

# EO100™ Standard Technical Addendum

## EO100.1: Shale Oil and Gas Operations

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| OWNER:    | Equitable Origin, Inc.                  |
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<sup>1</sup> Note, this document was updated in 2020 in order to align formatting and references with the updated EO100™ Standard for Responsible Energy Development. The content of the Performance Standards was not altered.

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## FOREWORD

The mission of Equitable Origin (EO) is to partner with business, communities and government to support transparent, sustainable and equitable development of energy through an independent, stakeholder-negotiated, market-driven certification system that distinguishes and rewards operators for outstanding social, environmental and safety performance.

In 2013, the EO Board approved a review of the applicability of the EO100™ Standard to unconventional oil and gas production, here defined as shale oil and gas. It was concluded that the EO100™ Standard broadly applies to shale oil and gas production but that additional stakeholder engagement would be necessary to ensure adequate coverage of specific social and environmental impacts associated with hydraulic fracturing and other activities at shale development sites. In 2014, EO conducted additional research and consulted with stakeholders on key concerns related to shale development and the EO Board approved the expansion of the scope of application of the EO100™ Standard to shale oil and gas operations.

EO considers this scope expansion to be aligned with our mission and an opportunity to increase our impact by bringing greater social and environmental responsibility, transparency, and accountability to increasingly common resource extraction practices. While shale development has arguably resulted in some positive impacts and is integral to the current and projected energy mix, shale development practices, such as hydraulic fracturing that uses high volumes of water, have already had significant social and environmental impacts on local communities and ecosystems.

This Technical Addendum to the EO100™ Standard for Responsible Energy Development serves to clarify specific Performance Targets under the following sections of the Standard for shale oil or shale gas operators seeking EO100™ certification:

- Principle 1: Corporate Governance, Transparency & Business Ethics
- Principle 2: Human Rights, Social Impacts & Community Development
- Principle 3: Indigenous Peoples' Rights
- Principle 4: Fair Labor & Working Conditions
- Principle 5: Climate Change, Biodiversity & Environment

The standards below reflect the expectations of operators regarding management and mitigation of social and environmental impacts associated with development of shale oil and gas resources. Many of the issues addressed in these standards are also applicable to conventional oil and gas operations, but they are emphasized here because of the often higher density of shale oil and gas infrastructure, and its increasing proximity to highly populated areas that have not previously undergone oil and gas development.

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## REFERENCES

- EO100™ Standard 2017
- EO100™ Standard Guidance
- EOP-101 Standard Development and Governance
- EOP-102 EO100™ Scope & Eligibility
- EOP-103 EO Policy on Association
- EOP-203 Complaints and Appeals

## SCOPE

This Technical Addendum applies specifically to shale oil and gas development sites. Extraction of shale gas and shale oil or tight oil utilizes technology commonly known as hydraulic fracturing as part of the well development process.

Other methods of extracting unconventional oil and gas resources are out of the current scope of the EO100™ Standard, including open pit mining, strip mining, underground mining, or in-situ extraction of hydrocarbons from oil sands or oil shales.

Operators are expected to implement the EO100™ Standard in full and reference this Technical Addendum to ensure that, for the following social and environmental performance targets, sites meet the intent of the targets' applicability to shale oil and gas operations due to the unique nature of potential risks and impacts that shale operations present to communities and the environment.

This Technical Addendum also applies to approved assessors carrying out EO100™ certification assessments as it includes assessment indicators to clarify data points to be gathered and reviewed during assessments of shale sites.

As per EOP-103 Scope & Eligibility policy, the guidelines apply to the Unit of Certifiable Production (UCP) or aggregated UCPs (see below).

## TERMS AND DEFINITIONS

**Unit of Certifiable Production (UCP):** (1) A well pad and all gathering pipelines, tanks and transfer equipment leading up to the point at which physical custody is transferred (e.g., Lease Automatic Custody Transfer or LACT Unit) and (2) all equipment (e.g., storage tanks, pipelines), facilities (e.g., production batteries) and services (e.g., workshops, accommodation camps, offices, warehouses, pipe yards, roads) that support part (1) of this definition whether or not the equipment, services or facilities are shared and regardless of their geographic location. Well pads that are essentially contiguous (e.g., separated by a roadway) must be treated as a single unit.

