days, 0.01 mg/L |
| Potassium (K) | | EPA 200.7/200.8 or SW846 6010D/SW846 6020A, 180 days, 1 mg/L |
| Sodium (Na) | | EPA 200.7/200.8 or SW846 6010D/SW846 6020A, 180 days, 1 mg/L |
| Other Elements (dissolved) | | |
| Barium (Ba) | Filtered (0.45µm) at lab, Plastic, HNO ₃ Preserved to pH<2 at lab & 4°C May also be filtered in the field and then immediately preserved to pH<2 | EPA 200.7/200.8 or SW846 6010D/SW846 6020A, 180 days, 0.001 mg/L |
| Boron (B) | | EPA 200.7/200.8 or SW846 6010D/SW846 6020A, 180 days, 0.1 mg/L |
| Selenium (Se) | | EPA 200.7/200.8 or SW846 6010D/SW846 6020A, 180 days, 0.001 mg/L |
| Strontium (Sr) | | EPA 200.7/200.8 or SW846 6010D/SW846 6020A, 180 days, 0.01 mg/L |

Table 3-2 – Minimum Required Laboratory Analytes (continued)

| Analyte | Filter, Container, and Preservative | Lab Method, Holding Time, LLO |
|---|--|---|
| Dissolved gases | | |
| Methane (CH ₄) Ethane (C ₂ H ₆) Propane (C ₃ H ₈) | Preferred – In-line sample collection system container such as Isoflask® with bactericide present in sampling device, per laboratory specifications Alternate- Unfiltered, 40ml VOA vial, may be preserved with HCl to pH<2 & 4°C | Lab-specific SOP for analysis if in-line sample collection vessel such as IsoFlask® used. RSK175 (for use with 40ml vials); 14 days preserved, 7 days non-preserved, recommend 48 hours; 0.005mg/L |
| Compositional and Isotopic Analysis (if [CH₄, Dissolved]>1mg/L) | | |
| Fixed Gases C ₁ -C ₆ (Gas Chromatograph Concentrations of N ₂ , O ₂ , CO ₂ , Ar, H ₂ , He, CH ₄ , C ₂ H ₆ , C ₃ H ₈ , iC ₄ H ₁₀ , nC ₄ H ₁₀ , iC ₅ H ₁₂ , nC ₅ H ₁₂ , iC ₄ , nC ₄ , iC ₅ , nC ₅ , and C ₆ +). mass spectrometric determination of δ ¹³ C of CH ₄ , and δD of CH ₄ and δ ¹³ C of C ₂ H ₆ , and δ ¹³ C of C ₃ H ₈ (If present at concentrations great enough to yield accurate data) | Preferred – In-line sample collection system container such as IsoFlask® with bactericide in sampling device, per laboratory specifications Alternate- 1000ml plastic with septa sealed lid with bactericide preservative added by lab in gel capsule | Lab Specific SOP, 6 weeks, NA |
| Organic Analytes | | |
| Benzene, toluene, ethylbenzene, o-xylene, m-+p-xylene, total xylenes (by sum of xylene isomers) | Unfiltered, 40ml VOA vial, HCl to pH<2 & 4°C | SW846 8260D, 14 days, 1 µg/L |
| Total Petroleum Hydrocarbons (TPH) (volatile) as Gasoline Range Organics (GRO) using retention time window between 2-methylpentane to 1,2,4-trimethylbenzene (approx.. C ₆ to C ₁₀ range) | | SW846 8015C and modifications or SW846 8260D and modifications, 14 days, 0.05 mg/L |
| TPH (extractable) as Diesel Range Organics (DRO) using retention time window of C ₁₀ -C ₂₈ Range | Unfiltered, 1L Amber Glass, & 4°C | SW846 8015C and modifications, 7 days, 0.5 mg/L |
| Bacterial Activity Reaction Tests | | |
| Iron Related Bacteria Slime Forming Bacteria Sulfate Reducing Bacteria | Unfiltered, Sterile Plastic, Unpreserved & 4°C | BART Method, days to reaction or 100cfu/100ml, test should be initiated within 24-48 hours of sample collection |

NA - Not Applicable

3.1- Sample Labeling

Sample containers should be properly labeled prior to, and/or during field work. Labels will be completed with indelible ink and will include the following minimum information:

- 1) Sample identification number (Facility ID created in the COGCC Environmental (COENV) database);
- 2) Water source name;
- 3) Sampler's initials;
- 4) Date and time of collection, and
- 5) Preservation type.

Labels can be waterproof stickers, tags, or written directly onto the container and can be covered with clear plastic tape after being filled out to keep the ink from running due to contact with water during sampling and moisture in the sample shipping cooler. Containers should be free from all other labels to prevent confusion.

3.1.1 - Facility Naming Convention

The facility name shall be generated based on the following naming convention:

- Water sources such as permitted water wells, monitoring wells or adjudicated springs will have a facility name which includes last name of the landowner followed by the permit number assigned by the DWR.
- Sources without an assigned permit number such as some livestock wells, other types of wells, or surface locations without an assigned permit number will have a facility name created by entering the landowner's last name followed by Quarter-Quarter, Section, Township, and Range.

3.2 – Water Source Sampling

Standard monitoring well sampling protocols require purging a specified number of well volumes prior to collecting water samples (ASTM D6452-18, 2018). However, most available water sources are used frequently, have longer screen intervals or open boreholes, are equipped with fixed depth high flowrate pumps, and water collection is not taken directly from the wellhead but rather through the closest practical sampling point; therefore, standard groundwater monitoring well sampling protocols may not be appropriate at all sites (Molofsky et. al, 2018). It is recommended that a withdrawal point, upstream of ancillary equipment (e.g. holding tanks, pressure tanks, water softeners, water treatment systems, conveyance piping, etc.) be identified. If no withdrawal points upstream of ancillary equipment are available, best judgement should be utilized in purging to flush the water holding capacity of piping and any equipment upstream of the withdrawal point (US EPA, 2017a). Specifically, purge calculations should include the water holding capacity of the pressure tanks to limit the potential CH₄ loss (Molofsky et. al, 2018).

An Operator must document, in detail, their procedures and provide the procedures to COGCC staff, upon request. Once the purge method has been established at specific water sources, the same procedure will be utilized for all subsequent sampling at the specific water source (Molofsky et. al, 2018).

3.2.1 - Water Source Purging

Instructions for acceptable water source purging practices can be found in ASTM D6452 - 18 Standard Guide for Purging Methods for Well Used for Groundwater Quality Investigations (2018); ASTM D6771-18 Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations (2018); Purging and Other Sampling Variables Affecting Dissolved Methane Concentration in Water Supply Wells (Molofsky et. al, 2018); Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures (Puls and Barcelona, 1996); and EPA Operating Procedure Groundwater Sampling, Number SESDPROC-301-R4 (2017a).

Water sources will be purged prior to sampling to obtain a water sample representative of the aquifer. The purging methods described below are meant to be used as guidelines, but may change with site conditions, purpose of sampling, and or/landowner concerns. Two methods for purging water sources are recommended:

- 1) fixed wellbore volume purging techniques, or
- 2) purging until stabilization of water quality parameters.

Many domestic water wells in Colorado yield a few hundred gallons, or less, per day, which may still provide adequate water volume to the users. As part of the pre-sampling activities, the samplers must determine if, during normal use, the water source has been purged frequently. If the well is used frequently, a representative sample can be collected after purging <1 wellbore volume (Molofsky et al., 2018). It is recommended to use the stabilization of water quality parameters method, discussed below, with detailed notes of well use recorded on the field sampling data sheet (Attachment 1). It is always prudent to take a conservative approach, utilizing low flow and/or low volume purging techniques (Puls and Barcelona, 1996; COGCC, 2008).

