

# Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation Groundwater Monitoring Plan Requirements Checklist



In order to develop a science-based groundwater monitoring plan, operators shall submit site-specific information including geology, geophysics, hydrogeology, geochemistry, and current and past field operations. Site-specific information will be used to evaluate potential mechanisms and pathways that may lead to groundwater impacts, and will be used to help in the design and review of a groundwater monitoring plan. As part of the groundwater monitoring plan, the operator shall submit proposed methods to be used to identify evidence of changes in chemical constituent concentrations in groundwater.

Area Specific Groundwater Monitoring Plan Requirements	
	<p>1. A map of the oil field with a 0.5 mile buffer surrounding the oil field and any oil and gas wells located outside of the oil field boundary, that shows, at a minimum, the following:</p> <ul style="list-style-type: none"> <li>a. Administrative boundary of the oil field</li> <li>b. DOGGR-approved oil and gas production limits</li> <li>c. Proposed area-specific groundwater monitoring boundary</li> <li>d. Any Water Boards approved area-specific groundwater monitoring boundaries</li> <li>e. Active or inactive produced water ponds</li> <li>f. Water supply wells (public, private, domestic, irrigation, and industrial)</li> <li>g. Surface features displayed on a topographic map</li> <li>h. Legend, north arrow, and bar scale</li> </ul>
	<p>2. A map of the area proposed for area-specific groundwater monitoring and a one mile buffer surrounding the area, that shows, at a minimum, the following:</p> <ul style="list-style-type: none"> <li>a. Administrative boundary of the oil field</li> <li>b. DOGGR-approved oil and gas production limits</li> <li>c. Active or inactive produced water ponds</li> <li>d. Active, inactive, idle, or abandoned water supply wells (public, private domestic, irrigation, and industrial)</li> <li>e. Active, inactive, idle, or abandoned oil and gas wells, indicating which wells have</li> <li>f. previously undergone well stimulation</li> <li>g. Oil and gas well(s) proposed to be stimulated</li> <li>h. Active, inactive, idle, or abandoned UIC wells</li> </ul>

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Area Specific Groundwater Monitoring Plan Requirements (continued)	
	<ul style="list-style-type: none"> <li>i. Proposed groundwater monitoring wells</li> <li>j. Line(s) of cross section</li> <li>k. Surface features displayed on a topographic map legend, north arrow and bar scale</li> </ul>
	<p>3. A map of the proposed groundwater monitoring network including a one mile buffer surrounding the area that shows, at a minimum, the following:</p> <ul style="list-style-type: none"> <li>a. Administrative boundary of the oil field</li> <li>b. DOGGR-approved oil and gas production limits</li> <li>c. Active or inactive produced water ponds</li> <li>d. Water supply wells (public, private domestic, irrigation, and industrial)</li> <li>e. Oil and gas well(s) proposed to be stimulated</li> <li>f. Estimated extent and orientation of the planned stimulation</li> <li>g. Active, inactive, idle, or abandoned UIC wells</li> <li>h. Proposed groundwater monitoring wells</li> <li>i. Where available, contours showing the potentiometric surface for each protected water aquifer, showing arrows indicating groundwater flow direction. The operator shall document whether the water levels were measured during pumping or non-pumping conditions</li> <li>j. Surface features displayed on a topographic map</li> <li>k. Legend, north arrow, and bar scale</li> </ul>
	<p>4. At a minimum, two scale cross-section(s) approximately perpendicular to one another that extend the length and width of the proposed monitoring area, and are representative of the area geology and hydrogeology, that show the following:</p> <ul style="list-style-type: none"> <li>a. Depth and/or extent of current oil and gas production limits as defined by DOGGR and zone to be stimulated</li> <li>b. Location of active or inactive produced water ponds</li> <li>c. Depth of the vadose zone and water table</li> <li>d. All geological units, formations, and structures clearly labeled</li> <li>e. The distribution of TDS in groundwater along the stratigraphic section between the water table and zone of stimulation</li> </ul>

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## Groundwater Monitoring Plan Requirements Checklist



Area Specific Groundwater Monitoring Plan Requirements (continued)	
	f. The distribution of gas presence and composition in groundwater, where available, along the stratigraphic section between the water table and zone of stimulation
	g. Depths and extent of any aquifers classified as exempt by the U.S. EPA (pursuant to Code of Federal Regulations, title 40, part 146.4)
	h. Depth and location of oil and gas well(s) proposed to be stimulated, showing the Axial Dimensional Stimulation Area (ADSA). As defined in DOGGR's Final Well Stimulation Treatment Regulations (July 1, 2015), the ADSA is the estimated maximum length, width, height, and azimuth of the area(s) affected by a well stimulation treatment. The Water Board's review of area-specific groundwater monitoring plans will occur in parallel with DOGGR's well stimulation permit review. Final Water Boards approval of a groundwater monitoring plan will not occur prior to DOGGR approving the ADSA.
	i. If multiple zones are proposed to be stimulated, include at least one proposed well to be stimulated for each zone
	j. The estimated extent and orientation of the planned stimulation
	k. Any wellbore within two times the ADSA of individual stimulation stages (this excludes wells located within the plan area of the ADSA, but that do not extend into this area)
	l. Any known geologic features within or intersecting five times ADSA of any stage that have the potential to constitute a leakage pathway, including faults, fractures, or changes in stratigraphy
	m. Depths and locations of any active and inactive UIC wells showing their zones of injection
	n. Depths and locations of all active, inactive, idle, or abandoned oil wells that have previously stimulated
	o. Any available geophysical logs (e.g., spontaneous potential, resistivity, and any porosity logs)
	p. Depths of low-permeability zones and the strata that contain them that will or might function to hydraulically isolate the protected waters or the surface from any fluids injected or produced during or following the well stimulation
	q. All wells shall be clearly marked and include well names or identification numbers
	r. Legend
	s. Elevation reference, preferably normalized to mean sea level elevation, with scale clearly shown