**Allowable UCP Aggregations:** multiple UCPs run by a single owner/operator, which share a single management system; are geographically proximate, interconnected, and within the same block; and which have a similar set of stakeholders. The number and type of aggregated UCPs must not inhibit effective adoption of or certification to EO100™.

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## PERFORMANCE STANDARDS

The following Performance Targets should be used by operators to ensure conformance with the EO100™ Standard Objectives referenced in the left-hand column. The performance standards elaborate on the Objective referenced and should be read in conjunction with the associated Performance Targets in the EO100™ Standard. The Assessment Indicator provides guidance to assessors on the specific information to review.

| EO100™<br>STANDARD<br>REFERENCE  | PERFORMANCE STANDARDS   | ASSESSMENT INDICATOR  |
|--|---|---|
| <b>Principle 1: CORPORATE GOVERNANCE, TRANSPARENCY &amp; BUSINESS ETHICS</b> |   |   |
| <b>1.4 Management Systems</b>  | Operator assesses impacts, including GHG emissions, along the whole value chain of the extraction process – machinery, trucks, energy use, transportation, etc. – and through all phases of the production cycle. <sup>2</sup>  | Lifecycle impact assessments  |
|  | Operator assesses potential negative socio-economic impacts on local communities of a large and sudden influx of labor, including violence, drug use, alcoholism, rape, inflation, availability of affordable housing etc. Operator develops mitigation measures in collaboration with authorized representatives of the affected community and local governments such as the design of temporary worker camps, community programs and cultural safeguards to reduce potential negative impacts and augment positive impacts. | Impact assessments include baseline socio-economic indicators and mitigation measures |
|  | Operator evaluates the cumulative and regional impacts of multiple drilling and production operations on the environment, notably on water use and disposal, land use, air quality, traffic and noise; and the indirect impacts of an influx of workers on local infrastructure. Operator   | Evaluation of cumulative risks and impacts  |

<sup>2</sup> Not including end use.

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|   | works in collaboration with other operators and with authorized representatives of the affected community and local governments to develop collective mitigation measures.   |   |
|   | Operator evaluates the impacts of new wells in light of existing impacts identified through monitoring activities identified in 1.4, 5.7, 5.10, 5.11 and 5.12.   | Evaluation of impacts of new wells        |
| <b>1.6 Transparency &amp; Disclosure</b>                                    | Operator provides affected communities with up-to-date information regarding ongoing uncertainties about the risks of shale development, including quantitative documentation of uncertainties when appropriate (e.g., quantified probabilities of risks to water or other resources, and characterization of resulting consequences).                         | Communication of risks and uncertainties  |
|   | Operator discloses the amount of fines issued and the number of sanctions (“Notices of Violation”) for violation of environmental laws and regulations.  | Numbers and amounts of NOVs and fines     |
|   | Operator discloses NOx and VOC emissions from well drilling, production and completion activities.   | Emissions of NOx and VOCs                 |
| <b>Principle 2: HUMAN RIGHTS, SOCIAL IMPACT &amp; COMMUNITY DEVELOPMENT</b> |  |   |
| <b>2.2 Fair, Inclusive Engagement &amp; Good Faith Consultation</b>         | Operator conducts meaningful community engagement and consultation around project risks and impacts that allows for broad participation of local communities. <sup>3</sup>   | Community engagement policies and records |
|   | Where operations encroach into urban and suburban environments, Operator engages and consults affected communities regarding appropriate setbacks (i.e., the distance between residential, commercial, or other potentially sensitive land use areas and well sites) in cases where regulation does not align with stakeholder expectations or does not exist. | Stakeholder consultation on setbacks      |

<sup>3</sup> For guidance, see [ICCR’s Social Sustainability Resource Guide: Building Sustainable Communities through Multi-Party Collaboration](#), 2011, ICCR; [Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets](#), 2009, International Finance Corporation

