An Inventory of Private Water Wells in the 05SB Watershed

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February 2010

Gimli, Manitoba

i. Abstract

Water wells are a primary source of drinking water for many residents in the Canadian Prairies. Understanding our ground water supply allows us to foresee water quality problems as they arise and take a proactive approach to developing methods to maintain the reliability of water well environments. This is fundamental to sustainable development and the maintenance and improvements to the quality of life for rural communities.

A well inventory program was conducted by the East Interlake Conservation District for the 05SB watershed from May 5th to August 19th of 2009. Water samples were collected from 363 active water wells to test for nitrate and bacteria concentrations. Additional well information such as well depth, size and type was collected in conjunction with the water samples to update the Province of Manitoba's provincial well records. Results of this comprehensive well survey indicate that 1 in 8 wells (41) failed to meet basic Canadian Drinking Water Quality Guidelines.

Public participation in this project was fair with 87.3% uptake. Positive public participation may be attributed to public awareness of potential health problems associated with poor water quality.

Information obtained in this survey will be used to aid in the development of an Integrated Watershed Management Plan within the Willow Creek (05SB) watershed. It is recommended that this type of program continue through future partnerships with Manitoba Water Stewardship – Groundwater and Office of Drinking Water sections – and the East Interlake Conservation District.

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ii. INTRODUCTION

In August 2005, the East Interlake Conservation District (EICD) became the seventeenth conservation district in Manitoba. It was formed with the collaboration of the Province of Manitoba, and the Federal Government, and surrounding Rural Municipalities. The purpose of the EICD is to address soil and water management issues using a cooperative, long-term, planned approach within defined watersheds. To better understand the watershed and ground water quality, a well water sampling program was implemented from May to August of 2009 within the Willow Creek watershed (05SB).

The Willow Creek watershed is one of the four watersheds within the EICD boundaries. It is located in along the west side of the south basin of Lake Winnipeg. Residences targeted were within or near the boundaries of the watershed. This included homes within the municipalities of Rockwood, Gimli, Armstrong and St. Andrews. Figure 1 shows the locations of the wells sampled.

The Government of Manitoba, namely the Groundwater Management Section and the Office of Drinking Water of Manitoba Water Stewardship, assisted the EICD throughout the project. A total of 363 private and rural wells were sampled, with particular interests focusing on the distribution and concentration levels of the most common health parameters affecting private well water quality. These include nutrients and bacteria (nitrates, total coliform and e. coli). All samples were analyzed by ALS Laboratory Group in Winnipeg, Manitoba. The well samples were also analyzed for conductivity and temperature via *in-situ* water analyses. Information about each well was collected from the well owner and recorded through the use of a standardized questionnaire.

A cooperative partnership between Manitoba Water Stewardship and the EICD was developed as a means to engage the public through the education of well owners in preventative and corrective measures for well maintenance, to provide a service to landowners by giving them free access to bacteria and nitrate analyses for their well, and to develop public awareness on how residents can participate with the EICD and governmental agencies to secure their water quality and quantity.

For Manitoba Water Stewardship and the EICD, this program acts to: identify “hot spots” of well water contamination within the 05SB watershed, collect data on the number and location of private water wells in the 05SB watershed, improve and supplement the Province of Manitoba’s water well database, and provide a benchmark of groundwater data from which to gauge any watershed improvement. This information can ultimately be used to assist in program development and watershed management planning. Successful implementation of this program and the use of the resulting data can potentially identify any activities or conditions which may lead to bacterial and/or nitrate contamination of private water wells and possibly prevent contamination of the groundwater aquifer as a whole.

