

Methods

An initial geostatistical analysis was conducted using BC's GWELLS database. GWELLS includes well records containing basic information on the well's location, construction, yield and lithology. Well data from the Okanagan Basin were extracted from GWELLS and imported into ArcMap (GIS software) to map the spatial distribution of wells and conduct a simple geostatistical analysis. The GWELLS database has three categories for aquifer lithology 1) Unconsolidated 2) Bedrock, and 3) Unknown. Before any analyses were conducted, the well logs of flowing wells were examined, and bedrock wells that had been mislabeled as 'Unknown' were corrected to 'Bedrock'.

Flowing bedrock and non-flowing bedrock wells were subsequently examined with respect to their relationship to lineament density. Regional scale lineament data, used in previous research by Voeckler & Allen (2012), were provided by Natural Resources Canada. The lineaments were mapped using both detailed aerial orthophotos and satellite (LANDSAT TM) images from the near-infrared band 4 (Figure 1 (left)). Kernel density maps were produced in ArcMap (Figure 1 (right)) and density values extracted at the location of each flowing well, flowing and non-flowing. Wells that fell outside the mapped lineament density area were excluded from analyses (39 wells excluded). The Wilcoxon Rank-Sum test (for non-parametric and independent data), also known as the Mann-Whitney U-test, was used to determine if the flowing and non-flowing bedrock wells are equally related to lineament density.

The Naramata region in the Okanagan Basin has a relatively high occurrence of flowing bedrock wells. This region was used to develop a vertical 2D conceptual model of the hydrogeologic conditions that result in flowing bedrock wells. The GWELLS database was used to examine well records for lithology, flow rates, and water levels for both flowing and non-flowing wells. ArcMap was used to examine spatial characteristics of the wells in the region.

Results

The initial geostatistical analysis determined that the Okanagan Basin has over 8000 reported wells, 533 of which were reported to be flowing at the time of drilling. Flow rates ranged up to 600 USgpm, but the majority of the flowing wells had unreported flow rates. Approximately 23% of the wells are completed in bedrock and of these bedrock wells 9% are flowing.

The lineament kernel density map (Figure 1) suggests that flowing bedrock and non-flowing bedrock wells are distributed throughout Okanagan Basin, clustering in regions with medium and high lineament density. Figure 2 shows percent frequency plots of flowing bedrock and non-flowing bedrock wells for different lineament densities. Flowing bedrock wells occur across the range of lineament densities, but are more common in areas of moderate to high lineament density, whereas non-flowing bedrock wells have a similar distribution, but are occur more frequently in lower lineament densities. The Wilcoxon Rank-Sum test compared the kernel density distributions of flowing and non-flowing bedrock well locations and determined that they do not have the same distribution at the 0.01 confidence level. This infers that higher lineament density is a factor that results in flowing bedrock wells.

