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| <p><b>GENERAL INSTRUCTIONS FOR EXCEL TEMPLATE:</b></p> <ol style="list-style-type: none"> <li>1. Do not leave blank rows above or between comments.</li> <li>2. Do not modify or delete the instructions or the column headings (<i>i.e.</i> the grey areas).</li> <li>3. Each comment must have an associated topic and recommendation.</li> <li>4. All formatting (<i>i.e.</i> bullets) will be lost when this file is uploaded to the Online Comment Table.</li> <li>5. If necessary, adjust the cell width and height in order to view all text.</li> <li>6. Cutting and pasting comments from WORD documents cannot include hard returns (spaces between paragraphs).</li> <li>7. If you would like to create paragraphs within a single cell, please use a proper carriage return (ALT &amp; ENTER).</li> </ol> |  | <p><b>App #: S12X-006</b></p> <p><b>Review of: 2nd Revision - Husky Oil Operations Limited - Groundwater and Surface Water Monitoring Plan</b></p> <p><b>Reviewing Agency: Aboriginal Affairs and Northern Development Canada (AANDC)</b></p> <p><b>Date: May 2nd, 2013</b></p> |
| <p><b>TOPIC</b></p> <p><i>Be as specific as you think is appropriate; for example a section or page of the document, a recommendation #, general comment, etc.</i></p>  | <p><b>COMMENT</b></p> <p><i>Comments should contain all the information needed for the proponent and the Board to understand the rationale for the accompanying recommendation.</i></p>  | <p><b>RECOMMENDATION</b></p> <p><i>Recommendations can be for the proponent or for the Board. Recommendations should be as specific as possible, relating the issues raised in the "comment" column to an action that you believe is necessary.</i></p>                         |
| <p><b>Groundwater and Surface Water Monitoring Program</b></p> <p>Schedules as a venue for GSWMP mandatory components</p>   | <p>The recently submitted groundwater and surface water monitoring programs from Husky and ConocoPhillips illustrate how monitoring programs can have similar context but be designed differently. Both programs have their own merits but both require modification.</p> <p>For example, the surface sampling locations were selected in each monitoring program to answer two different objectives:<br/> Husky's 39 surface sampling locations were selected almost evenly through the limits of their exploratory lots to measure baseline data (not to assess for project specific impact from construction activities or wellsites).<br/> ConocoPhillips on the other hand, concentrated all of their surface sampling locations along their winter road and well site operations (not to assess the conditions throughout their claim block to determine a regional baseline).</p> <p>AANDC agrees that both types of monitoring are required but the type and amount of monitoring must be properly balanced. Monitoring throughout the block assists in the process of future expansion of the project (long-term). Monitoring near active work areas and wellsites is better suited to detect potential impacts from these activities and wells.</p> <p>Again, AANDC would like to underline the importance for maintaining the base components of the GSWMP; such as, monitoring type, monitoring location, monitoring frequency/timing, data interpretation, data methods, data reporting, etc. These key aspects should be established in a similar fashion between each monitoring program/project. This will avoid inconsistencies amongst programs. A water licence schedule or template that outlines these requirements may assist the companies and the Board when developing and reviewing these types of programs.</p> | <p>AANDC recommends that a water licence schedule or template be developed to assist the proponents and the Board in developing and reviewing monitoring programs in the region.</p>  |

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| <p><b>Groundwater and Surface Water Monitoring Program</b><br/>Groundwater wells for Baseline and Operational Monitoring</p> | <p>Surface Water sampling sites for all 39 locations were identified in Table 2 of the plan. AANDC understands that Husky will be collecting a set of samples in the fall of 2013, as specified in the Groundwater and Surface Water Monitoring Program (GSWMP).</p> <p>Investigations are currently under way to assess confined, unconfined and surficial groundwater water quality within the study area. Up to 35 wells (bedrock and surficial) were initially planned; but only 3 were drilled to date: one at MW-01A (shallow); one at MW-09A (bedrock); and one at MW-19B (shallow) (see Table 1). The remaining surficial boreholes encountered permafrost and/or bedrock and were either abandoned or became thermistors monitoring stations.</p> <p>AANDC recommends that further details be provided on Husky's intention to further complete the groundwater monitoring program. As well, further details should be provided as to why drilling stopped when permafrost was encountered. Also, it would be helpful to understand what the company is referring to as bedrock. Further, please describe how these conditions prevented the proponent from drilling to establish deeper groundwater monitoring wells (also see comments #5 below).</p>   | <p>AANDC recommends that Husky provide further details on their future groundwater monitoring program given the anticipated increase in activity in their claim block and in the region.</p> <p>AANDC recommends that additional groundwater wells be drilled to assess the direction of groundwater flow in the area.</p> <p>AANDC recommends that company further explain the depth and type of conditions found in their well drilling program (e.g. permafrost, bedrock, water table, etc.).</p>  | <p>It is Husky's intention to expand the monitoring program in future years when and if additional development takes place. Currently the program is limited to existing access. Husky's plan was to drill enough bedrock wells in 2013 to allow the determination of the direction of groundwater flow. However, only one well encountered groundwater. Should additional suitable locations become available in the future, additional wells will be drilled. The results of the winter drilling program will be provided in a summary report.</p> |