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Area Specific Groundwater Monitoring Plan Requirements (continued)	
	<p>5. At a minimum, two scale cross-section(s) approximately perpendicular to one another that extend from the surface to a depth of at least 500 feet below the stratigraphically lowest protected water aquifer that show the following:</p> <ul style="list-style-type: none"> <li>a. Depth of protected water aquifers and strata containing them</li> <li>b. Depth of the vadose zone and water table</li> <li>c. All geologic units, formations, and structures clearly labeled</li> <li>d. The distribution of TDS in groundwater along the stratigraphic section between the water table and zone of stimulation</li> <li>e. The distribution of gas presence and composition in groundwater, where available, along the stratigraphic section between the water table and zone of stimulation</li> <li>f. Depths and extent of any aquifers classified as exempt by the U.S. EPA (pursuant to Code of Federal Regulations, title 40, part 146.4)</li> <li>g. Location of active or inactive produced water ponds</li> <li>h. All wells should be clearly marked and include well names, or identification numbers</li> <li>i. Groundwater elevation information</li> <li>j. Depths and locations of any active, inactive UIC wells showing their zones of injection</li> <li>k. At least one cross-section shall include construction detail for an upgradient groundwater monitoring well, and one or more downgradient monitoring wells</li> <li>l. Well construction details, where available, for water supply wells located within 1,000 feet of line(s) of cross section</li> <li>m. For each protected water aquifer, indicate any available hydraulic conductivity data (in meters per second) and the source of the data (e.g., hydraulic test)</li> <li>n. Any available geophysical logs (e.g., spontaneous potential, resistivity, and any porosity logs)</li> <li>o. Depth of low-permeability zones and the strata that contain them that will function to hydraulically isolate the protected waters or the surface from any fluids injected or produced during or following the well stimulation</li> <li>p. Map legend</li> <li>q. Elevation reference, preferably moralized to mean sea level elevation with scale clearly shown</li> </ul>
	<p>6. Information, including methods and supporting data, used for the determination of TDS in groundwater along the stratigraphic section between the water table and zone of stimulation.</p>

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Area Specific Groundwater Monitoring Plan Requirements (continued)	
	7. The locations, depths, screened intervals, and justification for each existing and new groundwater monitoring well(s) shall be included in the groundwater monitoring plan, including well completion reports for existing wells.
	8. If any water wells identified within 0.5 mile of individual stimulation stages are not to be used for groundwater monitoring, a technical justification for their exclusion shall be included.
	9. A detailed description of the well(s) to be stimulated, and any wells within two times the ADSA for any stage, including all of the following: <ol style="list-style-type: none"> <li>a. American Petroleum Institute (API) identification numbers</li> <li>b. Any available geophysical logs (e.g., including spontaneous potential, resistivity, and any porosity logs), and any other logs or tests that can provide information about the integrity of annular seals, including past mechanical integrity tests.</li> <li>c. Casing diagrams, including the following:               <ul style="list-style-type: none"> <li>• Depths of perforation intervals</li> <li>• Diameter and depth of borehole</li> <li>• Cement plugs inside casings, including top and bottom of cement plug, with indication of method of determination</li> <li>• Cement fill behind casings, including top and bottom of cement fill, with indication of methods of determination</li> <li>• Depths and names of the formations, zones, and markers penetrated by the well, including the top and bottom of the zone where well stimulation treatment will occur</li> <li>• Wellbore path giving both inclination and azimuth for directionally drilled wells</li> </ul> </li> </ol>
	10. For any geologic features within or intersecting five times the ADSA of any stage that have the potential to constitute a leakage pathway (including faults, fractures, and changes in stratigraphy), the operator shall identify the potential risk where the geologic feature may act as a conduit and impact protected water.
	11. For all existing wells to be used for monitoring, the operator shall submit well construction details and any lithologic information collected during well installation.
	12. For all proposed water wells that will be used for monitoring, the operator shall submit well construction details.
	13. For all drinking water wells located within one mile and downgradient of the surface projection of the zone(s) of stimulation, the operator shall submit well construction details, where available.
	14. A list of chemical additives and tracers anticipated to be used in the well stimulation, including: <ol style="list-style-type: none"> <li>a. A complete list of the names, Chemical Abstract Service (CAS) numbers, and estimated concentrations, in percent by mass, of each chemical constituent of the well stimulation fluids anticipated to be used in the treatment (if a CAS number does not exist for a chemical constituent, another unique identifier may be used, if available), and</li> <li>b. Radiological components or tracers to be used during the well stimulation treatment.</li> </ol>

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	c. Details regarding sampling and testing procedures to be used that are consistent with the methods outlined in Section 2.1.3 of the Model Criteria.
	15. Details regarding reporting procedures to be used that are consistent with the methods outlined in Section 2.1.4.
	16. A contingency plan outlining actions taken by the operator in the event of a well failure or breach, consistent with applicable DOGGR well stimulation regulations, is to be included in the groundwater monitoring plan. The contingency plan shall include a conceptual framework for monitoring well locations, depths, and well construction details to detect potential impacts of a well failure or breach.
	17. The proposed plan is to be signed and stamped by a California registered professional geologist or engineer.