KEARL SEEPAGE SUMMARY

Revision Date: February 28, 2024

Incident Summary

On May 11 2022, during regular water sampling and surveillance, an environmental contractor discovered discolored water north of Kearl's Drainage Pond 4. As the source of the water was unknown, a team was assembled to investigate and determine mitigation and containment measures.

Members of Kearl's Hydrogeology and Environmental teams conducted field surveillance and a desktop review of aerial imagery. They noted additional areas of interest north of the North Overburden Disposal Area (NODA), north of West External Tailings Area (WETA) and west of Water Body 3 (WB3). The response team further investigated the surface water, with a specific mandate to:

- identify and implement mitigation measures
- understand potential for environmental impact to key receptors
- understand the source/pathway of the water.

Water and soil sampling, along with vegetation and wildlife assessments were conducted for the areas of interest. In addition to environmental monitoring, Imperial lowered the water levels in perimeter ponds and ditches and initiated a geochemistry study. That study identified:

- no measurable impacts to the Firebag River, the Muskeg River or Waterbody 3
- no impacts to fish or wildlife populations.

Water samples did reveal the presence of key markers for industrial wastewater, which were reported to the Alberta Energy Regulator (AER). An *Action Plan* was developed and submitted to the AER that described the work that had been conducted to date, additional plans to confirm sources / pathways, and further geochemistry studies. Once the source and pathway were understood a *Source Control Action Plan* that outlined mitigation and containment measures was completed and submitted to the AER.

A separate investigation team was assembled to determine the root cause(s) of the process-affected water at surface.

Kearl's Seepage Interception System (SIS)

During Kearl's design phase, best-available water flow models predicted possible seepage from sources related to Kearl's West External Tailing Area (WETA):

- process affected water moving through the tailings dyke (dyke seepage)
- process affected water moving through the base of the ETA structure (pond seepage)
- run-off from the dyke construction process (cell construction seepage)
- fluids released from the Coarse Sand Tails stream (CST pore water seepage)
- process affected water from collection ditch infrastructure (ditch seepage)

To mitigate, a Seepage Interception System (SIS) was designed to detect migrating industrial wastewater and reclaim it back into primary containment. The system was commissioned in Aug/14 and was being operated in accordance with Imperial's approved *SIS Monitoring and Response Plan*.

Continual monitoring and testing of fluids from the SIS detected process-affected water markers (on lease) early in 2021. In response to the detection of process-affected water markers, and in accordance with the SIS Monitoring and Response Plan, pumping wells were subsequently activated.

Investigation Findings: Shallow Seepage

Kearl's SIS was not initially able to detect / capture shallow industrial wastewater. For further details, please refer to Imperial's initial seepage report, which was submitted to the AER on May 5, 2023.

Investigation Findings: Deeper Seepage

Water migrating through deeper pathways was not detected or captured by the SIS,. An in-depth TapRoot© investigation was completed to fully understand why deep seepage was not contained by the SIS.

Investigators noted that the interception system was designed based on predicted water flow models. While the design team expected the models would be directionally accurate, they were aware that actual flows could differ. This led designers to deliver a system that could be expanded as actual patterns became known through observation and actual field data.

When water quality data (collected over the initial years of operation) revealed no significant concentrations of key chemical markers, it was interpreted as confirmation that seepage was not occurring. However, seepage was most likely occurring at different locations and / or elevations than the installed SIS. Detailed findings as follows:

Root Cause # 1: Field data gathered from the monitoring wells did not match model predictions. Despite the discrepancy between model-predicted seepage and field measurements, data collected was interpreted to mean, and not that seepage could be occurring at different elevations or in different locations.

TapRoot© findings:

- situation not covered in Imperial's *SIS Monitoring and Response Plan*
- plans were written to define a response to the presence of seepage; not absence

Root Cause # 2: During an initial hazard identification exercise completed during SIS design, the Project team identified seepage as a potential risk. They stated that Operations would complete a Scenario-based Risk Assessment prior to start-up. This additional assessment did not occur until 2021, after chemical markers began to appear in water samples.

TapRoot© findings:

- risk assessment needs improvement

Root Cause # 3: During handover, some of the information required to operate and inform expansion of the SIS was not properly transferred from the Projects team to Operations.

TapRoot© findings:

- turnover process needs improvement
- communication of Standards, Policies, Administrative Controls (SPAC) needs improvement
- accountability needs improvement

Action Plan

Expanded Monitoring

Monitoring of the surface and ground water seep locations has been enhanced to:

- improve understanding of water chemistry and movement
- ensure that mitigations are effective at detecting and intercepting process-affected water
- ensure that fish / wildlife and local watersheds remain safe from process-affected water.

To achieve these objectives, extensive drilling programs have been initiated. Approximately 300 new wells were installed in 2022 and 2023, with an additional 300 wells planned for this winter (2023/4). Wells include monitoring and pumping wells, targeting both deep and shallow systems.

Flow Interruption and Fluid Collection

Available pumping wells are currently active, with the SIS operating at 99% utilization. Installation of additional pumping wells during the winter of 2024 is ongoing.

Surface and shallow ground water interception trenches, complete with water return pumps, have been constructed in the identified off-lease pathways (three of three locations complete). These trench systems are designed to interrupt and collect the industrial wastewater within the shallow groundwater system, preventing off-lease flow.

A shallow well point vacuum system has been installed in the vicinity of the WB3 seepage location. This technology is designed to dewater shallow systems, and is well suited for the area around WB3 and the suspected industrial wastewater source.

Impermeable ditch liners have been designed and installed in identified locations within the ETA collection and surface run-off ditches to prevent source water seepage to shallow ground water pathways.

Additional measures

The need for additional measures will be assessed based on the efficacy of the installed wells and trenching systems, as measured by the ongoing (enhanced) sampling and monitoring programs.