CASE STUDY

Canadian Natural Resources

Kirby Camp, Fort McMurray, AB

August 25, 2011

BI Pure Water (Canada) Inc. has completed a water treatment plant for Canadian Natural Resources Ltd. (CNRL). Located approximately 85 km northeast of Lac La Biche, the plant supplies potable water to the CNRL Kirby construction camp.

The package water treatment buildings are new insulated shipping containers to easily transport to different sites

Kirby In Situ Oil Sands Project Phase 1 construction commenced in the fourth quarter 2010. Peak production for Phase 1 is targeted to be 40,000 bbl/day in 2013. The Kirby In-Situ Oil Sands Project has minimized land disturbance by reusing a former pilot plant site. Steam Assisted Gravity Drainage (SAGD) technology is used for the recovery of bitumen from the in situ oil sands resources. This again minimizes surface disturbance.

CNRL and Rangeland Engineering retained BI Pure Water (BIPW) to prepare a water treatment plant design and build this new package water system. The design was to have duplicate systems in 45 foot long shipping containers on skids to handle the large construction camp requirements. After construction is finished, one of the systems will be moved and utilized elsewhere.

The BIPW water treatment plant was designed to treat a maximum flow of 189 L/Min (50 USGPM) raw water from two raw water supply pumps. The need was to reduce the amount of total dissolved solids and contamination by metals, particularly iron and manganese. The facility needed to meet the potable water requirements of Alberta Environment.

Raw water from two wells flows to Train A. A raw water equalization line connects Train A and Train B to supply raw water to Train B. These two package WTPs have been designed to supply potable water meeting Canadian standards. Two raw water supply pumps inside the raw water tanks feed the water to the media vessels. To reduce the amount of iron and manganese contamination, GreensandPlus media is used. Systems are included for preoxidation by potassium permanganate and disinfection by use of sodium hypochlorite. Activated carbon

is used to remove odour and taste. A chlorine residual in the potable water is provided with the addition of sodium hypochlorite.

Treatment methodology in more detail:

View of the GreensandPlus media vessels in the container

• Oxidation, converting dissolved metals to insoluble forms of iron and manganese by injection of a sodium hypochlorite or potassium permanganate solution, followed by their removal by two parallel manganese greensand filters. These filters also contain a layer of anthracite and a support layer of gravel.
• Activated carbon is used to remove odour and taste from the filtered water in two stages, a primary and a polishing stage.
• Disinfection by injection of a sodium hypochlorite solution with the capacity to attain a maximum concentration of 1 mg/L (ppm) in the treated water tanks and line flowing to the 159 cubic meter (1000 Barrel) storage reservoir tanks D1 and D2.
• The water is then distributed to end users with pumps pulling from the reservoir tanks.
• After the lines from the pumps come together, a potassium permanganate solution from the raw water tank is injected by a peristaltic pump. Efficient mixing is achieved by the static in-line mixer. The chemical provides oxidation and continuous regeneration of the filter media. The injection system is flow paced from the flow meters.
• After pre-oxidation, the stream enters the three parallel manganese greensand filters for iron and manganese removal. Each filter will process a flow of 64 L/min (17 USGPM). Filter backwash is triggered by total processed flow per filter (as measured by the system flow meter and/or by differential pressure over each filter (as measured by pressure transducers). When a filter is backwashing, processing of water to the reservoir is prevented by the closure of the motorized valve. The wash water is directed to the backwash holding tank (capacity 3,785 L), which permits drainage to waste at a slower rate.
• An activated carbon filter will do a preliminary treatment of the water for taste and odour. A second Activated Carbon filter will do a polishing treatment of the water for taste and odour.

• The final treatment phase in the new WTP consists of injection of a sodium hypochlorite solution by pump through the static mixer. The injection rate is flow paced via the system flow meter FT02 and is automatically controlled by a PLC-based control system based on the signal from the chlorine analyzer CL01.

• A level switch on the main reservoir will start/stop the treated water transfer pumps.

• The treated water is collected in the two reservoir tanks, before being pumped to the distribution system. Start/stop of well pumps P01 and P02 is controlled from an ultrasonic level gauge in the reservoir. The Camp Potable Water Distribution Pumps P-D1 and P-D2 with capacity each of 570 L/min (150 USGPM) at 65 psig, are controlled based on pressure in the

distribution line. A Singer type pressure control valve recirculates water.

• The chlorine residual must be above 0.2 mg/L (ppm) in the distribution system. This is particularly important if the water has resided in the reservoir for some time due to low demand. The residual will be manually checked at the end of the distribution system by a hand held chlorine analyzer.

GreensandPlus is an exact replacement for manganese greensand. It has the WQA Gold Seal Certification for compliance with NSF/ANSI 61. The bonus is that GreensandPlus is one of the few iron and manganese removal medias that only needs to use chlorine for continuous regeneration.

Activated carbon is used to remove odour and taste.

Energy saving items were included in this plant including R20 structural insulated panel ceilings and walls, energy efficient lighting, high efficiency electrical motors, VFDs installed for efficient flow control and water treatment at off peak hours.

The package plant was built in BI Pure Water's Port Kells, BC facility where it was thoroughly tested before shipment to site. This allowed for a quick "plumb and play" approach once the buildings reached site.

BI Pure Water (BIPW) specializes in reviewing water quality test results and prescribing the most cost-effective solution. BIPW engineers pilot, design, manufacture, install, start-up and commission package water treatment plants. The operators are then trained and the plants can be serviced on a regular basis. BIPW provides small and medium-sized water treatment plants for federal, provincial and municipal government, industry, remote camps, private water systems, resorts and First Nations communities.

Our engineered systems are cost effective:
- Years of water engineering expertise: electrical, mechanical and civil engineers specializing in water treatment on staff
- Custom designed to a specific water analysis and budget
- Systems are leak and flow tested at the factory, the PLC is operated and debugged before shipping for faster installation and start-up on site, lower total cost
- We don't sub-contract
- Complete design, build, install, parts