and A2 sands limits the possibilities of aquifer pumping testing within specific areas of Centennial South.

Core samples were collected for geotechnical laboratory analysis from four drillholes within the southern Project area. Permeability values of the sand units were estimated from 850 to 3,500mD, hydraulic conductivity – 3.3 to 280ft/d, and porosity – from 26 to 43%. Permeability of confining units was measured in the range from 17 to 204mD (or 1 to 2 order magnitudes lower than from productive sand units).

17.3.5 Hydrogeological Considerations for ISR Mining Performance

This section describes the current well field design and operating parameters for the Centennial North and Centennial South project areas based upon present available data.

An important aquifer parameter to consider in the design of an ISR well field is hydraulic conductivity/transmissivity within the ore body. This parameter defines aquifer drawdown and recovery due to pumping and injection, as well as residence time for the ISR mining lixiviant. An additional aquifer parameter of great importance for ISR well field design is the amount of hydraulic head above an upper confining unit (or available drawdown). A greater hydraulic head allows for higher concentrations of dissolved oxygen within the lixiviant, more aggressive pumping and injection, and reduced risk for gas lock in the producing formation.

Hydraulic Head

Powertech estimated that a hydraulic head of 40 ft (approximately 17.3 psi water pressure) is necessary within the orebody during mining (Petrotek, 2009a). Sufficient hydraulic head is required to accommodate the drawdown from the recovery wells, as well as maintaining the dissolved oxygen in the production aquifer.

The ability to maintain dissolved oxygen injected into the production aquifer is paramount to successful oxidation and mobilization of uranium required for in situ mining of uranium roll front deposits. The inability to maintain dissolved oxygen at depth within the production formation will reduce uranium recovery. In addition, if sufficient hydraulic head cannot be maintained, oxygen bubbles will fall out of solution and may cause a gas lock condition in the formation. The gas lock can reduce well performance, damage pumps and piping, and change the flow regime in the production aquifer; all limiting resource recovery.

Powertech plans to utilize aquifer enhancement through mine unit perimeter injection well fences to provide and maintain sufficient hydraulic head in mine units 4, 5, 6, 7, 8, and 9. As presented in Tables 17.1 and 17.2 the groundwater level in the southern portion of the Centennial project is not sufficient for in situ mining techniques without artificial enhancement. If designed properly, the use of aquifer enhancement will raise the groundwater level internal to the mine unit, saturating all available uranium ore, and create hydraulic head for recovery well drawdown and maintaining dissolved oxygen injected into the production aquifer.

Development of Aquifer Enhancement

The current ISR development plan for the Centennial project includes aquifer enhancement by raising the water table through fresh water injection on the well field perimeters of six mine units. Raising the water table will promote saturation of the ore bodies and sufficient hydraulic head above the mineral to maintain the dissolved oxygen at the levels required to recover uranium. Powertech completed a preliminary assessment of the aquifer enhancement process to estimate the potential development costs associated with the approach (Petrotek 2010) for the four well fields located in Centennial South. Investigations to further hydrogeologic characterization and better define the feasibility of this process may be considered.

Once the permissions are granted, the standard well field development work may be carried out: delineation drilling, installation of monitor wells, baseline groundwater sampling, and a production aquifer test. To collect supplemental data related to parameters for aquifer enhancement, the following studies may be considered:

- Additional core sample analysis to estimate porosity and other relevant hydrogeologic parameters;
- Extended baseline sampling, with an increased number of monitor wells and sampling frequency;
- Installation of injection and monitoring wells for pilot injection testing to demonstrate feasibility of aquifer enhancement; and
- Detailed implementation of hydrogeologic and ISR models to design production, monitoring, and freshwater injection systems of the well field.

Aquifer enhancement and control of mining solutions is proposed through development of a hydraulic fence that may be operated throughout mining and restoration of the well field. Preliminary design of the proposed hydraulic fence consists of a ring of freshwater injection wells located approximately half the distance between the mining patterns and the monitor well ring. Final injection well spacing for the hydraulic fence has yet to be determined, and will likely vary based on individual well field hydrogeologic parameters; at this time a spacing of 200 ft has been chosen for the economic analysis. Well screens for the hydraulic fence will be similar to the monitor wells, with the entire production aquifer screened. Figure 17-5 presents an idealized conceptual cross section of a mine unit utilizing a hydraulic fence for aquifer enhancement.