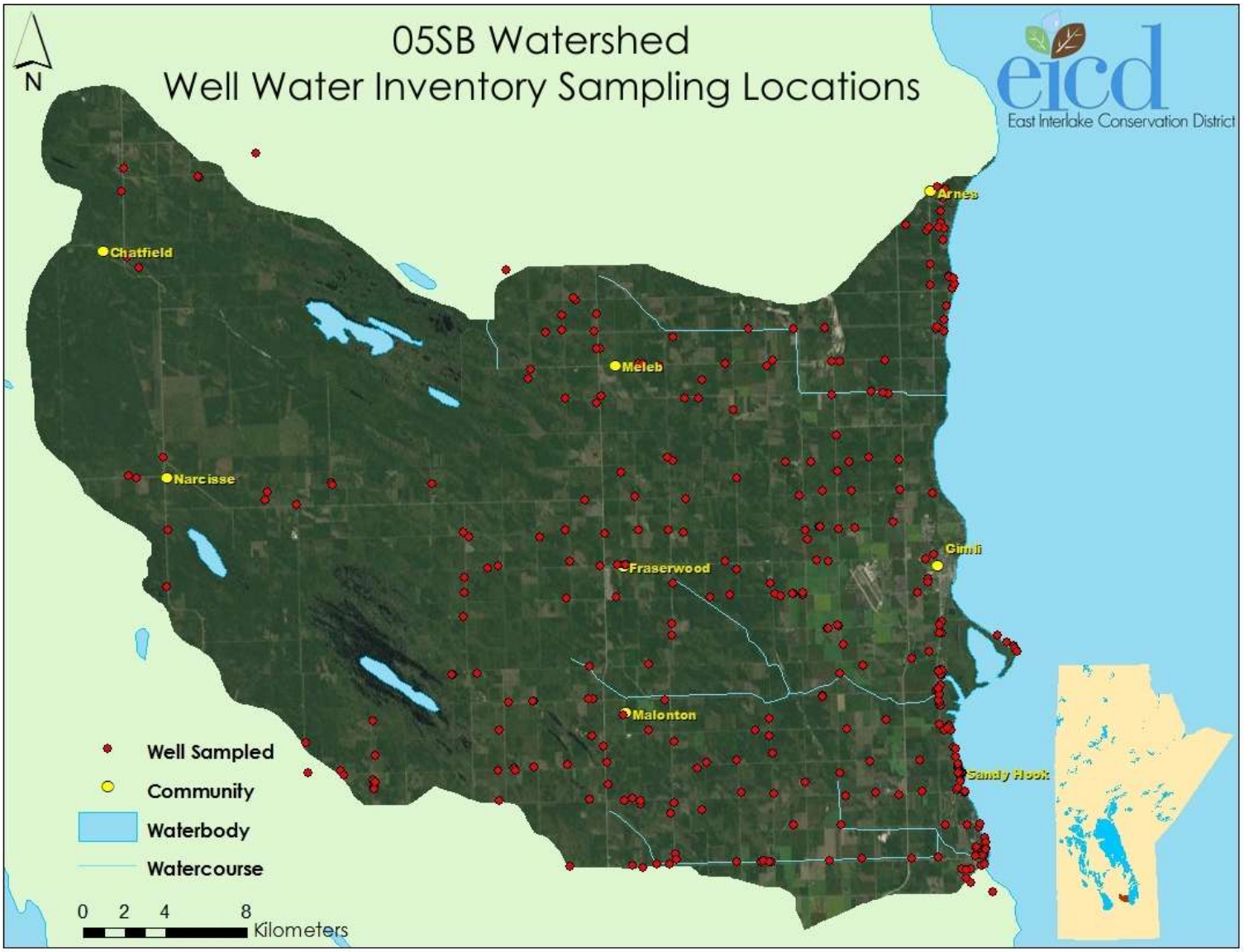

Figure 1. 05SB Watershed Well Water Inventory Sampling Locations

iii. METHODOLOGY

A. Sampling

Well water sampling locations were confined to the Willow Creek watershed and closely surrounding area. The goal of the project was to capture a representative assessment of the groundwater quality throughout the watershed. Sample locations throughout the area were selected based on landowner availability and with a goal of obtaining approximately two samples for every four square miles. This was difficult to accomplish, due to higher population densities situated along the lakefront compared to rural areas. Samples were collected from active wells on private property only. Participation by the well owner was voluntary and confidential. Samples were not collected from areas that are supplied by a municipal water source or from crown lands (i.e. wildlife management areas, provincial parks). The locations of the sampled wells within the watershed are shown on Figure 1.

Well water samples were collected from taps which would provide the most representative sample from the well. Therefore, taps connected to water treatment devices (i.e. filtration systems or softeners) were bypassed. Any devices directly attached to taps (i.e. aerators), were removed. All taps were opened fully and allowed to run for a minimum of five minutes prior to sampling, allowing standing water to be removed from household pipes and holding tanks.