| <p><b>Groundwater and Surface Water Monitoring Program</b><br/><i>Baseline monitoring VS Operations monitoring</i></p>       | <p>Husky conducted exploratory vertical hydraulic fracturing activities at wells H-64 and N-09 as authorized under S11L1-003. However, the licence did not include specific provisions to monitoring surface and groundwater in the area as the Groundwater and Surface Water Monitoring Program (GSWMP) is actually a requirement of the Land Use Permit (S12X-006). Monitoring as part of a water licence is important to assess potential impacts from both wells on local surface and groundwater. It would be beneficial to have a licence condition for future program to include a term and condition requiring monitoring and submission of a revised GSWMP.</p> <p>Husky's updated GSWMP provided an improved map that superimposes surface and groundwater sampling locations with the H-64 and N-09 wellsite locations, winter access and all-weather road access. However, the location of the surface sampling sites are not specific to any activities that occur in their discovery area (e.g. H-64 wellsite and N-09 wellsite). AANDC acknowledges that Husky's selection of monitoring sites is appropriate to determine baseline conditions across the discovery area. This is useful to help understand local conditions (e.g. runoff and flow for the road) and will be useful in the event that the exploration program advances to production and additional wells are required. However, project specific surface monitoring, such as sampling near the wellsites and along the road are sparse. Because of this, assessing the potential impact of these activities on surface water is not possible.</p> <p>Typically, monitoring stations are strategically positioned upstream (no effects - control site) and downstream (potential effects) from operations to assess the potential effects. The upstream and downstream method would not only apply to surface water monitoring station of a stream, but also to groundwater sampling locations once groundwater flow direction has been established (note again it is likely that more than one deep groundwater well would be required).</p> | <p>AANDC recommends that to monitor the potential for specific effects on surface and groundwater that may result from the undertakings authorized by a water licence, specific surface and groundwater monitoring stations should be added to the project monitoring in proximity to the location of the activity. These stations may be located near the activities and, where appropriate, be situated upstream and downstream of the area.</p> <p>AANDC recommends that details should be provided on a project specific basis (by proposed well sites) to monitoring the potential impact to surface and groundwater. These specific monitoring details should be included with the water licence/amendment application and included in a revised GSWMP.</p> | <p>Husky will revise the monitoring plan to include additional sampling locations as appropriate. The submitted plan includes the current sample points but does not exclude the potential for additional points to be added as further exploration takes place. When additional locations are identified, Husky will revise the GSWMP.</p>  |

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| <p><b>Groundwater and Surface Water Monitoring Program</b><br/>Guidelines comparison and data analysis</p>                    | <p>The reporting section of the Groundwater and Surface Water Monitoring Program (GSWMP), p. 6, specifies that Husky will prepare a combined surface water and groundwater monitoring report on an annual basis which will be submitted to the SLWB, at the end of December. This report will include analysis, interpretation and reporting on all sampling events.</p> <p>However, how the data will be analyzed, interpreted or reported is not specifically described in the plan. Will data be compared between sites, seasons, years, etc.? Will it be compared based on before and after comparisons? Will water quality be compared to national standard? If so, to what water quality standards will the results be compared?</p> <p>AANDC notes that no stations were specified in water licence S11L1-003 for the H-64 and N-09 wellsites. How will Husky interpret or determine if these well drilling or vertical fracturing activities had an impact on local surface and groundwater?</p> | <p>AANDC recommends that Husky further describe details on the interpretation and reporting of their monitoring program result.</p> <p>AANDC recommends that Husky indicate how the water quality data on its own will be compared and assessed.</p> <p>AANDC request that the company indicate how they would interpret whether their drilling or fracturing programs had an localized effect on surface or groundwater near the wellsites.</p> | <p>Results would be compared to CCME Guidelines for Freshwater Aquatic Life.</p> <p>The monitoring plan is intended to provide a baseline by which any changes in water quality may be compared. Changes that may indicate impacts from drilling, completion or other practices may be detected by the appearance of previously undetected analytes and/or statistical comparison between sampling events.</p> |
| <p><b>Groundwater and Surface Water Monitoring Program</b><br/>Groundwater and Surface Water Sample Analytical Parameters</p> | <p>In the Groundwater and Surface Water Monitoring Program (GSWMP) Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) need to be analyzed and reported separately from other hydrocarbon analysis so specific parameters can be assessed and measured individually instead of included as part of the total hydrocarbons(F1, F2, etc).</p> <p>Husky listed phosphate and it was unclear if they meant total phosphorus. When just 'phosphate' is listed it normally means orthophosphate. Total Phosphorus should be added to the general water quality parameters.</p> <p>For total hydrocarbons the F4 fraction was left out and the F4 fraction - total hydrocarbons should be included as well to ensure as many hydrocarbons are included for future analysis and assessment.</p>  | <p>Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) need to be analyzed and reported separately from other hydrocarbon analysis. Total Phosphorus and F4 fraction - total hydrocarbons should be added to Table 3. Groundwater and Surface Water Sample Analytical Parameters listed on page 10 of the GSWMP.</p>   | <p>BTEX analyses are included in the VOCs that are indicated in the analytical suite. Each compound is reported discretely by the laboratory. Phosphorus is included under "General Water Quality" and is reported as PO4-P in the table. The F4 hydrocarbon fraction is insoluble in water and there are no CCME criteria for comparison.</p>   |
| <p><b>Groundwater and Surface Water Monitoring Program</b><br/>Groundwater Elevation Measurements</p>                         | <p>It is stated in Section 2.2 Groundwater Elevation Measurements, "The depth to groundwater at each well (Table 1) will typically be measured from the top of the well casing using a water level tape." and while this would be normally sufficient there is concern with the long term vertical stability of the well casing given the surrounding permafrost conditions.</p> <p>The top of the well casing could change over time due heaving by the permafrost and this would affect the measured depth to the groundwater. A more standard reference point like the ground surface for example should be used so as to ensure consistency over time especially in an environment with permafrost.</p>  | <p>In an environment with permafrost present a better standard reference point like the ground surface should be used so as to ensure consistency over time when measuring the depth to groundwater.</p>   | <p>Husky has surveyed both the top of casing and the ground surface. Both will be used to verify the depth to groundwater and to determine whether "jacking" of the casing has occurred.</p>   |