Hydrogeological Assessment

FORTUNE MINERALS LIMITED

Groundwater Supply

The Upper Floral (Dalmeny) Aquifer is the only groundwater source in the vicinity of the site that has the potential to supply the volumes of water required for the proposed **Saskatchewan Metals Processing Plant** (SMPP), estimated at 183 imperial gallons per minute (IGPM). Pumping tests and subsequent 3D saturated-unsaturated groundwater flow modelling of the proposed FML well field indicate that the aquifer can meet the SMPP water demand without significant impact to third party users of this resource.

In April and May 2010, a twelve inch diameter production well was drilled and installed at the proposed site. Pumping tests were completed on the production well to determine the hydraulic characteristics of the aquifer and to establish an optimum pumping rate for the test well.

Based on the results of the testing, a pumping rate of 203 imperial gallons per minute (IGPM) was used for the 24-hour constant-rate pumping test, initiated on 13 May 2010. FML piezometers installed in the Upper Floral Aquifer and two third party water wells were monitored for hydraulic response due to pumping of the well over the 24-hour period.

Based on the 24-hour constant-rate pumping test, the single test well was capable of a long-term production rate of 121 IGPM.

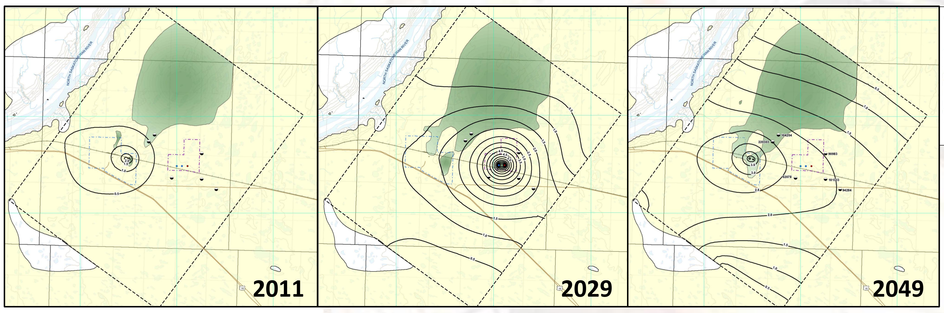
To meet the required water demand of 183 IGPM, a well array including two active wells and a third back-up well is planned.

Production well pump test

Groundwater Modelling

Conservative 3D groundwater flow modelling was completed to determine the long-term effect of pumping of the Upper Floral Aquifer on the aquifer and surrounding users. The results of the modelling indicate that the Upper Floral Aquifer is a viable water source for the proposed facility.

The modelling simulated water production from all major users including the town of Langham. The aquifer is simulated to become unconfined in the immediate vicinity of the wells at both well fields. The modelling indicates that water production by FML will not have any detrimental effects to other users of the resource. The FML monitoring well network will be used to monitor aquifer drawdown during water production to ensure the validity of numerical predictions.



The figures above show the drawdown in the aquifer present before commissioning of the proposed facility (2011), at the end of facility life (2029), and after the aquifer has recovered from the perturbations induced by the proposed facility (2049).

In 2011, prior to development of the proposed facility, the modelling indicates a maximum drawdown of 3.6 m and unsaturated conditions within the aquifer due to pumping at Langham.

In 2029, a maximum drawdown of 15.7 m is predicted, due to combined water production by FML and Langham over the 18 year period from 2011 to 2029. The modelling results indicate that local unconfined conditions generated at the SMPP do not extend beyond the boundaries of the site.

The figure on the right shows the locations of third party water wells used as observation points for the study. By 2049, all of the third party water wells recover to 2 m or less of the simulated hydraulic head in 2011.

PROCESS SOLUTION CHARACTERISTICS	
STREAM PROPERTIES	
Percent Solids	0.02
Temperature (°C)	39
pH	10 - 11
Specific Gravity	1.03
ELEMENTAL COMPOSITION (mg/L)	
Na	12,930
Mg	1,610
Al	0.00
S	10,400
Cl	1,620
Ca	180
Mn	0.00
Fe	0.00
Co	10
Ni	0.00
Cu	0.00
Zn	0.00
As	0.00
Cd	0.00
Au	0.00
Pb	0.00
Bi	0.00

Deep Injection Well

A deep injection well installed within the Mannville Group is proposed to dispose of process solution water. The Mannville Group extends across the province, and is present beneath the site at a depth of approximately 475 m. It is anticipated the Mannville Group will be able to receive the required solution water injection rate of up to 30 m^3/hr (110 IGPM).

Fortune Minerals will employ several methods to maximize the amount of aqueous solution that can be recycled at the SMPP, minimizing the injection requirements. Within each unit operation, solid-liquid separation will be used extensively to recycle water for reuse. The water treatment system will be comprised of media and cartridge filters for removal of suspended solids and a reverse osmosis unit.

The combined brine streams will be pumped to the underground saline aquifer. The injection stream will be the only liquid effluent produced by the SMPP processing requiring disposal. The estimated concentrations of the process solution requiring injection is shown in the table.

The total dissolved solids (TDS) concentration of the process solution water is anticipated to be 47,600 mg/L, similar to that naturally occurring within the Mannville Group in the Saskatoon area (30,000 to 70,000 mg/L). As a result, injection of this water from the processing plant is not expected to have any significant negative impacts to water quality in this unit. The Mannville Group has historically been used to dispose of industrial waste products in the Saskatoon area.

Process Residue Storage Facility

A 2D groundwater flow and contaminant transport model was completed for the PRSF. SEEP/W and CTRAN/W codes were coupled to predict the potential impact of the proposed PRSF on the underlying hydrostratigraphic sequence.

The silt and clay rich till of the Sutherland Group and the Saskatoon Group form the major aquitards for the area, and will be the natural barriers to potential subsurface contamination at the site. Since the Upper Floral Aquifer represents the most important groundwater receptor beneath the site, the principal aquitard controlling vertical contaminant migration within the study area are the oxidized and unoxidized tills of the Saskatoon Group. The PRSF will be designed to prevent impact to the Upper Floral Aquifer.

Results from the 2D groundwater flow and contaminant transport indicated that:

- ❑ Travel of the plume to the Upper Floral Aquifer would not occur within 500 years;
- ❑ The composite liner system virtually eliminates infiltration over the PRSF, resulting in an unsaturated zone and a net inward gradient of shallow groundwater beneath the cells;
- ❑ The unsaturated zone has reduced permeability which further protects deeper groundwater;
- ❑ The total travel distance for the 1% concentration front over 15 years is approximately 1 m; and
- ❑ The front shows no significant downward progress into the unsaturated oxidized Floral Formation till after 500 years.