During the well water sampling process, efforts were made to avoid contamination. Before sampling, the tap was cleaned with disinfecting wipes to remove any standing bacteria. Water samples were then collected in sterile containers provided by ALS Laboratory Group and labeled using waterproof ink with the sample identification number, the name of the well owner and the sampling date. The sample containers were filled to the line indicated on the container. The samples were analyzed for nutrients, bacteria, and water quality. Included in nutrients and bacteria were nitrogen, total coliform and e.coli. The water quality testing included the measurements of conductivity, total dissolved solids, salinity and temperature. The water quality samples were analyzed *in-situ* with a calibrated portable water quality metre[1]. Once well water samples were obtained, the sampling containers were immediately stored in a chilled cooler and submitted to the laboratory for analysis within a period of 24 hours.

[1] Hatch Model 51800 Conductivity Meter

B. Questionnaire

Information about the well owner, the property, the construction of the well, and the history of the well was requested from the well owner at the time of sampling and recorded on a standardized questionnaire. The purpose for the questionnaire was to allow for analysis of potential relationships between water quality data, well depth and well type. The information provided by the well owner was based on their current knowledge of their water well. This information was collected to allow Water Stewardship to update provincial records and to collect information that may indicate potential reasons for water well contamination.

C. Sample Shipping and Chain of Custody

Prior to submitting well water sample containers to the laboratory, a chain of custody (CoC) form was used to create an accurate and verifiable record which would be used to trace the possession and handling of well water samples from the moment of collection until receipt by the laboratory. A CoC form was required for all water samples collected during the well water inventory. The CoC included the name of the sample collector, the time the sample was collected, the mailing address of the well owner, the sample matrix, and the type of analysis requested. The CoC was signed and dated by the person shipping the sample containers and packed with the corresponding samples. Prior to shipping the samples, the questionnaire information was compared to respective sample containers to ensure the accuracy of the legal land location, the sample identification number, and the correct spelling of the name of the well owner.

Once all sample containers were properly packaged in the cooler, ice packs were added to the cooler to keep the samples at a temperature of approximately 4°C. The cooler was then sealed securely with tape to prevent the lid from opening. Samples were shipped via bus to Winnipeg and received the following day by ALS Laboratory Group within 24 hours of sampling.

D. Results

As per the Drinking Water Safety Act, ALS Laboratories immediately contacted the homeowner if their results did not meet Canadian Drinking Water Guidelines. Additionally, the EICD sent the homeowner a letter that provided steps that could be followed until the resample result could be confirmed.

If no contamination was present in the well water sample the well owner would receive the results either via e-mail or post. EICD received all results from ALS laboratories via e-mail.

All data was compiled in a Microsoft Office Access database which was shared with Water Stewardship.

iv. TEST RESULTS

Of the 363 wells that were sampled for bacteria and nitrate levels, 11.3% (41) of the well water samples failed the Canadian Drinking Water Guidelines (CDWG) for bacteria and/or nitrate. A summary of results is shown in Figure 2.