Regardless of purge method, onsite collection of water quality operational and indicator parameters such as water volume purged, visual and olfactory observations such as presence or absence of odor, bubbles or effervescence, qualitative determination of color of water if any, presence or absence of sediment, quantitative measurements of pH, water temperature, and conductivity must be monitored during the purge and recorded on a field sampling data sheet. Field parameter measurements should be collected using a multi-parameter instrument, utilizing an in-line flow-through device (ASTM D4448-01, 2019; ASTM D6452-18, 2018; ASTM D6771-18, 2018; Puls and Barcelona, 1996). Parameter stabilization is defined in Table 3-3 and is achieved once three successive measurements, taken 3 to 5 minutes apart, are within recommended ranges (ASTM D6771-18; Puls and Barcelona, 1996). , It is also recommended that quantitative instrumental determination of oxygen-reduction potential (ORP), dissolved oxygen (DO), and turbidity be measured and recorded at each sampling site.

Table 3-3 - Field Parameters

| Field Parameters | Field Methods | Lower Limit of Quantification (LLQ) | Parameter Stabilization Criteria ¹ |
|---------------------------------------|-----------------|-------------------------------------|---|
| Volume Water Purged Prior to Sampling | Measured Volume | NA | NA |
| Odor | Olfactory | NA | NA |
| Water Color | Visual, Photo | NA | NA |
| Bubbles | Visual, Photo | NA | NA |
| Effervescence | Visual, Photo | NA | NA |
| Sediment | Visual, Photo | NA | NA |
| pH | Field Meter | NA | ±0.2 SU |
| Specific Conductance | Field Meter | NA | ±3 % μS/cm |
| Temperature (water) | Field Meter | NA | ±0.3 % °C |
| Dissolved Oxygen | Field Meter | NA | ±10 % or ± 2 mg/L, whichever is greater |
| Turbidity | Field Meter | NA | ±10 % or ± 1 NTU, whichever is greater |
| Oxygen Reduction Potential | Field Meter | NA | ±10 % or ± 10 mV, whichever is greater |
| %LEL and/or CH ₄ | 4-Gas Meter | Range (0-100%) | NA |

NA - Not Applicable, Required Parameters, Recommended Parameters

If the water source is not routinely operated under normal use, volumetric purging with a minimum of three to five casing volumes should be purged prior to sampling (EPA, 2017a). After the volumetric purge, flow rates will be decreased to avoid drawdown in the water source, turbulence in the well bore, and to ensure any gas is not agitated out of solution.

Landowners frequently wish to capture the purge water in a cistern or portable tank, or to use in watering landscape features such as trees or shrubs. If purge water is not allowed to be discharged on location, it will be collected in portable tanks and stored on-site until the water can be transported and properly disposed off-site.

3.2.2- Water Source Sample Collection

Wells should be sampled immediately following purging. Samples should be collected and preserved as unfiltered, filtered, or dissolved gas samples, according to the specific sampling methods described below.

3.2.2.1 - Collection of Unfiltered Groundwater Samples

Unfiltered sample(s) containers should be filled directly from the pump discharge point (or via ¼" polyethylene tubing connected to the pump) into the laboratory-supplied sample containers. If sampling from a tap equipped with an aerator, the aerator should be removed, with landowner consent, prior to the sampling. If an in-line flow-through device was used during the purging, it should be disconnected or bypassed during sample collection (Puls and Barcelona, 1996). Preservation of unfiltered groundwater samples with acids should be done for certain analyses as listed in Table 3-1. The samples for analysis of volatile aromatic organic compounds and volatile petroleum range hydrocarbons will be collected in a manner that minimizes agitation, aeration, and overfill which would typically be done by direct fill of the 40ml vials.

3.2.2.2 - Collection of Filtered Groundwater Samples

Filtration and preservation at the laboratory are preferred; however, in some instances, field filtration is necessary.

When field filtration is necessary, samples will be filtered during collection using an in-line disposable 0.45-micron (μm) glass-fiber filter. When field filtering is performed, disposable tubing with the in-line filter will be connected directly to the pump discharge spigot, if possible. The pressure from the spigot/discharge point will be used to push water through the filter into the sample bottle. Alternatively, the in-line filter can be connected with tubing to a peristaltic pump to draw water from a pre-cleaned container through the filter. In all cases, the tubing and filter will be flushed with at least one liter of sample water before sample collection, and filtered water will be placed into laboratory provided sample containers. New filters will be used for each sample and decontamination procedures will be strictly followed. Preserve samples for metals analysis as listed in Table 3-1 if container did not have acid in the container provided by the lab.

3.2.2.3 - Collection of Groundwater Samples from Water Sources for Dissolved Gas Analysis

Groundwater samples collected for dissolved gas analysis from water sources with permanent pumps will be collected in IsoFlask® or equivalent in line sampling devices or by direct fill into non-preserved 40mL VOA vials equipped with gas-tight septa as described on Molofsky et al. (2016). Collection of samples utilizing in line sample collection devices such as outlined in Molofsky et al. (2016) is the preferred means of sampling for dissolved gas analysis. If bubbles are visible in 40ml vials then another sample will be collected. If it is not possible to get a bubble-free 40ml sample because the water is too effervescent, a vial with gas headspace is acceptable. The Operator should note this on the chain-of-custody (COC) and notify the laboratory that headspace was present in the field. In-line sampling containers may contain bactericide as preservative thus no acid should be added to the in line sample device before or after sample collection. Samplers should follow preservation guidance from the laboratory if using 40ml vials to collect samples. Many reports by and to COGCC staff indicate that acid preservation of certain types of groundwater samples (particularly those with elevated bicarbonate/carbonate alkalinity levels results in increased headspace in sealed 40ml vials which may lead to inaccurate analytical results of the dissolved gas analytes. Some laboratories have recommended use of a bactericide such as benzalkonium chloride for preservation of 40ml vial samples for dissolved gas analysis which

may be preferable to acid preservation techniques for this analysis. Field documentation provided to the COGCC must include type of container, preservative (if any) and method of sample collection for dissolved gas analyses.

3.2.2.4 - Collection of Groundwater Samples from Water Sources for Gas Composition and Isotopic Analysis

Groundwater samples collected for gas composition and isotopic analysis from water sources with permanent pumps will be collected in a closed-sample collection system container such as an IsoFlask® provided by the isotopic laboratory. Sample collection will be conducted using the manufacturer's specified tubing configuration and procedures (Isotech, 2014). The sampling device as provided by the vendor should contain a bactericide capsule and samples collected in such an in-line sampling device should be shipped and stored as recommended by the laboratory. Field documentation provided to the COGCC must include type of container, preservative (if any) and method of sample collection for gas composition and isotopic analyses.

3.3 - Spring and Seep Sampling

Collection of groundwater samples from springs or seeps will be collected as near to the source as possible. Prior to sampling, the field parameters pH, conductivity, water temperature, sediment/turbidity, DO, ORP, effervescence, bubbles, water color, and odor (if present) will be measured and recorded on a field sampling data sheet. A clean, white 5-gallon bucket should be used when monitoring for color, odor, and effervescence.

3.3.1 - Surface Water Sample Collection

Samples should be collected and preserved using the field methods for unfiltered samples, filtered samples, and dissolved gas samples according to the sampling protocol listed below.

3.3.1.1 - Collection of Unfiltered Surface Water Samples

Unfiltered samples should be collected by submerging a laboratory-supplied sample container or dipper directly into the spring and carefully transferring the sample to the sample container. If the sampling point is a seep, it may be necessary to use a pre-cleaned glass beaker to collect the water. Care should be taken to prevent the re-suspension of sediment into the water during sampling. The collected sample should be transferred from the dipper or beaker by allowing the water to run down the inside wall of the sample container to minimize sample disturbance. For those sample containers with preservative, special care should be taken not to overfill the container.

3.3.1.2 - Collection of Filtered Surface Water Samples

Filtration at the laboratory after receipt, followed by the appropriate preservation method will be the preferred method of filtering and preserving samples.

Alternatively, samples that will be field filtered must be collected using an in-line disposable 0.45 µm glass-fiber filter. The required water volume should be collected from the spring or seep using the dipper or beaker and placed in a pre-cleaned bucket. A hand vacuum pump and clean tubing should then be used to draw water from the bucket and push it through the in-line filter and into the sample container. In all cases, the tubing and filter should be flushed prior to sample collection and the filtered water should be collected directly into the pre-cleaned sample containers provided by the laboratory. New filters must be used for each sample, and decontamination procedures will be strictly followed. For those sample containers with preservative, special care should be taken not to overfill the container.