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| <b>2.1 Human Rights</b>                | Operator conducts a human rights impact assessment. <sup>4</sup>   | HRIA documentation               |
| <b>2.11 Grievance Mechanism</b>        | Operator identifies community impact concerns and responds to them. Concerns are discussed and appropriate responses are prepared, budgeted, implemented and monitored. Operator maintains statistics on local community concerns and reports them to senior management and back to the local community. <sup>5</sup>  | Disclosure of community concerns |
| <b>2.7 Community Health and Safety</b> | In affected communities, Operator establishes appropriate setbacks (defined as the greater of those required by law or those agreed to by stakeholders) from residential, commercial, or other potentially sensitive land use areas for locating well pads and other surface infrastructure. Operator uses best management practices for setbacks from occupied buildings such as houses, schools, churches, and commercial establishments and from potentially sensitive land use areas; and related concerns of local community stakeholders during the siting process. Within the site, different areas such as waste water pits, waste water treatment plans, wells, may require specific setback limits. Operator implements controls, mitigation, and agreements for financial compensation if episodic impacts occur. | Actual setback distances         |

<sup>4</sup> For guidance, see [IFC Guide to Human Rights Impact Assessment and Management](#); [Danish Institute for Business and Human Rights' Human Rights Compliance Assessment Tool](#); [European Commission Oil & Gas Sector Guide on Implementing the UN Guiding Principles on Business and Human Rights](#), 2013, Institute for Human Rights and Business and Shift; ["Integrating human rights into environmental, social and health impact assessments. A practical guide for the oil and gas industry"](#), 2013, IPIECA

<sup>5</sup> For guidance, see ["Community grievance mechanisms in the oil and gas industry. A manual for implementing operational-level grievance mechanisms and designing corporate frameworks"](#), IPIECA, January 2015

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|  | <p>Operator gathers and uses information about community road use to avoid negatively affecting the health of local community members such as ensuring safe driving practices, minimizing use of roads during peak hours and taking special precautions near schools (see also 6.6 Secondary &amp; Cumulative Impacts).</p> <p>Operator evaluates the level of dust created by the site’s use of local infrastructure and reduces and mitigates dust emissions where necessary.</p> <p>Operator adjusts activity schedules to prevent or reduce traffic congestion and maintains a record of associated traffic accidents.</p> <p>Operator evaluates road damage caused by its operations and compensates for or remediates any negative impacts.</p> | <p>Measures to address transportation impacts, including risks of transportation accidents in local communities; measures to reduce dust; traffic congestion levels; baseline and ongoing monitoring of road conditions</p> |
|  | <p>Operator regularly monitors community health and mitigates health risks related to potential health impacts of shale operations and the use of hydraulic fracturing, including but not limited to:</p> <ul style="list-style-type: none"> <li>• Traffic accidents</li> <li>• Silicosis, respiratory illnesses and dermal diseases associated with hydrocarbon exposures</li> <li>• Upper respiratory, neurological, gastrointestinal, and dermatological symptoms associated with hydrocarbon exposures and exposures to chemicals used in hydraulic fracturing</li> </ul>   | <p>Community health monitoring, mitigation plans, toxicology reports</p>  |
| <p><b>2.14 Economic &amp; Social Opportunities</b></p> | <p>Operator communicates anticipated job creation numbers and reports actual job creation figures over the course of the project.</p>   | <p>Disclosure of job creation figures disaggregated by number of jobs held by locals.</p>   |
| <p><b>Principle 3: INDIGENOUS PEOPLES’ RIGHTS</b></p>  |   |   |