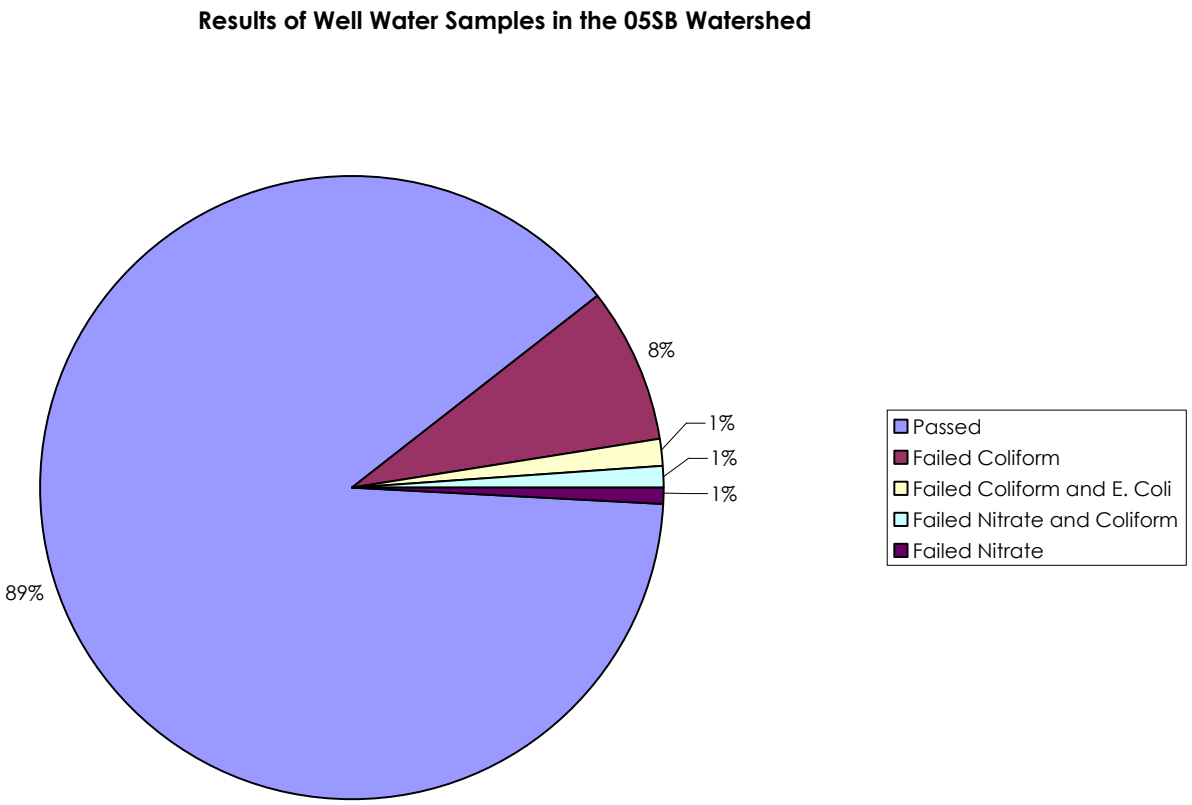

Figure 2: Summary of Well Water Samples in the 05SB Watershed

Of the 11.3% of the wells that failed, 70.7% (29) failed due to total coliform counts, 12.2% (5) failed for both *E. coli* and total coliform, 9.8% (4) failed for both nitrate and total coliform, and 7.3% (3) failed due to nitrate concentrations. The reasons for well test failures are shown in Figure 3.