3.3.1.3 - Collection of Surface Water Samples for Dissolved Gas Analysis

Surface water samples collected for dissolved gas analysis from springs or seeps will be collected in non-preserved 40 mL VOA vials equipped with gas-tight septa. If the water is insufficiently deep to collect a sample, a depression will be made to create a pool of water, as close to the discharge point as possible, and to allow the flow of water to flush the suspended solids prior to sampling. Submerge a clean 500 mL or larger glass container and fill completely. Use the direct fill method outlined by Molofsky (2016) and decant water into the 40 mL VOA vial. If bubbles are visible, collect another sample. If it is not possible to get a gas-free sample because the water is too effervescent, a vial with gas headspace is acceptable. The Operator should note this on the chain-of-custody (COC) and notify the laboratory that headspace was present in the field. Samplers should follow preservation guidance from the laboratory if using 40ml vials to collect samples. Many reports by and to COGCC staff indicate that acid preservation of certain types of groundwater samples (particularly those with elevated bicarbonate/carbonate alkalinity levels results in increased headspace in sealed 40ml vials which may lead to inaccurate analytical results of the dissolved gas analytes. Some laboratories have recommended use of a bactericide such as benzalkonium chloride for preservation of 40ml vial samples for dissolved gas analysis which may be preferable to acid preservation techniques for this analysis. Field documentation provided to the COGCC must include type of container, preservative (if any) and method of sample collection for dissolved gas analyses.

3.3.1.4 - Collection of Surface Water Samples for Gas Composition and Isotopic Analysis

Surface water samples for gas composition and isotopic analysis should be collected in a 1 liter plastic bottle with gas tight septa cap provided by the laboratory with bactericide capsule inside. Collection may require gentle transfer of water from a smaller glass bottle depending on depth and/or flow of surface water. Otherwise fill the 1 liter bottle by the direct fill method (Molofsky et al., 2016). In line sampling containers should be utilized for this test samples can be collected using an installed pump as described in section 3.2.3.4. Field documentation provided to the COGCC must include type of container, preservative (if any) and method of sample collection for gas composition and isotopic analyses.

4.0- FIELD ANALYSES AND OBSERVATIONS

Physically or chemically unstable parameters, such as pH, DO, and water temperature must also be measured in the field, rather than solely at a laboratory. Although the conductivity of most groundwater samples should be relatively stable during and after sampling, it is required that conductivity be measured in the field both as part of the evaluation of the effectiveness and completeness of the purge and as a reportable parameter for the groundwater at the time of sampling. Other recommended field parameters are DO content of the groundwater, as well as the turbidity of the groundwater at the time of sampling. Measurement of the ORP of groundwater at the time of sampling is also recommended if an in-line flow-through device for measurements is used for analysis. Any field analyses performed must be reported on the field sampling data sheet. The required field parameters and observation data are summarized in Table 3-3 - Field Parameters. General guidance for documentation of a groundwater sampling event are found in ASTM D6089-15 (2015).

Calibration of field instrumentation should follow the manufacturer's calibration and maintenance procedures detailed in the equipment's technical manuals. Calibration solutions should be replaced on or before the manufacturer's expiration date printed on each container, and unused, expired standards should be disposed of per manufacturer's instructions. Temperature corrections of pH and conductivity measurements are typically done by multi-parameter meters equipped with temperature probes, but if the pH and conductivity meters are not capable of performing temperature corrections to 25°C, then manual corrections must be performed, based on the measured temperature of the groundwater, before data is entered in the COENV database.

5.0- SAMPLE PRESERVATION, HANDLING, AND SHIPPING

Preservation of samples prior to shipment to a laboratory is done in several ways depending on analyte and method guidance. Recommended preservation for many organic analytes may be as simple as storing and shipping at 4°C with a range of acceptable water temperatures on receipt at a laboratory of 0 to 6°C. Other samples, such as water samples for analysis of volatile organic compounds (VOCs), should follow the preservation guidance developed in SW 846 Chapter 4 (U.S. EPA, 2018) and guidance identified in Table 3-1.

Water samples will be placed in a cooler, with ice or other coolant, immediately following collection unless otherwise indicated by the laboratory. Collected samples will be stored in refrigerated conditions that prevent freezing. If shipping is required, samples will be packed in a cooler with sufficient ice to maintain water temperature until the samples reach the laboratory. The coolers should be clearly labeled in order to expedite delivery to the selected laboratory and transported or shipped in a timely manner (preferably overnight) to minimize the potential for failure to meet method-specified hold times. Laboratory-supplied trip blanks and temperature blanks will be included with each cooler. After the cooler is properly packed, a signed custody seal will be placed across the opening edge of the cooler, signed over to the laboratory or freight carrier, and a copy of the COC form retained, demonstrating transfer of custody.

Table 3-1 provides a summary for sample collection, storage, and preservation techniques by method or type of analyte. Laboratory specific requirements may supersede the procedures summarized and any deviations should be approved by the COGCC staff.

6.0- CHAIN OF CUSTODY DOCUMENTATION AND RECORDS MANAGEMENT

Guidance for general COC practices can be found in ASTM D4840-99(2018)e1, Standard Guide for Sample Chain-of-Custody Procedures.

Samples must be handled, stored, and shipped in accordance with COC procedures. COC procedures require that all samples be maintained under the control of the sampler (i.e., in sight or in a secure, locked environment controlled by the sampler) from the time of collection until delivery. The analytical laboratory will provide a COC form that includes the following:

- Operator;
- Sample identifications (facility name, facility ID, legal location);
- Sample frequency (e.g., initial, 1st subsequent, 2nd subsequent);
- Sample reason (e.g. 609 or 318A.f);
- Date and time of collection;
- Requested analysis;
- Preservatives;
- Matrix, number of bottles;
- Field parameters (optional); and
- Signatures.

The sampler must also sign the COC form releasing the samples to the laboratory at the time of delivery to the lab or at the time of release to the shipping courier. The laboratory also signs the COC form accepting custody of the samples at the time of delivery by the sampler or the shipping courier. The COC form and any other documentation (shipping receipts, bills of lading) should be sealed in a zipper lock plastic bag and taped to the inside top of the cooler to limit the potential for water damage to the form. Once the cooler is prepared to insure sample integrity, shipping tape and custody seals (adhesive labels signed and dated by the sampler) should be securely placed on the cooler such that the cooler cannot be opened without breaking the seal (ASTM D4840-99, 2018).

7.0- ANALYTICAL PROCEDURES AND QUANTITATION LIMITS FOR LABORATORY AND FIELD METHODS

Analysis of samples must be completed by laboratory(ies) accredited by the NELAP in general and more importantly for analytical procedures and analytes of concern in this SAP. NELAP accreditation extends to both matrix (such as groundwater, which has been listed as non-potable water (NPW) matrix in NELAP terminology), as well as to analytical technology (such as gas chromatography/mass spectrometry (GC/MS)), and to individual analytes (such as benzene or toluene). As an example, an acceptable laboratory would be accredited for analysis of benzene and toluene by purge and trap GC/MS techniques for the non-potable water matrix.

State or national accreditation may not be possible at this time for some analytes or analytical technology such as the specialized isotopic ratio determination of the carbon and hydrogen present in CH₄, dissolved gases and/or the use of bacterial activity reaction test (BART) biodefectors.

Analytes, appropriate methodology, and expected achievable detection limits are included in Table 3-1. There are many acceptable methods used for determination of the analytes in the anions and general water quality parameters and not all are listed in Table 3-1.

8.0- FIELD AND LABORATORY QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Data integrity will be assured and verified through:

- 1) Field sampling practices that comply with this SAP;
- 2) Sample analysis by an accredited analytical laboratory(ies);
- 3) Laboratory practices which follow approved analytical methods;
- 4) When available, collection and analysis of field quality assurance samples; and,
- 5) Data quality reviews of the laboratory and field practices.

All samples will be analyzed by laboratory(ies) that are NELAP accredited for the matrices and analytical processes that will be used for sample analysis, where such accreditation exists. Approved and accepted analytical methods, such as test methods for Evaluating Solid Waste SW846 or other methods such as Standard Methods for the Examination of Water and Wastewater, which are recognized standard industry practice, will be used for sample analysis as indicated in Table 3-1. Deviations to the analytical methods should be approved by the COGCC staff prior to sampling.

