

ConocoPhillips Groundwater Quality Monitoring Plan

Arapahoe County, Colorado

APTIM

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Prepared for:



ConocoPhillips Company

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Acronyms and Abbreviations

ACRONYM	Definition
APTIM	APTIM Environmental and Infrastructure, LLC
BMP	Best Management Practices
BOCC	Board of County Commissioners
bgs	below ground surface
COGCC	Colorado Oil & Gas Conservation Commission
COGCC Program	COGCC Statewide Groundwater Sampling and Monitoring Program
ConocoPhillips	ConocoPhillips Company
DWR	Colorado Division of Water Resources
GPS	Global Positioning System
MOU	Memorandum of Understanding
NA	not applicable
OA	City of Aurora Operators Agreement
O&G	oil and gas
Rule 609	COGCC Statewide Groundwater Monitoring Program Rule 609
SEO	State Engineer’s Office

1.0 INTRODUCTION

APTIM Environmental & Infrastructure, LLC (APTIM) has been contracted by ConocoPhillips Company (ConocoPhillips) to perform groundwater sampling and monitoring to meet the requirements set forth in the City of Aurora Operators Agreement (OA), the Colorado Oil and Gas Conservation Commission (COGCC) Statewide Groundwater Sampling and Monitoring Program Rule 609 (Rule 609), and the Arapahoe County Board of County Commissioners (BOCC) Memorandum of Understanding (MOU) to monitor groundwater quality conditions around proposed oil and gas well locations in Arapahoe County. This Groundwater Quality Monitoring Plan presents the actions which APTIM proposes to take on behalf of ConocoPhillips to ensure all groundwater monitoring requirements are met for proposed oil and gas (O&G) well locations within the City of Aurora, Colorado.

1.1 Background

ConocoPhillips is committed to the Water Quality Monitoring requirements set forth by the OA and associated Best Management Practices (BMP) between ConocoPhillips Company, Burlington Resources Oil & Gas Company LP, and the City of Aurora (City), Colorado. This protocol requires collecting baseline water quality samples from domestic water wells located within a ½ mile radius of a proposed O&G well location. To complete these requirements, the following water sampling protocol has been developed and a Colorado PG or PE will review and certify the plan once all comments issued by the City have been addressed and incorporated into this plan. The certification will be included as Appendix A of site-specific plan. The City of Aurora BMPs satisfy the requirements of COGCC Rule 609 and the Arapahoe County MOU.

2.0 PHASE I – ENVIRONMENTAL DUE DILIGENCE

Once APTIM has received notice from ConocoPhillips to conduct Phase I Environmental Due Diligence the following tasks are completed:

1. Well Location Survey Plat (location survey is previously completed by 3rd Party Civil Surveyor and approved by ConocoPhillips prior to submittal) is provided to APTIM by ConocoPhillips.
1. APTIM conducts Phase I Environmental Due Diligence to identify any available sampleable domestic water sources within ½ mile of the proposed O&G location. Due Diligence is composed of the water well identification steps noted in Section 2.1 and utilizes the best available data, including the Colorado Division of Water Resources (DWR), Well Permit Search Database (<http://www.dwr.state.co.us/WellPermitSearch/default.aspx>) and a review of all publicly available digitized permit records. The anticipated Phase I Due Diligence schedule is included in Appendix C of site-specific plan.

2.1 Water Well Identification

APTIM will Review all water wells within ½ mile of the proposed O & G well.

Water wells that were correctly permitted through the State Engineer's Office (SEO) also known as the DWR and have completion records available for review and confirmation that the well was correctly installed according to the permit requirements will be given higher priority over wells with incomplete records or permits. The ranking criteria and well identification steps APTIM will utilize are listed below and are based on COGCC and BMP requirements and are listed in decreasing priority as it pertains to well prioritization:

1. **Proximity to proposed location** - Domestic water wells closest to the proposed oil and gas well location are given a higher priority than those located further away from a proposed oil and gas well location.
2. **Type of water source** - Well maintained domestic water wells are preferred over other available water sources. Domestic water wells are given a higher priority than wells used for the following purposes, livestock, irrigation, monitoring, etc.
3. **Orientation of sampling location** - Sample locations from both down gradient and up-gradient locations are preferred if available over cross-gradient locations. If the groundwater flow direction is not known or cannot be inferred from topographic data, sample locations are prioritized to ensure wells are sampled in a radial pattern around the proposed oil and gas well location.
4. **Aquifer availability** - Multiple aquifers are preferred if available. Higher priority is assigned to various domestic water wells to ensure adequate aquifer representation is maintained when possible, sampling the deepest and shallowest aquifers is preferred.
5. **Condition of water source** - Water sources which are improperly maintained, non-operational, or otherwise have an impediment to sampling are not required to be sampled and are given a lower or "Not Applicable" (NA) priority. The condition and status of a domestic water well is determined based on the presence or absence of well completion records or other documentation available for review on the DWR well permit database including but not limited to approved permits, well completion documents (well construction, pump installation and test reports etc.), expired permits, emergency verbal agreements and associated permits, plugging and abandonment reports, visual field inspection reports, monitoring hole notices, and age of well. Domestic water wells with documents that indicate a correctly permitted well has been completed are placed at a higher priority than wells with (for example) expired permits, monitoring hole notices without completion records, plugging reports, etc. which may be improperly maintained and could call into question the integrity of the well.

APTIM will then prepare a list of well owner names and contact data for the wells identified based on the criteria listed above utilizing the DWR Database and County Tax Assessor data. No contact with well owners will be made at this time unless specifically requested by ConocoPhillips.

Any wells which do not match the criteria listed above will be documented and labeled “Not Applicable” for sampling and include justification why sampling is not possible or not recommended. The specific criteria used to determine each individual well’s sample rank will also be included for review in site-specific plan **Table 1**.

APTIM will then finalize the list of available water monitoring sources and provide the list of water wells to ConocoPhillips and the permitting consultant along with a location map showing all identified water wells within ½ mile of the proposed O&G location, as shown in site-specific plan **Figure 1**. The well information as noted above in Section 2.1 will include well permit number, water well receipt number, approximate distance to the proposed O&G location, well status, well completion date, total depth, permitted aquifer, sampling priority, determination of sampling priority, well documentation available, tax parcel id, property owner, property owner mailing address, well owner, well owner mailing address, and well location description as listed in site-specific plan **Table 1**.

2.1.1 Aquifer Sample Priority

If four or fewer wells have been identified in Section 2.1, APTIM will attempt to contact the landowners and obtain samples from all those wells following the steps outlined in Section 3 below. If greater than four wells have been identified in Section 2.1, APTIM will attempt to contact and obtain samples from additional wells until all available aquifers are included in the sample list or until no more differing well aquifer options remain, as per city approval. APTIM will contact landowners based on the previously assigned sample priorities and will substitute lower priority wells (in sequence) if APTIM is unable to gain sample consent from landowners higher in the priority list. The landowner contact and water well sample priority will follow the Sampling Priority column as listed in site-specific plan **Table 1**.

2.2 Variance Process

ConocoPhillips may request a variance from conducting water monitoring if the below conditions are met.

1. No Available Water Sources within the ½ mile radius;
2. Water sources are deemed unsuitable;
3. The owner of the water well declines access or requires payment for access;
4. The variance request will be sent to the below contact list at Aurora Water by ConocoPhillips:

Sean Lieske - slieske@auroragov.org; (720) 859-4411

Sarah Young - syoung@auroragov.org; (303) 739-7279

Joshua Godwin - jgodwin@auroragov.org; (720) 859-4307

If conditions for a variance are identified for this location during the initial Phase I Due Diligence research, APTIM will suggest a variance request be prepared by ConocoPhillips. The conditions which trigger a variance request recommendation will be documented and provided to ConocoPhillips and is also included for review as **Appendix B** of site-specific plan. The variance will be submitted to the City prior to the O&G permit submittal to the City, when possible, by ConocoPhillips. The Aurora Water General Manager has 10 business days from the date of receiving the variance request to respond to the request. If no response is provided, the variance request is deemed approved. A variance will be submitted to COGCC with the same information upon State Drilling Permit (Form 2/2A) approval.

2.3 Installation of Water Monitoring Wells

If the City requires the installation of water monitoring well(s) (Requested Wells), the following will occur.

1. Prior to ConocoPhillips submitting the O&G permit to the City (when possible), ConocoPhillips will attempt to obtain rights to drill water monitoring well(s) on property down gradient from the proposed O&G location.
 - a. APTIM will perform the preliminary surface location review and provide a downgradient map and will also coordinate with ConocoPhillips Surface Land to identify the optimal monitoring well location(s) and obtain rights to a downgradient location(s) from surface landowners. Monitoring well location options will be communicated with the City prior to finalizing the location with the surface landowner.
2. Once rights to drill are obtained by ConocoPhillips and after receiving notice to proceed, APTIM will submit permit application(s) to install monitoring well(s) to the SEO. It is anticipated that monitoring well(s) will be installed at least one month prior to the commencement of drilling for the O&G location.
 - a. Monitoring wells will be installed as either a nested well or as individual wells capable of testing all available aquifers downgradient from the O&G location and will be located on or near the location. ConocoPhillips and the City will agree on the placement, design, and installation schedule of the monitoring well(s) prior to monitoring well permit submittal to the SEO.
 - b. If the surface owner denies the request to drill a monitoring well, requires money for the right to drill, imposes conditions, or does not respond within 30 days to ConocoPhillips's attempts to contact, an Easement Well may be required by the City and the below steps regarding an Easement Well may apply.