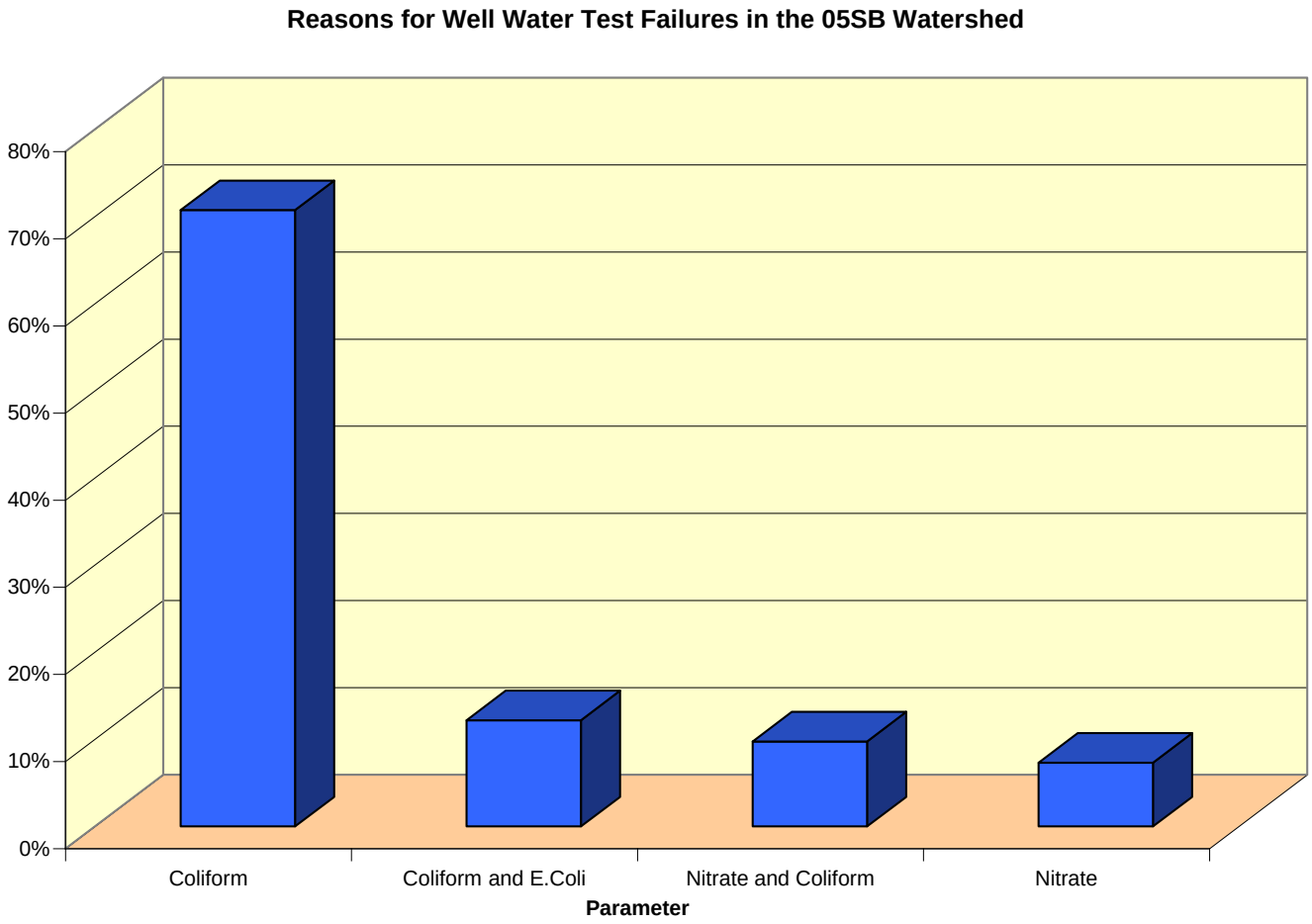

Figure 3: Reasons for Well Water Test Failures in the 05SB Watershed

Due to a low number of sites (7) failing nitrate counts, it was not possible to create a map through the use of inverse distance weighting (IDW) techniques that extrapolate possible nitrate levels between known points using 75% of the nitrate results (the remaining 25% being used to test the interpolation). IDW techniques were used in a previous study of the 05OJ watershed. In this study, potential areas of nitrate contamination or 'hot-spots' appeared to correlate with the areas of shallow overburden. This is apparent in the 05SB watershed as well. Only 31 of the 363 total wells sampled were located In the western portion of the watershed, where overburden is thinnest. Of these wells, 4 (12.9%) failed CDWG for nitrate. These four sites account for 57% of nitrate failures throughout the whole watershed.

Areas with thin overburden have been classified as being vulnerable to groundwater contamination due to their increased susceptibility to anthropogenic nitrate being introduced through agricultural activities (i.e. application of inorganic fertilizer, land application or storage of manure, and confined livestock pens)[2].

In a previous study of water wells in the 05OJ watershed, 54 out of 524 (10.3%) wells sampled failed CDWG for nitrate. This is not surprising, given that it is characterized by shallow overburden and a high amount of agricultural land use. Agriculture is not as prevalent in the 05SB watershed, as reflected in the nitrate results of wells in the watershed. Only 7 out of 363 (1.9%) of wells sampled in this region exceeded nitrate guidelines. The difference in land use between the two watersheds is shown in Figure 7.