Where Standard Methods or EPA published methods are not available, standard industry practices will be followed. Laboratory quality assurance samples, such as matrix spike/matrix spike duplicates, will be prepared in the laboratory and analyzed as specified by the designated method. Laboratory quality assurance sample results must be reported along with the original sample results on the laboratory report including the COGCC EDD, and an analytical narrative shall be provided as part of the laboratory report.

8.1 - Field Control Samples

Field quality control samples shall be collected following an Operator's specified procedures. All field quality control sample results shall be submitted to the COGCC. Guidance for general protocols can be found in ASTM D7069-04(2015), Standard Guide for Field Quality Assurance in a Groundwater Sampling Event. Generally recommended practices are provided below.

8.1.1 - Field Duplicate Samples

The following protocol will be followed for field duplicate sample collection:

- one complete set of duplicate samples should be collected for every 20 groundwater samples collected, but not less than one per year.
- duplicate samples should be collected at approximately the same time as the original sample using identical sampling methods (ASTM D7069-04, 2015).
- each duplicate sample should be given a fictitious sample identification number, which is recorded on the field sampling data sheet.
- the laboratory will not be informed that the sample is a field duplicate, ensuring no analytical bias will occur; and
- duplicate samples should be analyzed for the same analytes as the original sample.

Duplicate sample results should be evaluated based on the relative percent difference (RPD) between the sample result and the duplicate. RPD is calculated as:

$$RPD = \frac{|S - D|}{0.5(S + D)} \times 100$$

Where,

- RPD = Relative Percent Difference
- |S-D| = Absolute value of S - D
- S = Sample Result (original)
- D = Duplicate Result

A data quality objective of $RPD \leq 20\%$ will be used for original and duplicate sample values that are greater than five times (5x) the practical quantitation limit (U.S. EPA 2017b). In instances when RPD is $\geq 20\%$, field and laboratory data will be reexamined to identify potential causes for the observed differences, and, if necessary, update SOPs as appropriate to minimize future variances.

8.1.2 - Field Equipment Blanks

Equipment blanks should be collected if decontaminated sampling equipment (e.g., sampling pump with dedicated discharge hose, sample dipper, beaker, etc.), is used to collect the samples to be analyzed for major cations (dissolved) and/or VOCs. One equipment blank sample shall be collected for every 10 groundwater samples taken with decontaminated sampling equipment, but no less than one per year. Equipment blanks should be collected immediately following equipment decontamination by running distilled or de-ionized water through or over the sampling equipment and collecting the rinse water in the sample container.

The use of equipment that requires decontamination will be minimized to reduce cross-contamination and reduce the cost of field equipment blanks, where possible.

8.1.3- Trip Blanks

Trip blanks should be used to assess contamination introduced during shipping and/or field handling procedures. Trip blanks should be collected at a frequency of one blank per cooler. Trip blanks should be collected at a frequency of one blank per cooler. Trip blank VOA vials are filled by the analytical laboratory staff under controlled conditions, transported to the sampling site, and transported back to the laboratory without being exposed to sampling procedures. Trip blanks will be analyzed for VOCs. Trip blank results should have concentrations less than the laboratory method detection limit (MDL). An Operator should verify negative results on all trip blanks and will adjust procedures accordingly if results above the MDL are identified.

8.1.4- Field Blanks

Field blanks will only be collected if the sampling technician believes that site conditions might cause the sample to become cross contaminated by VOCs or CH₄ (i.e., the water source is located adjacent to hydrocarbon or CH₄ storage or fueling area).

Field blanks will be collected by filling a clean glass VOA vial, equipped with a gas-tight septum, with distilled water and leaving the sample container open during the entire period of volatile sample collection. Immediately prior to capping, a few drops of distilled water should be added to the vial to create a positive meniscus. The vial should then be capped and inverted to check for air bubbles. If bubbles are present, the vial should be opened, additional water should be added, and the vial should be resealed and checked again for air bubbles. This procedure should be repeated until a bubble-free container is obtained.

Field blanks should be analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX) and dissolved gases (CH₄, ethane, and propane). BTEX and dissolved gases concentrations should be less than the MDL.

8.2 - Data Quality Reviews

Data quality reviews should be performed after all data reports have been received from the laboratory. Data quality reviews should be documented on a data quality review sheet (see Attachment 2) which should be stored in the project files with the field sampling data sheet and the laboratory analytical data reports. The objective of the data quality review sheet is to confirm that all data was properly collected and is suitable for release to COGCC. The data quality review should:

- Review all field sampling data sheets to confirm that:
 - The water source was properly purged;
 - The flow rate was reduced prior to sampling;
 - Water quality field parameters had stabilized prior to sampling, if necessary; and
 - No site conditions were noted that suggest the samples may not be representative.
- Review all laboratory data reports to confirm that:
 - Proper custody was maintained from the time of sampling to laboratory receipt;
 - All samples were analyzed for the requested analyses;
 - Proper laboratory methods were used for analyses;
 - Sample holding times were met;
 - Laboratory quality assurance samples such as matrix spikes and matrix spike duplicates were collected and analyzed according to the laboratory method, and all laboratory quality control sample results were within method acceptance limits; and
 - Field quality control samples meet the data quality objectives, listed above.
- Specify corrections needed and dates by when those actions should be completed.
- Certification by the data reviewer confirming that the data was collected in accordance with the SAP and that the data is suitable for incorporation into the COGCC database.

9.0- EVALUATION OF DATA QUALITY

An Operator is expected to review field sampling records to ensure that samples were collected in accordance with this SAP or if re-sampling may be required prior to submittal to the COENV database. COC records and the condition of samples upon receipt at the laboratory should also be evaluated to ensure the use of proper sample containers and preservatives by the samplers. A basic review of laboratory results and QC processes will also be

completed and will include the following minimum data quality checks (SM1030 Data Quality, 2017). If values are identified outside of the listed acceptance ranges, the sample should be re-analyzed.

Calculation of TDS from the concentrations of major cations and anions, sum of the following constituents (mg/L):

$$TDS = 0.6 (\text{alkalinity as } CaCO_3) + Na^+ + K^+ + Ca^{2+} + Mg^{2+} + Cl^- + SO_4^{2-} + SiO_3^{2-} + NO_3^- + F^-$$

- 1) Calculation of cation-anion balance must be done and reviewed with typical criteria acceptance as follows:

$$\% \text{ difference} = 100 \times \frac{\Sigma \text{ cations} - \Sigma \text{ anions}}{\Sigma \text{ cations} + \Sigma \text{ anions}}$$

| Anion Sum (meq/L) | Acceptable Difference |
|-------------------|-----------------------|
| 0-3.0 | ± 0.2 meq/L |
| 3.0-10.0 | ± 2% |
| 10.0 – 800 | 5% |

- 2) Measured TDS concentration should be larger than the calculated TDS calculation and reviewed with acceptance levels of:

$$1.0 < \frac{\text{measured TDS}}{\text{calculated TDS}} < 1.2$$

- 3) Calculated EC calculation should be larger than measured EC value, and reviewed with acceptance levels:

$$0.9 < \frac{\text{calculated EC}}{\text{measured EC}} < 1.1$$

- 4) Calculation of anion and cation sums should be approximately 1/100 of the measured EC, and reviewed with acceptance levels of:

$$100 \times \text{anion (or cation) sum, meq/L} = (0.9 - 1.1) EC$$

- 5) Calculated TDS to EC ratio and reviewed with acceptance levels of:

$$\text{calculated TDS} / \text{conductivity} = 0.55 - 0.7$$

- 6) Measured TDS to EC Ratio should be between 0.55 and .07

10.0- HEALTH AND SAFETY

The health and safety of personnel and water source owners must be addressed by an Operator’s health and safety program and include protocols to be followed at sample sites. General aspects of the safety plan need to address what personal protective equipment (PPE), such as hard hats, safety glasses, chemical resistant gloves, sturdy boots, long pants, etc. should be used and under what conditions during the collection of samples. While sampling, the field staff shall explain to the water source owner or representative what and why PPE is required.

