Case Study

Schlumberger WATER SERVICES

About Schlumberger Water Services

We offer innovative groundwater solutions through professional expertise to meet the advancing technological requirements of today's professionals.

Schlumberger's Water Services division specializes in assessing, developing, and managing groundwater resources using some of the finest, advanced and cost-effective technologies available today.

Whether you're looking for field-scale data collection, data management, modeling, or resource decision-making solutions, our teams of specialists are here to help you address all your groundwater projects safely and efficiently.

Applied Technologies:

- Visual MODFLOW*
- HydroGeo Analyst*
- GIS Mapping

Tailings Pond Evaluation and Impact Assessment

Athabasca, Alberta, Canada

Site characterization of the open pit mine

Highlights:

- Assessing evironmental impact of tailings pond in open pit mine
- Subsurface characterization through groundwater modeling
- Developing a 3D hydrostratigrahpic model
- 3D simulation of subsurface flow patterns
- Evaluating remediation scenarios such as implimenting an interceptor trench

Background

Syncrude Canada Ltd. has been operating its open pit oil sand mine on the west side of the Athabasca River since 1978. In 2000, the mining operations expanded to the east side of the river. The new mine, Aurora North, is located approximately 70 kilometers north of the City of Fort McMurray, Alberta where the tailings pond is constructed above grade. In general, the Quaternary overburden in the area consists of Holocene organics (muskeg) and Pleistocene glacial deposits that unconformably overlie Lower Cretaceous sediments, predominantly McMurray Formation (oil sand) and Clearwater Formation clays and shales which act as a bedrock. Thin layers of Holocene clays are also present.

Oil sand is a bitumen-saturated sedimentary deposit of Cretaceous age. Mining of the ore is accomplished by using hydraulic and electric shovels, and the ore is hauled to crushers by heavy haul trucks. From the crushers the ore is prepared into a sand-slurry, which is transported via pipeline to the Extraction Plant where the bitumen is separated from the sand. The sand is transported via pipeline to an external storage site. Since much of the process is associated with tailings, and is stored above grade in a tailings pond, there is a concern over the potential impact on the surrounding natural groundwater systems.

Challenges

Understanding groundwater flow and potential environmental impacts at tailings sites is very challenging. During this study we employed data analysis and groundwater simulation tools to evaluate existing and future conditions. A conceptual model and 3D hydrostratigrahpic model were developed using existing geologic information at the site.

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Case Study: Tailings pond evaluation and potential impact assessment

To expedite conceptualization and geologic characterization, we adapted our existing data analysis tools to work directly with the facies definitions and interpretations completed by Syncrude's geologists and hydrogeologists. This allowed the development of an accurate representation of geologic and hydrogeologic conditions for subsequent groundwater modeling and simulation.

Examining interactions between tailings ponds and surface water bodies at the open pit mine

Solution

The objective of this project was to characterize groundwater conditions at the tailings pond and to perform groundwater modeling to estimate seepage rates from the tailings pond through the shallow geologic units into the surrounding groundwater systems. Groundwater modeling was preformed to understand the groundwater flow and potential seepage pathways from the tailings pond to the surrounding groundwater regime. Three separate tailings dyke designs/foot prints were evaluated including during the project. For each of the scenarios the following were considered;

- Groundwater flow and contaminant transport
- Groundwater seepage rates
- Potential contaminant migration rates
- Groundwater flux from the tailings pond to the Muskeg River and north to Stanley Creek

A critical component of this study was identifying potential contaminant pathways and receptors and incorporating these features into a groundwater flow and contaminant transport model. A groundwater flow and transport model was developed based on the developed conceptual model. The flow model was developed using Visual MODFLOW Premium and was calibrated using monitored water levels at observation wells and seepage measurements taken at various locations surrounding the tailings pond and at chimney drain discharge sites. After calibrating the groundwater model using all available site data, the model was applied to assess future conditions at the site and mitigation alternatives to reduce the risk of environmental impacts at nearby streams.

Results

Based on the groundwater modeling, a series of abatement options were considered. The groundwater model illustrated that an interceptor trench would be capable of intercepting any tailings water that escaped into the groundwater system. A sensitivity analysis was also conducted to evaluate the uncertainty in different model input parameters and to identify which parameters had the largest influence on model predictions. Based on the sensitivity analysis, the hydraulic conductivity of the material at the base of the tailings pond was identified as the parameter that had the largest influence on model predictions.

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