



LINEAMENT ASSESSMENT

To target groundwater exploration in the counties of Stettler, Flagstaff and Paintearth

In response to water supply concerns in the Alberta counties of Stettler, Flagstaff and Paintearth, and the additional adverse effects of recent drought conditions in Eastern Alberta, a lineament assessment was launched by Agriculture and Agri-Food Canada's Prairie Farm Rehabilitation Administration (PFRA) in order to identify zones with greater potential for groundwater development. Extra Rural Water Development Program (RWDP) funding for the 2001-2002 year enabled AAFC-PFRA to contract J.D. Mollard and Associates Limited, to perform this study.

Area of Study

The study area is a block covering Townships 38-42 and Ranges 14-17 West of the Fourth Meridian. The study area includes parts of the County of Stettler, Flagstaff County, and the County of Paintearth as shown in Figure 1.

The study area was identified in recent municipal groundwater assessment studies as being an area of relatively poor groundwater development potential.

Data Available

The study used existing sources of data such as: air photos, Landsat (satellite) imagery, Radarsat (satellite imagery), topographic / digital elevation model (DEM) data, groundwater assessment reports for each of the counties, bedrock and surficial geology maps, and available water well data.

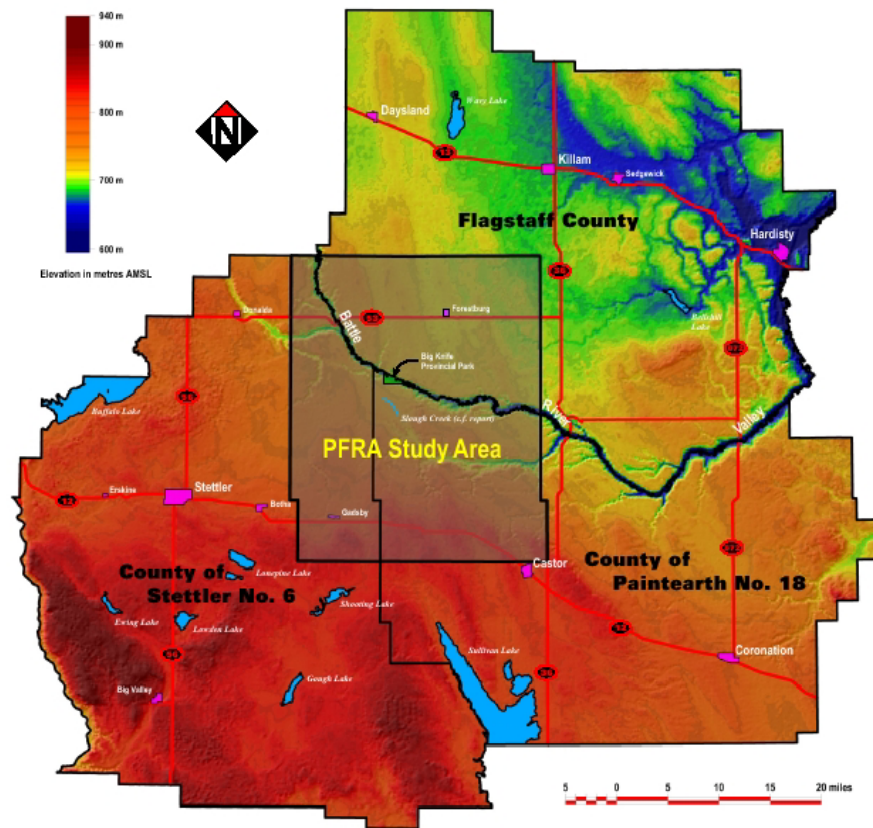


Figure 1

Background

Lineaments are linear features on the earth's surface that are visible in air photos, satellite imagery and in features on the landscape (e.g. creeks) that show up on maps. Past experience in other areas of the Prairies has shown that lineament type features (especially those that are longer and closer spaced) are sometimes associated with higher local water well yields. The lineaments are thought to represent areas where the underlying bedrock is more fractured, hence higher in local permeability and allowing

groundwater to move more easily toward a water well. In some cases, test holes drilled 20 to 30 metres apart (one on the lineament type feature, one off) have had remarkably different well yields, and it is suspected that this is due to locally increased fracturing and permeability.