10.1 - Materials and Waste Management

All materials and wastes, whether fluid or solid, generated during sampling and monitoring activities, must be properly handled, disposed, and documented in accordance with applicable federal, state, and local regulations.

Under special circumstances for large volume well purging, a sample will require coordination of waste water handling instructions, storage, transport, disposal resources, and any necessary manifesting or alternative tracking documents.

11.0 - DATA SUBMISSION

An Operator will upload all required data into the COENV database and submit to respective well owner(s), within 3-months of the sampling event as directed by 609 or 318A.f. Prior to upload into the COENV database or submittal to landowners all data, reports, and communications will receive a QA/QC check.

11.1 - COENV Database

An Operator will upload and submit the following electronic information into the COENV database:

- Facility ID (already in existence or newly created) in the COENV database;
- Division of Water Resources permit and receipt number for the sampling location (if permitted);
- Name and address of water source owner;
- GPS coordinates for the water source (wellhead or spring) and coordinates need to be in decimal degrees of latitude and longitude using the NAD83 reference, surveyed in accordance with COGCC Rule 215 with an accuracy of five decimals in the North American Datum 1983 (NAD 83);
- API number(s) for the associated oil and gas well(s);
- Sample type – initial or baseline, one-year post-completion or five-year post-completion;
- Date and time each sample was collected;
- Collection point (e.g. domestic, stock, irrigation, industrial, or municipal water supply well, or bradenhead);
- Laboratory name;
- Sample reason (e.g. 609 or 318A.f); and
- Results of field monitoring and observations must be submitted electronically to the COGCC. A simplified spreadsheet EDD can be utilized for this purpose, or results may be included on the COC and submitted with the laboratory provided EDD.

All samples submitted to the COGCC shall include the following information and file types:

- 1) Correctly formatted laboratory EDD (Either XML or Excel);
- 2) A portable document format (PDF) copy of the complete lab report including QA/QC data; and
- 3) A PDF copy of the field sampling data sheet that includes all the location information, purge information, and field parameters collected.

Laboratory results for each sample collected will be submitted via a Form 43 using the laboratory's XML or spreadsheet EDD, formatted appropriately for the COENV database. The EDD must include quality control data such as results of method blanks, results of matrix spike or laboratory control samples, results of duplicate samples, and surrogate or tracer recoveries. PDF copies of calibration logs, field sampling data sheets, photographs, and laboratory results must also be uploaded to the database.

Access to the portion of the database where facilities can be created and data uploaded is controlled, and credentials must be obtained prior to any attempt to use the COENV database by completing a Form 1A (Designation of Agent). Operators or their designated agents (i.e., contractors, consultants, or laboratories) can obtain necessary logon credentials in a manner similar to that used in E-Forms.

11.1.1 - Electronic Data Deliverables

There are two accepted versions of the COGCC EDD that may be uploaded to the COENV database via Form 43. One is an XML EDD that is based on the EPA Water Quality Data (WOX) XML schema. The second is a Microsoft Excel-based EDD. Both the XML and Excel-based EDD are in hierarchal format. The EDDs do not look, nor do they function, like a common flat file EDD. The EDDs are designed to transfer data to the COGCC database and should not be used as an analytical tool by themselves.

Prior to being accepted into the database the EDDs go through a rigorous automated QA/QC check. If the information provided in the EDD fails to meet the valid value requirements, the EDD will be rejected. If an EDD is rejected, it will be necessary to make corrections and resubmit the EDD. Once an EDD has been accepted by the database, COGCC staff will conduct a brief review of the information in the EDD. Once the review process has been completed, the EDD will be verified and saved into the database.

Data received by the COGCC will be posted to the COGCC website and be available for public review. Once verification has been completed by the COGCC staff, the data will be available within a couple of hours.

Help Regarding the EDD requirements can be found at:

https://cogcc.state.co.us/documents/about/COGIS_Help/EnviroDB/EnviroDB.htm

Help regarding the EDD Form 43 upload process can be found at:

https://cogcc.state.co.us/documents/reg/Forms/instructions/Form_Instructions/Form_43_Instructions_09282018.pdf

11.1.2 - Special Circumstances Reporting

In accordance with the COGCC Operator Guidance, an Operator will notify the water source owner and the COGCC immediately and will submit a Form 42 (Notice of Field Operations) if:

- 1) Methane concentration increases by more than 5 mg/L between sampling;
- 2) Methane concentration is detected at or above 10 mg/L;
- 3) Composition/isotopic data test results indicate thermogenic gas or a mixture of thermogenic and biogenic gas; and/or
- 4) BTEX compounds or TPH are detected.

Immediate notification is considered within 24 hours of receipt of analytical data from the laboratory. If analytical results are being re-analyzed, timely reporting is expected after the results have been confirmed. Delays in timely reporting due to third party consultants or additional internal data review should be avoided; the raw data can be reported immediately, with a caveat that additional review may be undertaken, and the results are therefore to be considered preliminary.

An operator may use any reasonable means to provide notifications to the water well owners. In-person or verbal notifications should be followed with written correspondence; written correspondence may be provided through e-mails or formal letters with delivery or receipt confirmation.

The report to the water source owner will include a description of the findings and an explanation if potential health risks for continued use of the water were determined to be present. A written letter to the landowner detailing the sample findings and potential health risks will also be provided and the findings will be reported to the COGCC.

12.0 - REFERENCES

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- ASTM D4840-99(2018)e1, Standard Guide for Sample Chain-of-Custody Procedures, ASTM International, West Conshohocken, PA, 2018, www.astm.org
- ASTM D5088-15a, Standard Practice for Decontamination of Field Equipment Used at Waste Sites, ASTM International, West Conshohocken, PA, 2015, www.astm.org
- ASTM D5358-93(2019), Standard Practice for Sampling with a Dipper or Pond Sampler, ASTM International, West Conshohocken, PA, 2019, www.astm.org
- ASTM D6089-15, Standard Guide for Documenting a Groundwater Sampling Event, ASTM International, West Conshohocken, PA, 2015, www.astm.org
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United States Environmental Protection Agency (EPA), 2018. SW-846 Update VI chapter 4 revision 6 (Table 4-1). Accessed on 29 July, 2019 at <https://www.epa.gov/hw-sw846/chapter-four-sw-846-compendium-organic-analytes> .

ATTACHMENT 1 - Example Field Sampling Data Sheet

Field Sampling Data Sheet

COGCC Facility ID _____ Facility Name _____ Date of Sample _____

Site Address _____ Site Contact _____ Phone # _____

Sample Type (baseline, post-drill, etc.): _____ O&G API Number _____

Property Owner Name _____ Phone # _____

Mailing Address _____

Individuals Present (Who was on-site during the sampling?) _____

Handed Out:

Introduction Letter? **Y N**

FAQ Sheet? **Y N**

How Well Do You Know Your Water Well Booklet? **Y N**

Water Well Information from Permit Records

Permit Number: _____ Receipt Number: _____ Total Depth (ft): _____ Static Water Level (ft): _____

Yield (GPM): _____ Well Diameter (in): _____

Water Well Information Onsite

GPS Location (field): _____

GPS Location (post-processed): _____

Legal Location (qtrqtr Section Township Range): _____

Casing height (in.): _____ Ground Elevation (ft): _____ How determined: _____

Approximate distance to the Oil & Gas well pad: _____

%LEL at wellhead (if measured): _____ %CH₄ (by volume) at wellhead (if measured): _____

Photo(s) Taken? **Y N** Weather conditions: _____

Where was the sample taken? (Outside Tap, Well House, Kitchen Tap, Spring, Seep, etc.) _____

Condition of the Well, Spring or Seep (Wellhead sealed? Does the ground slope away from the well? Visible contamination of spring/seep? etc.): _____

Field Sampling Data Sheet – Page 2

Facility Name: _____

Landowner Comments on Water Quality: _____

Purge Method _____ Fixed Wellbore Volume _____ Stabilization of Water Quality Parameters

Purge rate (gpm) _____ Purge Time (min) _____ Total Purge Volume (gal) _____

Sampling flow rate (gpm): _____

Water Quality Field Parameters

| Clock Time | Elapsed Time | Water Level | Flow Rate (calc) | Temp (°C) | pH | EC (uS/cm) | ORP (mV) | DO (mg/L) | Turbidity | Odor | Color / Sediment | Bubbles / Effervescence |
|------------|--------------|-------------|------------------|-----------|----|------------|----------|-----------|-----------|------|------------------|-------------------------|
| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |

Additional Information:

Sampler's Name _____ Company: _____
(Print)

Sampler's Signature _____ Date: _____

ATTACHMENT 2 - Example Data Quality Review Sheet

Data Quality Review Sheet

COGCC Facility ID _____ Facility Name _____ Date of Sample _____
Site Address _____ Site Contact _____ Phone # _____
Sample Type (baseline, post-drill, etc.) _____ O&G API Number _____
Oil & Gas Well _____ Location/API# _____

Field Sheet Review

- 1) Was the well/spring properly purged? _____
 - a. Please provide purge volume if applicable _____
- 2) Was the flow rate reduced prior to sampling? _____
- 3) Were field parameters measured prior to sampling? _____
- 4) Did field parameters stabilize prior to sampling? _____
- 5) Did site conditions or other factors suggest that the samples may not be representative of groundwater? If yes, please describe _____

Laboratory Data Review

- 1) Were the samples received at the recommended water temperature of $\leq 6^{\circ}\text{C}$? _____
- 2) Were the samples properly preserved? If no, please explain _____

- 3) Was proper chain-of-custody maintained? If no, please explain _____

- 4) Were all samples analyzed for the requested analyses? _____
 - a. If no, can the remaining sample be analyzed within the recommended hold time? _____
- 5) Were the proper methods used? _____
 - a. If no, can the remaining sample be analyzed within the recommended hold time? _____
- 6) Were all sample holding time limits met? If no, please explain _____

- 7) Were the correct reporting limits used? If no, please explain _____

- 8) Were laboratory quality assurance samples collected and analyzed (*i.e.*, *matrix spikes & matrix spike duplicates*) according to laboratory methods? If no, please explain _____

9) Were laboratory quality assurance sample results within acceptance limits? If no, please describe _____

Data Quality Review Sheet – Page 2

Facility Name: _____

Field Control Samples

- 10) Were **field duplicate** samples submitted? _____ *If no, proceed to trip blank questions.*
- 11) Were the original and duplicate samples $\geq 5x$ the practical quantitation limit (PQL) _____
- 12) Was the Relative Percent Difference (RPD) $\leq 20\%$? If no, please describe _____
- 13) Were **trip blanks** submitted? _____ *If no, proceed to equipment blank question.*
- 14) If trip blanks were submitted, were the VOC constituent concentration results below method detection limits? _____
- 15) If **equipment blanks** were submitted, did the results meet the equipment blank data quality objectives specified in the Sampling and Analysis Plan? _____
- 16) If **field blanks** were submitted, did the results meet the field blank data quality objectives specified in the Sampling and Analysis Plan? _____

Corrective Actions

- 17) Are corrective actions required to remedy any data quality issues? If yes, please describe _____
- 18) Date by when corrective actions must be completed _____
- 19) Summary of Corrective Actions (once completed) _____

Data Suitability Statement

Based upon this data quality review and your professional judgment, have the data been collected and analyzed in general accordance with the COGCC Model Sampling and Analysis Plan? Yes No
(Circle one)

Are the data suitable for release for incorporation into the Colorado Oil and Gas Conservation Commission environmental database? Yes No *(Circle one)*

Data Quality Reviewer's Name: _____ Company: _____
(Print)

Data Quality Reviewer's Signature: _____ Date: _____

**APPENDIX C:
ANALYTICAL RESULTS FROM WATER SAMPLE
COLLECTED ½ MILE NORTH OF INVICTA PAD**

APPENDIX TO WATER QUALITY MONITORING PLAN - RESULTS OF WELL 1/2 MILE NORTH OF INVICTA PAD

| FacilityID | SampleID | SampleDate | Matrix | LabID | LabSample | Sampler | Method | Co | ParamName | ParamDesc | Result | Value | Units | Detection | Qualifier | Location |
|------------|----------|-------------|--------|-------|-----------|---------|-----------|-----------|---------------|-----------|---------|--------|-------|-----------|-----------|---|
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | BART | IRB | BACTERIA | | 0 | cfu/ml | | | | SE SW SECT 21 35 65 W |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | BART | IRB | BACTERIA | | 0 | cfu/ml | | | | DEPTH NOT INDICATED |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | BART | SLYM | BACTERIA | | 0 | cfu/ml | | | | NO FIELD RECORDS ASSOCIATED WITH SAMPLE FOUND |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | BART | SLYM | BACTERIA | | 0 | cfu/ml | | | | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | BART | SRB | BACTERIA | | 0 | cfu/ml | | | | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | BART | SRB | BACTERIA | | 0 | cfu/ml | | | | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | E300.0 | 14797-55 | {NITRATE | | 0.1 | mg/L | | 0.1 | U | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | E300.0 | 14797-65 | {NITRATE | | 0.1 | mg/L | | 0.1 | U | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | E353.2 | NO2-NO3 | NITRATE/N | | 0.1 | mg/L | | 0.1 | U | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | E353.2 | NO2-NO3 | NITRATE/N | | 0.1 | mg/L | | 0.1 | U | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | E365.4 | 7723-14-0 | PHOSPHOF | | 0.1 | mg/L | | 0.1 | U | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | E365.4 | 7723-14-0 | PHOSPHOF | | 0.1 | mg/L | | 0.1 | U | |
| 767019 | 622677 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E504.1 | 96-12-8 | 12-DIBRON | | 0.02 | ug/L | | 0.02 | < | |
| 767019 | 622677 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E504.1 | 106-93-4 | 12-DIBRON | | 0.01 | ug/L | | 0.01 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E515.1 | 94-75-7 | 24-DICHLO | | 1 | ug/L | | 1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E515.1 | 75-99-0 | DALAPON | | 2.5 | ug/L | | 2.5 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E515.1 | 88-85-7 | DINOSEB | | 1 | ug/L | | 1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E515.1 | 87-86-5 | PENTACHL | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E515.1 | 001918-02 | PICLORAM | | 0.5 | ug/L | | 0.5 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E515.1 | 93-72-1 | SILVEX (24 | | 0.25 | ug/L | | 0.25 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 15972-60 | {Alachlor | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 1912-24-9 | ATRAZINE | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 50-32-8 | BENZO(a)P | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 103-23-1 | bis(2-ETHY | | 0.5 | ug/L | | 0.5 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 117-81-7 | bis(2-ETHY | | 2 | ug/L | | 2 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 12789-03 | {CHLORDAN | | 1 | ug/L | | 1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 72-20-8 | ENDRIN | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 58-89-9 | GAMMA-B | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 76-44-8 | HEPTACHL | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 1024-57-3 | HEPTACHL | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 118-74-1 | HEXACHLO | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 77-47-4 | HEXACHLO | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 72-43-5 | METHOXY | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 1336-36-3 | POLYCHLO | | 0.5 | ug/L | | 0.5 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 122-34-9 | SIMAZINE | | 0.1 | ug/L | | 0.1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E525.2 | 8001-35-2 | TOXAPHEN | | 2 | ug/L | | 2 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E531.1 | 116-06-3 | ALDICARB | | 1 | ug/L | | 1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E531.1 | 1646-88-4 | ALDICARB | | 1 | ug/L | | 1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E531.1 | 1646-87-3 | ALDICARB | | 1 | ug/L | | 1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E531.1 | 1563-66-2 | CARBOFUF | | 1 | ug/L | | 1 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E531.1 | 23135-22 | {OXAMYL | | 1 | ug/L | | 1 | < | |
| 767019 | 622677 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E547 | 1071-83-6 | GLYPHOSA | | 5 | ug/L | | 5 | < | |
| 767019 | 622677 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E548.1 | 145-73-3 | ENDOTHAL | | 8 | ug/L | | 8 | < | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | E549.2 | 85-00-7 | DIQUAT | | 0.4 | ug/L | | 0.4 | < | |
| 767019 | 622660 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | E900.0 | 12587-46 | -.GROSS ALF | | 1.13 | pCi/L | | | | |
| 767019 | 622660 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | E900.0 | 12587-47 | -.GROSS BET | | 0.0119 | pCi/L | | | U | |
| 767019 | 622660 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | E904.0 | 15262-20 | -.228RADIUI | | -0.0574 | pCi/L | | | U | |
| 767019 | 641127 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | E904.0 | 15262-20 | -.228RADIUI | | 0.243 | pCi/L | | | J | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | Kelada-01 | 57-12-5 | TC Total CYAN | | 0.005 | mg/L | | 0.005 | < | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | RSK-175 | 74-84-0 | ETHANE | | 0.0207 | mg/L | | 0.013 | | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | RSK-175 | 74-84-0 | ETHANE | | 0.0192 | mg/L | | 0.013 | | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | RSK-175 | 74-82-8 | METHANE | | 12 | mg/L | | 0.1 | | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | RSK-175 | 74-82-8 | METHANE | | 13.3 | mg/L | | 0.1 | | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | RSK-175 | 74-98-6 | PROPANE | | 0.02 | mg/L | | 0.02 | U | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | RSK-175 | 74-98-6 | PROPANE | | 0.02 | mg/L | | 0.02 | U | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | SM 4500-S | 18496-25 | -.SULFIDE | | 0.05 | mg/L | | 0.05 | U | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | SM2320B | 71-52-3 | BICARBON | | 219 | mg/L | | 20 | | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | SM2320B | 71-52-3 | BICARBON | | 190 | mg/L | | 20 | | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | SM2320B | ##### | CARBONA | | 20 | mg/L | | 20 | U | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | SM2320B | ##### | CARBONA | | 20 | mg/L | | 20 | U | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | SM2320B | TotAlk | TOTAL ALK | | 220 | mg/L | | 20 | | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | SM2320B | TotAlk | TOTAL ALK | | 190 | mg/L | | 20 | | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | SM2540C | 10-33-3 | TOTAL DIS | | 336 | mg/L | | 10 | | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | SM2540C | 10-33-3 | TOTAL DIS | | 449 | mg/L | | 10 | | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | SM4500-S | 18496-25 | -.SULFIDE | | 0.04 | mg/L | | 0.04 | < | |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | SM4500-S | 6/4/7783 | HYDROGE | | 0.05 | mg/L | | 0.05 | U | |
| 767019 | 622676 | Jan 4 2021 | WATER | 10058 | G2101005 | Apex | SM5540C | MBAS | methylene | | 1 | mg/L | | 1 | < | |
| 767019 | 622660 | Jan 4 2021 | WATER | 10202 | L1302232 | Apex | SM7500-RI | 13982-63 | -.226RADIUI | | 0.128 | pCi/L | | | U | |
| 767019 | 641127 | Jul 21 2021 | WATER | 0 | L1517668 | APEX | SM7500-RI | 13982-63 | -.226RADIUI | | 0.52 | pCi/L | | | | |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 7440-37-1 | ARGON | | 0.981 | MOL % | | 0.005 | | |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 7440-37-1 | ARGON | | 1.09 | MOL % | | 0.005 | | |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | BTU | BRITISH TH | | 412 | BTU | | | | |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | BTU | BRITISH TH | | 407 | BTU | | | | |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 106-97-8 | BUTANE | | 0.0001 | MOL % | | 0.0001 | ND | |
| | | | | | | | | | | | | | | | | |