The injection wells of the hydraulic fence will likely be supplied with Colorado-Big Thompson (CBT) water acquired through purchase. CBT water is of very good quality, and Powertech has completed a preliminary geochemical analysis that show no adverse affects of mixing CBT water with the native groundwater of the Fox Hills aquifer (Knight Piésold, 2010). No modeling has been completed by Powertech to assess the effect of the hydraulic fence on the surrounding water resources during operation.

Several additional factors will be important in the next stages of design of the Centennial project to successfully implement aquifer enhancement:

- Hydraulic conductivity of the mine unit to:
    - Estimate the area of influence of the freshwater injection wells,
    - Estimate the required available drawdown for recovery wells,
    - Estimate the height to which the water table will need to be raised,
    - Estimate the time required to flood the mineralized zone, and
    - Calculate the rate of freshwater injection on the perimeter required to maintain the increased hydraulic head within the mine unit.
- Thickness and hydrogeologic characteristics of the vadose zone; and

- Thickness and hydrogeologic characteristics of overlying confining units – if the thickness of the vadose zone is less than the height of the potentiometric surface required to create the necessary hydraulic head for ISR mining.

Further data collection and well field modeling may need to be completed to further understand the application these mining techniques to the Centennial Project.

North Project Area

The present well field plan for the Centennial North area utilizes five-spot well patterns (four injection wells, and one central recovery well), 100ft well spacing (square side length) for mine units 1, 2, and 3, with an average pumping rate of 20 gpm. Mine units 4 and 5 will be developed with 70ft well spacing and an average recovery well pumping rate of 10 gpm. The average mining thickness (screen length) in the north project area is 15ft. Of the five mine units planned in Centennial North, only units 4 and 5 will require aquifer augmentation via a hydraulic fence (Figure 17-6).

Analysis of the Upper Fox Hills sub-aquifer suggests that the anticipated recovery-well pumping rate of 20gpm is within the aquifer's potential based on aquifer test data from the Mine Unit 2 (Section 33, T10N, R67W). Data from the aquifer test located in the Mine Unit 4 (Section 9, T9N, R67W) indicate that sustainable pumping rates, without aquifer enhancement, may be lower than 10gpm. Aquifer enhancement may be required to successfully develop several planned mine units in this area based upon present available drawdown data (Table 17.5). The North project area may be an ideal candidate for initial testing of aquifer enhancement by using a hydraulic fence. The vertical distance between the present static water level and the ground surface provide ample room for operational testing and optimization of injection wells for artificially raising the water table within the A sands of the Upper Fox Hills Sandstone.

Table 17.5: Assessment of Available Drawdown, Hydraulic Conductivity & Potential for Aquifer Enhancement at Individual Mine Units in Centennial North

Mine Unit	Available Drawdown	Production Aquifer Hydraulic Conductivity Based on Pumping Test Data	Depth to Production Aquifer Static Water Level from Ground Surface	Potential Increase in Available Drawdown Through Aquifer Enhancement
1	Unknown Anticipated to be greater than 200ft	-	Unknown, probably greater than 200ft	Not Required
2	196ft based upon water level measurements from IN08-33-PW1	Aquifer testing resulted in 1.05ft/d	305ft	Not Required
3	IS-006 indicates an available drawdown of 100ft in the south of the mine unit. IN08-3-MM1 indicates 204ft of available drawdown to the north and east of the mine unit.	-	424-239ft	Not Required
4	21ft based upon water level measurements from IS-009T	Aquifer testing yielded results of 1.67ft/d and 0.77ft/d	400ft	360ft
5	IN08-15-MM1 to the northeast of the mine unit indicates 31ft of available drawdown.	-	209ft	169ft