The most common types of lineaments seen on air photos, satellite imagery, and topographic maps are those created by creeks that follow relatively straight paths, make a sudden change in direction, and then further downstream change direction again. In other cases, photos or imagery may show long linear changes in soil tone (more moisture?), or a series of sloughs that form a relatively straight line for many kilometres.

Lineaments identified in one township in the study area are shown superimposed over an air photo in Figure 2. The circles represent proposed drilling locations that were identified in the later stage of the study.

Lineament analyses works best where the overlying glacial deposits are relatively thin.

Objective

The main objective of the study was to identify specific locations or areas within the study area where groundwater potential may be increased due to fracturing in the bedrock.

Lineaments used in combination with available geological and water well data were to be used to identify areas or specific locations of groundwater development potential.

Specific recommendations for future possible field investigations (e.g. test drilling) would be identified for each area of increased groundwater development potential (see text below right for an example of detailed site-specific recommendations taken from the report).



Figure 2

Study Methodology

Lineaments were identified by intensive examination, and in some cases computer processing, of the data sources. This was then followed by a review of geological and water well data of air photos, and subsequent identification of areas judged to have higher groundwater exploration potential.

Site 1:

Suggested EM-31 traverses (dark lines) at two test drilling locations (1a and 1b). Purpose of EM-31 traverse is to locate thickest section of aquifer for bored well site exploration, recharge potential.

SE31-40-16 W4M (fair to good prospect)

- Threading springs in 1971 airphoto
- Lineaments
- Deeper aquifer section possible
- Aquifer recharge

SW23-40-16-W4M (good prospect)

- Recharge from long narrow slough (lineament)
- Surface materials look granular (sandy glacial-lake delta)
- Expect thickest aquifer on NE side of the Slough
- Potential for bank storage with a low earthfill dam

Findings of the Study

The dominant lineament trends (directions) in the study area match the regional trends seen in the Canadian Prairies. Prominent lineaments identified from all data sources (air photos, topography (DEM), satellite imagery) are shown in Figure 3.

The most promising lineament zones to prospect for groundwater are: i) locations where these zones follow larger or small drainage channels, and ii) where sloughs are connected by small intermittent drainage ways. However, lineaments by themselves are less helpful in finding groundwater than when they are combined with other geological and water well data.

Surface geology indicators interpreted from air photos were identified and considered along with the regional groundwater study data to help define more promising groundwater exploration targets. Even then, field reconnaissance followed by the drilling of several test holes may be required to find a good groundwater source at the recommended test-drilling locations.