APPENDIX TO WATER QUALITY MONITORING PLAN - RESULTS OF WELL 1/2 MILE NORTH OF INVICTA PAD

| | | | | | | | | | | | |
|--------|--------|-------------|-------|-------|-----------|------|-----------|------------------------|-----------------|--|-----------|
| 767019 | 641129 | Jul 21 2021 | WATER | 10098 | 835863 | APEX | SOP | delta13C_IDELTA 13C | -6.2 ? | | |
| 767019 | 622611 | Jan 4 2021 | WATER | 10098 | 780360 | Apex | SOP | delta13C_IDELTA 13C | -5.5 ? | | |
| 767019 | 622611 | Jan 4 2021 | WATER | 10098 | 780360 | Apex | SOP | delta18O_ DELTA 18C | -13.53 ? | | |
| 767019 | 641129 | Jul 21 2021 | WATER | 10098 | 835863 | APEX | SOP | delta18O_ DELTA 18C | -13.7 ? | | |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | deltaD_C1 DELTA D C: | -304.6 ? | | |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | deltaD_C1 DELTA D C: | -298 ? | | |
| 767019 | 622611 | Jan 4 2021 | WATER | 10098 | 780360 | Apex | SOP | deltaD_H2 DELTA D H | -104.2 ? | | |
| 767019 | 641129 | Jul 21 2021 | WATER | 10098 | 835863 | APEX | SOP | deltaD_H2 DELTA D H | -103.6 ? | | |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 74-84-0 ETHANE | 0.015 mg/L | | 0.0002 |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 74-84-0 ETHANE | 0.028 MOL % | | 0.0001 |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 74-84-0 ETHANE | 0.02 mg/L | | 0.0002 |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 74-84-0 ETHANE | 0.031 MOL % | | 0.0001 |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 74-85-1 ETHENE | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 74-85-1 ETHENE | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | HDF HELIUM DI | 0.7 NA | | |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | HDF HELIUM DI | 0.64 NA | | |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 1333-74-0 HYDROGEI | 0.01 MOL % | | 0.01 ND |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 1333-74-0 HYDROGEI | 0.01 MOL % | | 0.01 ND |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 6/4/7783 HYDROGEI | 0 MOL % | | ND |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 6/4/7783 HYDROGEI | 0 MOL % | | ND |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 75-28-5 ISOBUTAN | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 75-28-5 ISOBUTAN | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | IC5 ISOPENTAN | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | IC5 ISOPENTAN | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 74-82-8 METHANE | 12 mg/L | | 0.0002 |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 74-82-8 METHANE | 40.09 MOL % | | 0.0002 |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 74-82-8 METHANE | 11 mg/L | | 0.0002 |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 74-82-8 METHANE | 40.63 MOL % | | 0.0002 |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 7727-37-9 NITROGEN | 55.04 MOL % | | 0.01 |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 7727-37-9 NITROGEN | 49.76 MOL % | | 0.01 |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 7782-44-7 OXYGEN (C | 8.64 MOL % | | 0.01 |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 7782-44-7 OXYGEN (C | 2.46 MOL % | | 0.01 |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 109-66-0 PENTANE | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 109-66-0 PENTANE | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 74-98-6 PROPANE | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 74-98-6 PROPANE | 0.0002 mg/L | | 0.0002 ND |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 74-98-6 PROPANE | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 74-98-6 PROPANE | 0.0002 mg/L | | 0.0002 ND |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | 115-07-1 PROPENE | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | 115-07-1 PROPENE | 0.0001 MOL % | | 0.0001 ND |
| 767019 | 641128 | Jul 21 2021 | GAS | 10098 | 836462 | APEX | SOP | SpGrav SPECIFIC G | 0.82 RATIO_AIR | | |
| 767019 | 622610 | Jan 4 2021 | GAS | 10098 | 781708 | Apex | SOP | SpGrav SPECIFIC G | 0.811 RATIO_AIR | | |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7429-90-5 ALUMINUM | 0.2 mg/L | | 0.2 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-36-0 ANTIMON | 0.01 mg/L | | 0.01 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-38-2 ARSENIC | 0.01 mg/L | | 0.01 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7440-38-2 ARSENIC | 0.01 mg/L | | 0.01 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7440-39-3 BARIUM | 0.104 mg/L | | 0.005 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-39-3 BARIUM | 0.191 mg/L | | 0.005 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-41-7 BERYLLIUM | 0.002 mg/L | | 0.002 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-42-8 BORON | 0.2 mg/L | | 0.2 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7440-42-8 BORON | 0.2 mg/L | | 0.2 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-43-9 CADMIUM | 0.002 mg/L | | 0.002 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-70-2 CALCIUM | 26.7 mg/L | | 1 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7440-70-2 CALCIUM | 13.3 mg/L | | 1 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7440-47-3 CHROMIUM | 0.01 mg/L | | 0.01 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-47-3 CHROMIUM | 0.01 mg/L | | 0.01 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-50-8 COPPER | 0.01 mg/L | | 0.01 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7440-50-8 COPPER | 0.01 mg/L | | 0.01 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7439-89-6 IRON | 0.232 mg/L | | 0.1 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7439-89-6 IRON | 0.777 mg/L | | 0.1 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7439-92-1 LEAD | 0.006 mg/L | | 0.006 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7439-92-1 LEAD | 0.006 mg/L | | 0.006 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7439-95-4 MAGNESIUM | 1 mg/L | | 1 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7439-95-4 MAGNESIUM | 2.04 mg/L | | 1 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7439-96-5 MANGANESE | 0.0273 mg/L | | 0.01 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7439-96-5 MANGANESE | 0.0138 mg/L | | 0.01 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 9/7/7440 POTASSIUM | 2 mg/L | | 2 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 9/7/7440 POTASSIUM | 2.7 mg/L | | 2 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7782-49-2 SELENIUM | 0.01 mg/L | | 0.01 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-22-4 SILVER | 0.005 mg/L | | 0.005 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-23-5 SODIUM | 147 mg/L | | 3 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7440-23-5 SODIUM | 108 mg/L | | 3 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6010 | 7440-24-6 STRONTIUM | 0.348 mg/L | | 0.01 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-24-6 STRONTIUM | 0.655 mg/L | | 0.01 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-28-0 THALLIUM | 0.01 mg/L | | 0.01 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6010 | 7440-66-6 ZINC | 0.188 mg/L | | 0.05 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6020 | 7782-49-2 SELENIUM | 0.002 mg/L | | 0.002 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW6020 | 7440-61-1 URANIUM | 0.02 mg/L | | 0.02 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW6020 | 7440-61-1 URANIUM | 0.001 mg/L | | 0.001 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW7470 | 7439-97-6 MERCURY | 0.0002 mg/L | | 0.0002 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW7470 | 7439-97-6 MERCURY | 0.0002 mg/L | | 0.0002 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW8015 | 68334-30-1 TEPH DIESEL | 0.185 mg/L | | 0.1 B |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW8015 | 68334-30-1 TEPH DIESEL | 0.1 mg/L | | 0.1 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW8015 | 8006-61-9 TVPH - Gas | 0.1 mg/L | | 0.1 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- | APEX | SW8015 | 8006-61-9 TVPH - Gas | 0.1 mg/L | | 0.1 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- | Apex | SW846 82(| 71-55-6 111-TRICH | 0.001 mg/L | | 0.001 U |