Mine units 1, 2, and 3, will be operated for approximately 21 months based on present mine planning completed by Powertech. Utilizing the planned recovery well pump rate of 20gpm, and assuming balanced flow within a given five-spot pattern, a 150,000ft^3 mining block will have approximately 41 pore volumes circulated through the pattern during the mining period. Mine units 4 and 5 will be operated for the same 21 month duration, utilizing a recovery well pumping rate of 10 gpm. Within the 73,500ft^3 mining block of these units, approximately 43 pore volumes will be circulated. This number is higher than the 30 pore volumes utilized to obtain the 74% to 78% indicated leach efficiencies during bottle roll testing; however, bottle roll assessment does not account for unbalanced flow regimes within a well pattern that can increase the length of the mining period to achieve the same recovery. Nor do they account for the net effect of the hydraulic fence in operation at well fields 4 and 5.

South Project Area

The present well field plan for Centennial South project utilizes five-spot well patterns (four injection wells, and one central recovery well), 70ft well spacing (square side length), and an average mining thickness (screen length) of 15ft. The anticipated average pumping rate for the recovery wells is 10gpm. The project area plan outlines the development of four mine units in the South project area; all utilizing a hydraulic fence to raise the operational groundwater level (Figure 17-7).

Hydrogeologic data for Centennial South is limited to water levels, core data, and mapping of geophysical log correlations in that there has been no aquifer tests in the area to date. However, from core data, the hydraulic conductivity of the production aquifer in Centennial South appears similar to that of Centennial North, and therefore the same potential for an increased mining period over 21 months may be conservatively estimated. Within Centennial South, the uranium hosting WE sand is nearer to the surface, and in some places less than 100 ft from the surface. Successful mining of the complete resource will require a competent overlying aquitard to provide the barrier required to raise the hydraulic pressure of the aquifer for ISR mining. Laboratory analyses of the overlying confining units have been completed indicating favorable aquitard characteristics. However, aquifer and injection testing will be required to further investigate the continuity of the confining units throughout the South project area prior to construction of the mining well field.

As stated previously, Powertech performed a preliminary study of enhancing unsaturated aquifers containing uranium mineralization. Although not analyzed in concert, a brief discussion combining the results of the Centennial North groundwater model (Petrotek 2009b) and the Centennial South infiltration study to determine water requirements for aquifer enhancement (Petrotek 2010) is warranted. Utilizing the proposed spacing and pumping rate from recovery well and assuming productive sand hydraulic conductivity of 2ft/d, it was estimated by Petrotek (2009b and 2010) that the hydraulic pressure of the production formation will need to be increased to a point equal to a 40 ft of groundwater elevation above the target uranium mineralization to maintain a pumping rate of 10 gpm and dissolved oxygen in the projected concentrations required for mining based on the completed work to date. Table 17.4 provides the relative projected flood levels to the minimum ground surface within each mining unit of the South project area, although many variables in elevation exist, present data suggest that for mining to approach all mineralization in this project area, the overlying and presently unsaturated aquitard must be competent. Limited core data suggest the adequacy of this unit; definitive data will be collected prior to mining operations.

Table 17.6: Flood Level and Available Drawdown with Planned Hydraulic Fence in Centennial South

Mine Unit	Minimum Ground Surface Elevation (ft)	Projected Flood or Potentiometric Level Elevation* (ft)	Range of Available Drawdown – Height of Flood Level Above Base of Overlying Aquitard (ft)
6	5,360	5,324	35-57 (average of 46)
7	5,358	5,347	29-55 (average of 43)
8	5,310	5,262	17-44 (average of 22)
9	5,302	5,297	22-50 (average of 36)

*- Flood level as determined by Petrotek (2010)

17.3.6 Hydrogeologic Considerations for ISR Mining Impact to Groundwater System and Operational Risk

The results of the pumping test planned for spring 2010 will provide sufficient data to develop a groundwater model to assess the potential well field pumping rates, production schedule, and impact of the mining operation to the regional groundwater system for Centennial North. Additional considerations associated with the enhancement of the production aquifer through freshwater injection may include:

- Results from 2007 aquifer testing in Centennial North indicate relatively low hydraulic conductivity values for the production aquifer, but are not consistent with core data. Hydraulic conductivity in Centennial South is likely similar or greater according to core data; however, due to present groundwater conditions, future aquifer testing may be limited to specific areas where mineralization is sufficiently submerged;
- Available drawdown over much of Centennial North is sufficient for ISR development. The potentiometric surface may require enhancement at Mine Units 4 and 5 for ISR mining techniques to be efficient;
- Under present pre-mining groundwater conditions, ISR mining techniques likely cannot be applied to Centennial South without aquifer enhancement of the mineralized sands;
- There are likely limitations to increasing the hydraulic head due to relatively shallow mineralization in Centennial South. Investigations of the continuity of the overlying confining units of the shallow mineralization in Centennial South may be considered. The ability to raise the hydrostatic pressure of the mineralized aquifer is directly related to the amount of oxygen which can be dissolved in the lixiviant and can effect extraction rates.
- Further investigation of the geochemical effects of mixing injection water and groundwater in a uranium bearing aquifer may be considered.

17.4 Assessment of Centennial Project Hydrogeology

The data confidence level is typical of a uranium ISR project at this stage in development. The completion of the planned 2010 aquifer test will significantly improve hydrogeologic knowledge of the project. The overall development strategy for the Centennial Project, including aquifer enhancement, will require very detailed knowledge of hydrogeologic variability across individual mine units. Prior to the development of each individual mine unit, Powertech will complete a thorough hydrogeologic characterization program including but not limited to:

- Detailed delineation on 50-100 ft centers and mapping of the ore body;

- Installation of monitor wells;
- Baseline sampling of groundwater; and
- Aquifer testing.

Additional activities for mining the well fields where elevation of the water table is necessary include:

- Additional coring to determine porosity and other parameters relevant to the groundwater elevation process;
- Baseline sampling to include existing water within the sand unit if available, but also additional sampling of nearest down gradient water quality. Overlying and underlying sand units are to be sampled as well, with an expected higher sampling frequency than normal well fields;
- Injection tests to demonstrate the hydrogeologic feasibility; and
- Use of hydrogeologic modeling to design the systems (production, monitoring, and CBT injection) in greater detail.

The data derived from this work will utilized in the regulatory approval process for each individual mine unit.

17.5 Commercial Operating Plan (Lyntek and SRK)

Section 17.5 is a combined effort of Lyntek and SRK. SRK comments and opinions, where present, contain “SRK” in the pertinent sentences and paragraphs.

17.5.1 Uranium ISR Process Overview

In principle, in situ recovery from permeable sandstone formations is conducted by injecting a solution (lixiviant) into a mineralized section of the formation and extracting a uranium loaded production composite solution (PC) for treatment in a surface facility to recover the dissolved uranium. Typically, solution treatment produces a barren solution from which a bleed stream is disposed for control of soluble impurities. The remaining solution is reconstituted with reagents, restored with natural ground water to the desired flowrate, and re-injected.

As is the case with nearly all ISR operations, the well fields for the Centennial Project will use oxygen as the oxidant for tetravalent uranium and carbon dioxide as a complexing agent to form water-soluble uranyl dicarbonate , $[UO_2(CO_3)_2]^{-2}$, or uranyl tricarbonate, $[UO_2(CO_3)_3]^{-4}$. Although the oxygen and carbon dioxide are introduced into the lixiviant as gases, they dissolve under the static pressure produced by the hydraulic head in the injection well. The target concentrations of oxygen and carbon dioxide, respectively, will be 400mg/L and 200mg/L, yielding an anticipated PC concentration of 60mg/L U_3O_8.

17.5.2 Process Benefits

Many impacts typically associated with conventional uranium mining and milling processes are avoided by employing uranium ISR mining techniques. The ISR benefits are substantial in that no tailings are generated, surface disturbance is minimal in the well fields, and restoration, reseeding, and reclamation can begin during operations. As a particular well field is depleted, ground water restoration can begin soon after, significantly reducing both the time period of