3. If ConocoPhillips is unable to obtain rights to drill a monitoring well on property down gradient from the proposed O&G location pursuant to the OA, the City may request that ConocoPhillips drill monitoring well(s) capable of testing all available aquifers on one of the City's easements (Easement Well) within ½ mile of the O&G location.
 - a. If an Easement Well is requested, ConocoPhillips and the City will coordinate to identify the optimal monitoring well location(s) downgradient from the O&G location. Once the location is finalized, APTIM will submit permit application(s) to install monitoring well(s) to the SEO. It is anticipated that monitoring wells will be installed at least one month prior to the commencement of drilling for the O&G location.
 - b. Monitoring wells will be installed as either a nested well or as individual wells capable of testing all available aquifers on one of the City's easements. ConocoPhillips and the City will agree on the placement, design, and installation schedule of the monitoring wells prior to monitoring well permit submittal to the SEO.
 - c. If the City has not obtained an easement prior to ConocoPhillips beginning drilling operations, the City may request the easement well be installed anytime during the drilling, completions, or production phase of the O&G well once the City has obtained a suitable easement.
 - d. Timelines regarding easement availability will be provided by the City on a case by case basis to ConocoPhillips. ConocoPhillips will notify the City that an Easement Well is requested at least 40 weeks prior to the commencement of oil & gas drilling operations. Easement Well schedules as noted in Appendix C of site-specific plan may be adjusted depending on easement availability.
 - ConocoPhillips collaborates with City staff to determine the location – 2 weeks
 - City drafts and finalizes License Agreement – 6 weeks
 - City acquires easement (concurrently with “draft and finalize License Agreement) – 26 weeks
 - ConocoPhillips submits “Notice of Intent” to SEO and installs the easement well – 8 weeks
 - ConocoPhillips takes water samples prior to spud – 4 weeks
4. The City's request to drill a City Easement Well is outside of the O&G permit application process. The City shall not delay the O&G permit application process if the City chooses to request that ConocoPhillips drill a City Easement Well. The City shall process ConocoPhillips's O&G Permits once ConocoPhillips has complied with or received a

variance regarding the Baseline Water Quality Testing or has agreed to drill a Requested Well.

5. Monitoring wells will be constructed according to industry standards as per the Well Construction Rule 2 CCR 402-2 and according to any permit requirements as directed by the SEO. Construction diagrams which are representative of typical monitoring well construction as per Rule 2 CCR 4020-2 are shown in site-specific plan Figure 2. Construction diagrams specific to this O&G location will be provided as part of continued discussions with the City regarding monitoring well construction, placement, and approval for this O&G location.
6. Testing of these monitoring wells will be conducted using standard industry procedures, consistent with the COGCC Rule 609 Model Sampling and Analysis plan and will include the intervals and analytes as listed in Section 3.2 and 4.0 below for baseline and subsequent sampling.
7. The anticipated monitoring well permitting and installation schedule is included in Appendix C of site specific plan.
8. Any timelines listed herein will be subject to change based on City requirements and O&G location specific issues which may be outside of ConocoPhillips' control.
9. Timelines listed are dependent upon receipt of COGCC permit approvals. ConocoPhillips (COPC) will make all good faith efforts to ensure monitoring well installation will be completed prior to conducting hydraulic fracturing of the oil and gas well. In the event that circumstances outside of COPC's control affecting the monitoring well installation schedule should occur, e.g. supply chain shortages, contractor availability issues, or permit approval delays (SEO), COPC will notify the City. In this event, COPC and the City of Aurora will agree to negotiate in good faith a resolution acceptable to both parties to insure adequate groundwater monitoring and protection measures are put in place.

3.0 PHASE II – LANDOWNER NOTIFICATION AND BASELINE SAMPLING

Once authorization from ConocoPhillips is received along with confirmation of the approved sample list, APTIM will proceed with Landowner Notification and Baseline Sampling. Baseline Sampling is conducted prior to the commencement of drilling a new well. Landowner Notification and Baseline Sampling includes the activities as noted below.