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| <p><b>3.1 Free, Prior and Informed Consent</b></p>             | <p>Operator obtains Free, Prior and Informed Consent (FPIC) for the disposal or long-term storage of hazardous materials on the lands or territories of Indigenous Peoples.</p> <p>Operator obtains FPIC for transport (across lands/territories), transfer (within lands/territories), and injection of wastewater, flowback and produced water, or other byproducts (within indigenous lands or territories, or in areas from which chemicals in wastewater could migrate to indigenous lands or territories).</p> <p>Operator obtains FPIC for extraction of water for use in hydraulic fracturing where the water is drawn from sources within indigenous lands or territories.</p> | <p>Evidence of consent for wastewater handling practices and water extraction</p>                    |
| <p><b>Principle 4: FAIR LABOR &amp; WORKING CONDITIONS</b></p> |   |  |
| <p><b>4.9 Occupational Health &amp; Safety</b></p>             | <p>Operator conducts due diligence when hiring contractors regarding health &amp; safety issues; ensures contractor conformance with operator’s health &amp; safety policies and evaluates health &amp; safety performance of contractors.</p>  | <p>Contractor due diligence and oversight</p>  |
|  | <p>Operator minimizes risk of traffic accidents by ensuring all employees and contractors receive comprehensive worker training on driving safety, including driving heavy vehicles in residential or commercial areas.</p>   | <p>Job-related mortality from worksite or traffic accidents; driving safety training for workers</p> |
|  | <p>Operator ensures chemical labeling, training, Personal Protective Equipment (PPE), secondary containment and monitoring procedures are in place to safely manage the handling, storage and disposal of chemicals.</p>  | <p>Safety procedures and training for chemical management</p>  |
|  | <p>Operator conducts hazard risk assessments, including explosion risks, and develops risk management plans to mitigate incidents.</p>  | <p>Risk assessments</p>  |



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|  | <p>Operator regularly monitors worker health, especially where employees are exposed to hazardous chemicals, naturally occurring radioactive materials from flowback or produced water, and/or hydrocarbons. Worker health monitoring includes but is not limited to:</p> <ul style="list-style-type: none"> <li>• Silicosis, respiratory illnesses and dermal diseases associated with hydrocarbon exposures</li> <li>• Upper respiratory, neurological, gastrointestinal, and dermatological symptoms associated with hydrocarbon exposures and exposures to chemicals used in hydraulic fracturing</li> </ul> <p>Any airborne or waterborne health impacts identified should trigger additional impact evaluations for nearby populations in potentially affected communities.</p> | Worker health monitoring   |
| <b>4.10 Emergency Preparedness &amp; Response Planning</b>         | Operator provides proper training for onsite workers in case any exposure to hazardous materials and pays for the proper emergency equipment. Operator ensures emergency protective equipment is accessible and available for immediate use.  | Emergency equipment types and location   |
| <b>Principle 5: CLIMATE CHANGE, BIODIVERSITY &amp; ENVIRONMENT</b> |   |  |
| <b>5.2 Emergency Preparedness &amp; Response Planning</b>          | Operator has procedures in place for responding to spills and releases, including local experts and specialists that are technically qualified to respond to emergencies in a timely manner.  | Emergency response plans; onsite management plans for incidences of spills and leaks |
| <b>5.4 Waste Production &amp; Management</b>                       | Operator reduces discharge of flowback fluid through means such as reducing water use, recycling of flowback water and other means. Operator ensures that drilling wastes do not have contact with surface water or fresh groundwater.  | Regular reductions of discharge of wastewater; wastewater management plan            |
|  | Operator identifies and manages hazards from naturally occurring radioactive materials (NORM), including safe handling, storage, and disposal.  | Practices to address NORM risks  |