[2] Betcher, p.6

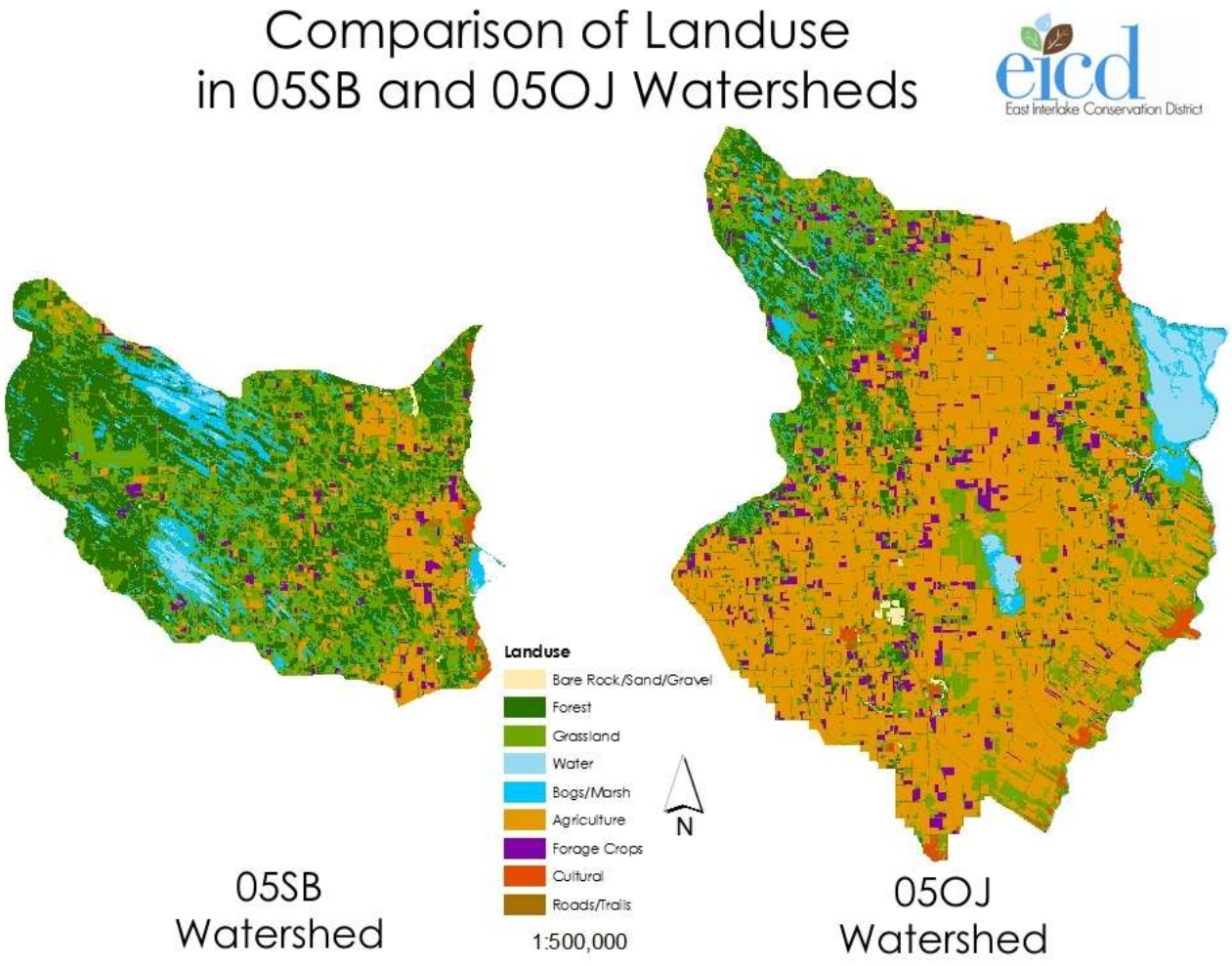

Figure 4: Comparison of land use in the 05SB and 05OJ Watersheds

v. PUBLIC PARTICIPATION

Public participation in this project was fair with 87.3% uptake. Positive public participation may be attributed to public awareness of potential health problems associated with poor water quality.

vi. CONCLUSION

Prior to implementation of this program, detailed information regarding the health of the aquifer directly under watershed 05SB was not available. A key finding as a result of this program was that only 11.3% of rural water wells failed to meet basic Canadian Drinking Water Quality guidelines in this watershed. Hopefully increased programming targeted at rural audiences regarding proper maintenance and well installation can decrease this statistic even further. This program acted as an initial education campaign and hopefully raised the public's awareness of drinking water quality in watershed 05SB.

The data gathered through the partnership between the EICD and Water Stewardship will be crucial to the successful development of a watershed management plan for the region. It is recommended that a continued partnership exist in the future to allow the last remaining watershed (05SD) to be surveyed in 2010.

vii. REFERENCES

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Hatch Model 51800 Conductivity Meter

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