3.1 Well Owner Communication

APTIM will prepare a mailing list and an access request letter for each water well owner on the approved sample list as identified in Section 2.1 and shown in site-specific plan **Table 1**. Landowner communications attempts will begin as soon as possible and preferably prior to

submitting the O&G permit application. The anticipated landowner communication schedule is included in Appendix C of site-specific plan.

1. If APTIM is unable to obtain sample permissions for the wells identified in Section 2.1 prior to ConocoPhillips submitting the O&G permit to the City, to the extent that no sampleable water sources are available, the process to install monitoring well(s) as noted above in Section 2.3 will be initiated as soon as possible and preferably prior to submitting the O&G permit application to the City.

Letters will be sent to the address of record and follow-up phone calls (if contact information is available) will be made within approximately 5-10 business days. If a negative response is received (i.e. returned letter stating access is denied, or a verbal denial is issued), or there is no response to either the letter, or phone calls after 30 days, then that will constitute a denial of permission to sample. Samples will only be collected where permission has been granted by the landowner. Efforts to contact landowners and any refusals will be documented.

All requests for additional information not pertaining specifically to the sampling process will be directed to a ConocoPhillips representative.

3.2 Baseline Water Quality Testing

Once APTIM has received consent from landowners, APTIM will proceed to schedule and sample private water wells, using standard industry procedures consistent with the COGCC Rule 609 Model Sampling and Analysis plan and will test for the following analytes:

Baseline water quality test

<i>Inorganic Chemicals</i>
Antimony, Arsenic, Asbestos, Barium, Beryllium, Cadmium, Chromium, Cyanide, Fluoride, Mercury, Nitrate, Nitrite, Total Nitrate and Nitrite, Selenium, and Thallium
<i>Volatile Organic Compounds</i>
Methane, Ethane, Propane, BTEX as Benzene, Toluene, Ethylbenzene and Xylenes, Total Petroleum, and Hydrocarbons (TPH) Vinyl Chloride, Carbon Tetrachloride, 1,2-Dichloroethane, Trichloroethylene, Para-Dichlorobenzene, 1,1-Dichloroethylene, 1,1,1-Trichloroethane, cis-1,2 Dichloroethylene, 1,2-Dichloropropane, Ethylbenzene, Monochlorobenzene, o-Dichlorobenzene, Styrene, Tetrachloroethylene, Toluene, Trans-1,2 Dichloroethylene, Xylenes (total), Dichloromethane (methylene chloride), 1,2,4-Trichlorobenzene, 1,1,2 Trichloroethane
<i>Synthetic Organic Contaminants</i>
Alachor, Aldicarb1, Aldicarb sulfoxide, Aldicarb sulfone, Atrazine, Carbofuran, Chlordane, Dibromochloropropane, 2,4-D, Ethylene dibromide, Heptachlor, Heptachlor epoxide, Lindane, Methoxychlor, Polychlorinated biphenyls, Pentachlorophenol, Toxaphene, 2,4,5-TP (Silvex), Benzopyrene, Dalopon, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate, Dinoseb, Diquat, Endothall, Endrin,

Glyphosate, Hexachlorobenzene, Hexachlorocyclopentadiene, Oxamyl (Vydate), Picloram, Simazine, 2,3,7,8-TCDD (Dioxon)
Radionuclides
Combined radium-226 and radium-228, Gross alpha particle activity (including radium-226 but excluding radon and uranium), Beta particle and photon radioactivity
Secondary Maximum Contaminant Levels
Aluminum, Chloride, Color, Corrosivity, Foaming Agents, Odor, pH, Silver, Sulfate, Total Dissolved Solids, Zinc
PFOA (perfluorooctanoic acid) and PFOS (Perfluorooctane Sulfonate)
General Water Quality
Alkalinity, Conductivity & TDS, pH, Dissolved Organic Carbon (or Total Organic Carbon), Bacteria, and Hydrogen Sulfide
Major Ions
Bromide, Chloride, Magnesium, Potassium, Sodium, Sulfate
Metals
Boron, Copper, Iron, Lead, Manganese, Strontium, Uranium, and Radium
Other
Water Level, Stable isotopes of water (Oxygen, Hydrogen, Carbon), Phosphorus

1. If four or fewer available water sources exist within a ½ mile radius of the location of a proposed O&G well, a sample shall be collected from each available water source. Any additional sampling efforts will be completed as described above in Section 2.1.1 Aquifer Sample Priority
2. The City of Aurora BMPs allow for ConocoPhillips to rely on existing groundwater sampling data provided the sample was collected in accordance with accepted City standards and within 12 months preceding the beginning of drilling activities for the applicable O&G location. In addition, the analytical data must include all the constituents as noted above and there must not have been any significant O&G activity within 1 mile of the sample location since the sample was initially collected and prior to beginning the drilling phase for the applicable O&G location.
3. The anticipated sampling schedule is included in Appendix C of site-specific plan.