APPENDIX TO WATER QUALITY MONITORING PLAN - RESULTS OF WELL 1/2 MILE NORTH OF INVICTA PAD

| | | | | | | | | | |
|--------|--------|-------------|-------|-------|----------------|----------------------|--------------------|-------------|---------|
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(79-00-5 | 112-TRICH | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(75-35-4 | 11-DICHL | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(120-82-1 | 124-TRICH | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(95-50-1 | 12-DICHL | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(107-06-2 | 12-DICHL | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(78-87-5 | 12-DICHL | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(106-46-7 | 14-DICHL | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(71-43-2 | BENZENE | 0.001 mg/L | 0.001 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW846 82(71-43-2 | BENZENE | 0.001 mg/L | 0.001 U |
| 767019 | 622625 | Jan 4 2021 | WATER | 10202 | L1302272- Apex | SW846 82(71-43-2 | BENZENE | 0.001 mg/L | 0.001 U |
| 767019 | 641130 | Jul 21 2021 | WATER | 0 | L1517671- APEX | SW846 82(71-43-2 | BENZENE | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(56-23-5 | CARBON T | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(108-90-7 | CHLOROBE | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(156-59-2 | cis-12-DIC | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(75-09-2 | DICHLORO | 0.005 mg/L | 0.005 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(100-41-4 | ETHYLBEN; | 0.001 mg/L | 0.001 U |
| 767019 | 641130 | Jul 21 2021 | WATER | 0 | L1517671- APEX | SW846 82(100-41-4 | ETHYLBEN; | 0.001 mg/L | 0.001 U |
| 767019 | 622625 | Jan 4 2021 | WATER | 10202 | L1302272- Apex | SW846 82(100-41-4 | ETHYLBEN; | 0.001 mg/L | 0.001 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW846 82(100-41-4 | ETHYLBEN; | 0.001 mg/L | 0.001 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW846 82(179601-23 M | +P-XYLE | 0.002 mg/L | 0.002 U |
| 767019 | 641130 | Jul 21 2021 | WATER | 0 | L1517671- APEX | SW846 82(179601-23 M | +P-XYLE | 0.002 mg/L | 0.002 U |
| 767019 | 641130 | Jul 21 2021 | WATER | 0 | L1517671- APEX | SW846 82(95-47-6 | o-XYLENE | 0.001 mg/L | 0.001 U |
| 767019 | 622625 | Jan 4 2021 | WATER | 10202 | L1302272- Apex | SW846 82(95-47-6 | o-XYLENE | 0.001 mg/L | 0.001 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW846 82(95-47-6 | o-XYLENE | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(95-47-6 | o-XYLENE | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(100-42-5 | STYRENE | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(127-18-4 | TETRACHL | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(108-88-3 | TOLUENE | 0.001 mg/L | 0.001 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW846 82(108-88-3 | TOLUENE | 0.001 mg/L | 0.001 U |
| 767019 | 622625 | Jan 4 2021 | WATER | 10202 | L1302272- Apex | SW846 82(108-88-3 | TOLUENE | 0.001 mg/L | 0.001 U |
| 767019 | 641130 | Jul 21 2021 | WATER | 0 | L1517671- APEX | SW846 82(108-88-3 | TOLUENE | 0.001 mg/L | 0.001 U |
| 767019 | 641130 | Jul 21 2021 | WATER | 0 | L1517671- APEX | SW846 82(1330-20-7 | TOTAL XYL | 0.003 mg/L | 0.003 U |
| 767019 | 622625 | Jan 4 2021 | WATER | 10202 | L1302272- Apex | SW846 82(1330-20-7 | TOTAL XYL | 0.002 mg/L | 0.002 U |
| 767019 | 622625 | Jan 4 2021 | WATER | 10202 | L1302272- Apex | SW846 82(1330-20-7 | TOTAL XYL | 0.003 mg/L | 0.003 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW846 82(1330-20-7 | TOTAL XYL | 0.003 mg/L | 0.003 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(1330-20-7 | TOTAL XYL | 0.002 mg/L | 0.002 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(1330-20-7 | TOTAL XYL | 0.003 mg/L | 0.003 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(156-60-5 | trans-12-D | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(79-01-6 | TRICHLOR | 0.001 mg/L | 0.001 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW846 82(75-01-4 | VINYL CHL | 0.001 mg/L | 0.001 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW9040 | ##### PH LAB | 8.35 SU | T8 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW9040 | ##### PH LAB | 8.33 SU | T8 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW9050 | 10-34-4 SPECIFIC O | 563 UMHOS/C | 10 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW9050 | 10-34-4 SPECIFIC O | 856 UMHOS/C | 10 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW9056 | 24959-67-(BROMIDE | 1 mg/L | 1 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW9056 | 24959-67-(BROMIDE | 1 mg/L | 1 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW9056 | 16887-00-(CHLORIDE | 49.9 mg/L | 1 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW9056 | 16887-00-(CHLORIDE | 149 mg/L | 5 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW9056 | 16984-48-(FLUORIDE | 0.965 mg/L | 0.15 |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW9056 | 16984-48-(FLUORIDE | 0.749 mg/L | 0.15 |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW9056 | 14797-55-(NITRATE | 0.1 mg/L | 0.1 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW9056 | 14797-65-(NITRITE | 0.1 mg/L | 0.1 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW9056 | 14808-79-(SULFATE | 5 mg/L | 5 U |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW9056 | 14808-79-(SULFATE | 5 mg/L | 5 U |
| 767019 | 641126 | Jul 21 2021 | WATER | 0 | L1517668- APEX | SW9060 | 10-35-5 TOTAL ORC | 2.08 mg/L | 1 B |
| 767019 | 622659 | Jan 4 2021 | WATER | 10202 | L1302232- Apex | SW9060 | 10-35-5 TOTAL ORC | 1.42 mg/L | 1 B |