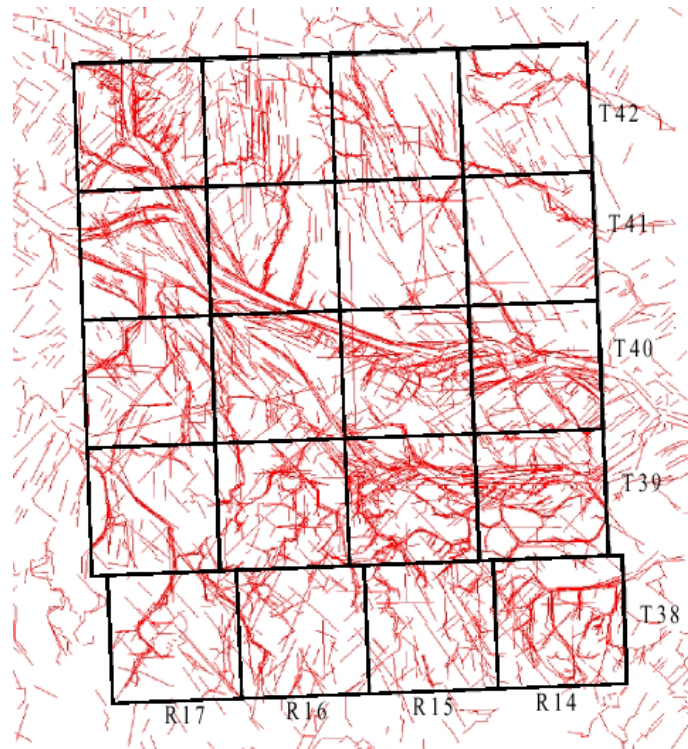


Figure 3

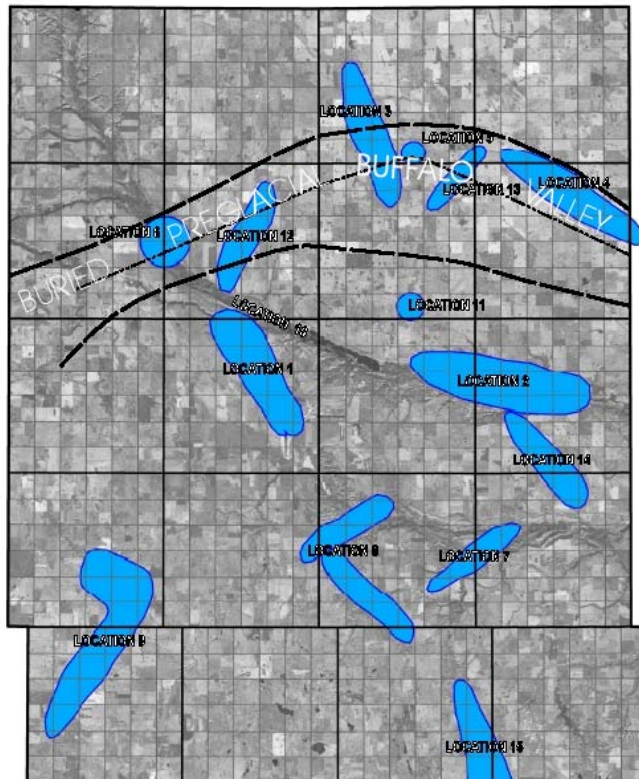


Figure 4

The study identified 15 areas (blue areas on Figure 4) where the potential for developing a groundwater supply was judged to be better than average. The Buffalo Lake buried valley is also shown on the figure and was judged to represent the best site for higher volume groundwater development (up to about 1,000 cubic metres per day or about 150 imperial gallons per minute).

Other identified target areas included low terraces and alluvial fans located along the Battle River. However, water quality may be poor in some of these deposits.

More detailed descriptions of specific drilling targets are presented in the report (complete report reference is given on the last page).

Conclusions

Lineaments in the Stettler-Flagstaff-Paintearth study area are probably among the better expressed in the Western Canadian Prairies. However, surficial lineaments by themselves are less helpful in locating areas of higher groundwater development potential than when they are combined with photo-interpreted groundwater indicator clues, hydrogeology maps, and good water well data.

Lineaments could be mapped from drainage maps, topographic or DEM maps, air photos, Landsat imagery, and Radarsat imagery. In most cases, consistent regional orientations were observed with all lineaments. High-altitude air photos provide the best reliability of lineament identification.

The best lineament zones are those that follow drainage courses (channels, or interconnected chains of sloughs). Geological and water well data helped to define the most promising groundwater exploration targets. Field reconnaissance would be required to recommend specific test-hole locations. Several test holes may be necessary to find a good groundwater source.

Fifteen potential target areas were identified in the report that may have higher groundwater development potential. Specific areas worthy of future investigation are:

- The Buffalo Lake buried valley – yields of up to about 1,000 m³/day (150 igpm) are possible with well-designed exploration strategies. However, extensive field investigations may be required to locate high-yielding water wells.
- Low-level terraces and alluvial fans along the Battle River – these areas represent better prospects for finding groundwater (particularly in drought years) in the thick alluvial deposits or the underlying fractured bedrock. Water quality may be poor (testing and sampling required to confirm).

Consideration should be given to the recommended test-hole drilling programs, as a start upon which to build an area-wide groundwater exploration program using lineament data as a speculative prospecting tool, along with available useful hydrogeological data.

Recommendations

A more detailed field assessment of local groundwater data and conditions should be made prior to identifying test-drilling sites in any of the identified target areas. Additional assessment is also required to determine the reliability of supply in each of the target aquifers during prolonged drought.

Future groundwater exploration studies and investigations should be reviewed to determine the success rate of using lineaments as a groundwater prospecting tool to locate specific locations of higher groundwater development potential.

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Report JD Mollard and Associates Limited, March 2002, Lineament Assessment of Part of Stettler, Flagstaff and Paintearth Counties, Alberta, Prepared for Agriculture and Agri-Food Canada.