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| <b>5.7 Greenhouse Gas Emissions</b> | <p>Operator implements best available practices and technologies for reducing GHG emissions from production and infrastructure operations, such as green completions<sup>6</sup>; use of natural gas, renewable energy or other reduced-emission methods to power well pad operations; conversion of vehicle fleets to lower emission fuels; replacement of high-bleed pneumatic controllers with low or no-bleed pneumatic controllers; use of pipelines instead of trucks or railcars to move water or produced oil/gas.</p> <p>Operator implements a comprehensive Leak Detection and Repair (LDAR) program with at least quarterly checks that cover all infrastructure in order to minimize fugitive emissions.</p> <p>Operator contributes to innovation, including renewable energy, where possible, by piloting and deploying novel technologies and practices that reduce emissions or enhance the energy efficiency of operations.</p> | Use of GHG emissions reduction practices; GHG emissions in line with or less than legal requirements |
|                                     | Waste gas is not vented except for emergency purposes. No combustible gas is vented. Operator establishes a gas capture plan and eliminates flaring for new operations or progressively reduces flaring of ongoing operations.   | Gas flaring and venting  |
|                                     | Operator discloses all methane emissions from production operations.   | Methane emissions rates  |
|                                     | Operator discloses the frequency of its LDAR program.  | LDAR monitoring reports  |
|                                     | <p>Operator checks on at least a quarterly basis equipment for leaks using best available measurement technologies and fixes any leaks detected as part of a LDAR program.</p> <p>Operator systematically verifies the quality of the compressors, seals, caps, vents, gaskets and valves to ensure they do not deteriorate through the life of the well.</p>  | Ongoing quality monitoring of seals, caps, vents, gaskets and valves                                 |

<sup>6</sup> Green completions: equipment to capture gas and condensate that comes up with hydraulic fracturing flowback, preventing their release into the air.

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| <b>5.10 Air</b>   | <p>Operator reduces air emissions from drilling, well completion, transportation and related project infrastructure as measured against previous years on a per-BOE basis. Where diesel trucks are part of the operation near settled areas, operator encourages the use of ultra-low-sulfur diesel fuels in line with the lowest available sulfur content fuel in the area of operation.</p> <p>Operator uses best management practices to control dust.</p> <p>Operator ensures that all equipment on the well pad is equipped for minimizing methane and other air emissions<sup>7</sup>, and conducts quarterly checks of this equipment to ensure it is working properly as part of a systematic Lead Detection and Repair Program.</p> | Air emissions rates; measures to reduce VOCs, methane NOx, SOx from transportation |
|                   | <p>Operator monitors baseline and ongoing emissions levels, including volatile organic compound (VOC), methane and NOx emissions from operations.</p>  | Baseline and ongoing monitoring of end of pipe emissions                           |
| <b>5.11 Water</b> | <p>Operator incorporates a commitment to the right to water in its human rights policy and endorses the UN CEO Water Mandate.<sup>8</sup></p>  | Community water use and water risk assessment                                      |
|                   | <p>Operator ensures that its water use does not impede the local community's use of water to the level needed to meet their needs in the short and long term. Operator assesses; documents; procures, where necessary; and respects water rights and water use rights, of local and indigenous communities, both formal and informal, that are affected by the site's water use. Water use is sustainable relative to community use and renewable supplies.<sup>9</sup> Operator measures sustainability of water use by sources (aquifer, river, basin, catchment). In countries where water rights are commoditized, fair compensation is made to appropriate parties for acquisition of the necessary</p>                                 |  |

<sup>7</sup> For example, switching from high or intermittent bleed to low-bleed pneumatics, using plunger lifts for liquids unloading, and using solar pumps in place of chemical injection pumps.

<sup>8</sup> [http://ceowatermandate.org/files/Ceo\\_water\\_mandate.pdf](http://ceowatermandate.org/files/Ceo_water_mandate.pdf)

<sup>9</sup> For guidance, see [UN Global Compact CEO Water Mandate: Guidance for Companies on Respecting the Human Rights to Water and Sanitation](#), Pacific Institute and Shift, January 2015

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|  | water (see also 1.6 Transparency & Disclosure and 5.4 Waste Production & Management and 5.12 Land).  |  |
|  | Operator manages impacts related to storm water and extreme flow events.   |  |
|  | Operator monitors surface water withdrawals tied to seasonal flows to ensure flow rates are not significantly impacted considering cumulative impacts and are in line with local regulations and with sustainability of local community access and use where regulations do not exist.   |  |
|  | Operator works with local communities to conduct joint monitoring of water resource impacts.   |  |
|  | Operator develops local source water protection plans that include addressing regional water risks, engaging with key stakeholders and supporting projects that improve watersheds and aquifers.   |  |
|  | In areas with high water risk <sup>10</sup> , operator assesses potential long-term water constraints drilling and completion plans, including projected water needs for re-fracturing, manages risks associated with well-bore integrity challenges that may occur for old wells and takes appropriate actions. <sup>11</sup> |  |
|  | In areas of high water risk, operator does not use water for hydraulic fracturing from a source that is also used as a source for a community water supply.  |  |
|  | Operator evaluates chemical additive use and substitutes less toxic compounds or reduces amounts used. Operator develops screening tools to analyze the risks associated with each chemical additive and requires increasing levels of management approval for higher-toxicity   | Reduction of toxicity of fluids used in drilling and completing wells, |