4.0 SUBSEQUENT ANNUAL SAMPLING

APTIM (or appropriate contractor) will conduct post-stimulation sampling of previously sampled water sources annually following the completion of the first O&G well at a well site until the Reclamation Phase is completed for the well site.

If APTIM is unable to obtain sample permissions for subsequent annual sampling, a notification will be submitted to the City in order to discuss potential alternate sampling schedules. A variance request may also be submitted at that time and the potential for monitoring well installation as outlined in the City of Aurora OA may be initiated.

Efforts to obtain sample permissions for all subsequent annual sampling events will follow the notification processes outlined in Section 3.1 and will begin approximately 3 months before the anniversary of the first O&G well completion date for the well site. Subsequent sampling will only be carried out where the landowner provides consent and will follow all the standard industry procedures, consistent with the COGCC Rule 609 Model Sampling and Analysis plan and test for the following analytes:

Subsequent annual water quality test

<i>General Water Quality</i>
Alkalinity, Conductivity & TDS, pH, Dissolved Organic Carbon (or Total Organic Carbon), Bacteria, and Hydrogen Sulfide
<i>Major Ions</i>
Bromide, Chloride, Fluoride, Magnesium, Potassium, Sodium, Sulfate, and Nitrate + Nitrite as N
<i>Metals</i>
Arsenic, Barium, Boron, Chromium, Copper, Iron, Lead, Manganese, Selenium, Strontium, Mercury, Uranium, and Radium
<i>Dissolved Gases and Volatile Organic Compounds</i>
Methane, Ethane, Propane, BTEX as Benzene, Toluene, Ethylbenzene and Xylenes, Total Petroleum, and Hydrocarbons (TPH)
<i>Other</i>
Water Level, Stable isotopes of water (Oxygen, Hydrogen, Carbon), Phosphorus

4.1 Enhanced Water Quality Testing

If subsequent sampling shows degradation of water quality, additional measures may be required including:

- If free gas or a dissolved methane concentration levels greater than one milligram per liter (mg/l) are detected in a water source, determination of the gas type using gas compositional analysis and stable isotope analysis of the methane (carbon and hydrogen) will be conducted.
- If the test results indicate thermogenic or a mixture of thermogenic and biogenic gas, an action plan to determine the source of the gas will be developed.

- Immediate notification to the City, the COGCC, and the owner of the water well if the methane concentration increases by more than five mg/l between sampling periods, or increases to more than 10 mg/l.
- Immediate notification to the City, the COGCC and the owner of the water well if BTEX and/or TPH are detected as a result of testing. Such detections may result in required subsequent sampling for additional analytes.
- Further water well sampling in response to complaints from water source owners.
- Timely production and distribution of test results in electronic deliverable format to the City, the COGCC and the water source owners.
- All water source testing must be conducted by the ConocoPhillips or, if requested by a surface owner, by a qualified independent professional consultant.
- If ConocoPhillips identifies degradation to water quality as a result of its oil and gas development, ConocoPhillips shall be responsible to mitigate the degradation of water quality to the applicable regulatory standards.

APTIM will carry out the above tasks, after receiving authorization from ConocoPhillips, if analytical results indicate a degradation in water quality.

5.0 REPORTING RESULTS

APTIM will provide Baseline Water Report and Subsequent Annual Water Reports to ConocoPhillips following the conclusion of each task respectively. The *Baseline Water Report* and *Subsequent Annual Water Reports* will include an accounting of the efforts APTIM has undertaken to sample available water sources as well as documentation, including analytical results, pertaining to each water well sampled as part of both baseline and subsequent sampling efforts. APTIM will also provide analytical results to the water well owners, as well as upload the analytical results to the COGCC database per Rule 609 within 30 days of receiving the results.

ConocoPhillips will provide copies of the analytical results to the City along with sub meter GPS information for sampled wells and other field observations to include any of the following as identified by APTIM during each sampling event; damaged or unsanitary well conditions, adjacent potential pollution sources, odor, color, sediment, and effervescence. This information is to be provided within 30 days after receiving final analytical results.