<sup>10</sup> Areas of high water risk are defined as those areas experiencing drought; high water stress areas where the majority of surface and groundwater is already allocated for municipal, industrial and/or agricultural uses or where water availability, water quality and the accessibility of water negatively affect the ability to meet the human and ecological demand for freshwater; or areas experiencing groundwater depletion. For guidance, see the [WWF Water Risk Filter](#) and the [World Resource Institute's \(WRI\) Aqueduct Tool](#).

<sup>11</sup> For example, increasing the use of recycled water or making use of water sources that do not contribute to normal or forecast community demands.

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|  | <p>additives. Operator does not use diesel oil, kerosene, BTEX (benzene, toluene, ethylbenzene, xylene), jet A aviation fuel, or #2 fuel oil in fracturing fluids.<sup>12</sup> Operator does not use or is actively moving away from using petroleum distillates.</p>   | <p>including fluids used for hydraulic fracturing</p>                         |
|  | <p>Operator ensures the integrity of the casing to reduce the risk of leakage of fracturing fluids, saline formation water or hydrocarbons into a shallow aquifer due to imperfect sealing of the cement column around the casing. Operator ensures that wells are properly sealed before perforation and stimulation.<sup>13</sup></p> <p>Operator routinely<sup>14</sup> tests well integrity using pressure testing and other methods that meet or go beyond regulation such as temperature, acoustic, or ultrasonic and that take into account potential decreases in well-bore integrity over time.</p> | <p>Integrity safeguards; existence of proper seals</p>                        |
|  | <p>Upon completion, operator ensures the integrity of plug and abandonment measures and the isolation of freshwater aquifers.</p>  | <p>Well-bore integrity</p>  |
|  | <p>Operator mitigates risk of spills at the surface through secure storage on site, preferably fully contained in stable, weather-proof storage facilities. Volumes are minimized by expedited treatment, recycling or disposal.</p>   | <p>Integrity of wastewater and produced water storage facilities</p>          |
|  | <p>Operator verifies the location of aquifers prior to stimulation via hydraulic fracturing. Where appropriate, computer simulations that include all available geologic information, the presence of faults, stress regimes and the presence of existing wells, either active or abandoned, are</p>   | <p>Minimum-depth limitations, isolation of wells from freshwater aquifers</p> |

<sup>12</sup> Hydraulic fracturing fluids include all well stimulation fluids and gases that are used to enhance the production of hydrocarbons from a well. This includes hydraulic fracturing (with and without proppants), water and steam flooding, gas fracking, acid fracking and matrix acidizing.

<sup>13</sup> The cementing of the casing strings is planned and monitored to ensure that the casing formation annulus is sealed completely, loss zones are addressed either mechanically or by using lower density slurries.

<sup>14</sup> The frequency of such testing is determined by the risk and severity of losing isolation and the history of the producing area including the experience of other operators.

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|  | <p>performed to understand the propagation and vertical growth of the induced fractures, taking into account the impact of the presence of wells and faults.</p> <p>Operator uses and discloses minimum-depth limitations on hydraulic fracturing, based upon local hydrogeologic conditions. Minimum-depth limitations meet or exceed local regulations.</p>   |   |
|  | <p>Operator uses recycled<sup>15</sup> water and reuses water as much as possible. Operator has a policy to use non-potable or brackish water whenever technically feasible within cost limitations.</p>  | <p>Policy on non-potable/ recycled water use</p>  |
|  | <p>Operator stores fluids to be injected and flowback water in closed tanks. Operator does not use pits or impoundments for any liquid other than freshwater.</p>   | <p>Use of closed tanks; pits used only for freshwater</p>   |
|  | <p>Operator conducts baseline and post-completion sampling of individual wells and surface water within a minimum radius of 2,500 feet, or regulator limit, whichever is greater, prior to drilling of wells and installs monitoring wells to monitor the quality of water in aquifers in productive use that are being drilled through. Testing includes levels of hydrocarbons, arsenic, mercury and total dissolved solids in aquifers and surface streams.</p> <p>Results of all baseline and monitoring tests are made available to stakeholders.</p> <p>Operator undergoes an independent review of groundwater contamination using qualified<sup>16</sup> independent, groundwater geologists.</p> | <p>Baseline and ongoing monitoring of surface water quality; baseline measurements and ongoing monitoring of chemicals and methane gas in groundwater</p> |
|  | <p>Operator publicly discloses the composition of fracturing fluids including the specific chemical species, MSDS numbers, concentrations and volumes of chemicals to be used, prior to fracturing the well. If there are any changes in fracturing fluids used, then the operator also publicly discloses the composition of fracturing fluids used after fracturing.</p>  | <p>Disclosure of chemical composition of and quantities in fracturing fluids prior to fracturing</p>  |

<sup>15</sup> Recycled water is the waste water from flow-back of fracturing fluid. It does not include the release of treated waste streams back to surface waters.

<sup>16</sup> From an accredited academic institution with appropriate background knowledge.

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|                  | Where trade secret protection is asserted, such assertions are made public and substantiated by a public body, where possible and in accordance with national, state, or other applicable law.  |   |
|                  | Operator discloses total water uses on a quarterly basis for each well by source and the amount of water used to produce one BOE.<br><br>Operator discloses volume of total fluids injected, volume of freshwater injected, volume of wastewater injected, volume of flowback water injected, and fluids recovered. Operator discloses flowback water and produced water volumes and disposal methods.  | Total water use by source; water intensity; amount of flowback water and amount of produced water |
|                  | Operator discloses proportion of recycled water used in well drilling, production and completion.   | Proportion of recycled water to non-recycled water used   |
|                  | Operator publicly reports progress in reducing volumes of toxic chemicals used, as well as substitution of less-toxic chemicals used in its operations.   | Quantitative disclosure of progress in toxicity reduction   |
|                  | Operator ensures that clean-up of ground and surface waters are an integral part of the remediation process to avoid degrading the water quality and to reduce the risk of environmental liabilities.   | Remediation plan for ground and surface water   |
| <b>5.12 Land</b> | Operator performs a 3-D seismic (or equivalent analytical approach to identify unknown faults) survey of the project area before drilling to locate faults. Injecting wastewater into the ground is only carried out following a pre-drilling evaluation to establish a geological baseline for the location of faults to identify the potential risk of enhanced seismic activity (see also 5.14 Monitoring).<br><br>Operator studies the formation wastewater is to be injected into and minimizes the risk of coming into contact with aquifers. | Pre-drilling evaluation of seismic risks; distance of wells from active faults                    |



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|                              | Operator evaluates landscape-level impacts due to the high number of wells required for full field development and develops and implements mitigation measures in consultation with local communities. | Evaluation of landscape impacts and mitigation measures |
|                              | Operator minimizes operation's physical footprint by maximizing the number of wells on one pad.  |   |
|                              | Operator co-locates infrastructure (e.g. roads and pipelines in the same right of way) to minimize surface disturbance.  |   |
|                              | Operator evaluates potential risks and impacts to wildlife migratory corridors and habitat for species of concern when locating infrastructure.  |   |
| <b>5.13 Land Restoration</b> | Operator ensures remediation of soil, where affected.  | Remediation plan for soil                               |





## BACKGROUND REFERENCES:

- 'Battlement Mesa Health Impact Assessment', Garfield County, Colorado, 2011, <http://www.garfield-county.com/environmental-health/battlement-mesa-health-impact-assessment-draft2.aspx>
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