



## Tongue River Agronomic Monitoring & Protection Program 2007 Fact Sheet



**December 2007**

The Agronomic Monitoring and Protection Program (AMPP) was developed to measure crop yields and monitor key properties of irrigated soils in the Tongue River Drainage (TRD). The program was also developed to detect impacts to irrigated agricultural soils due to the discharges associated with development of coalbed natural gas (CBNG) in the basin. AMPP was designed by two professional soil scientists and an agronomist from Montana, namely William Schafer, Kevin Harvey, and Neal Fehringer.

Fidelity Exploration & Production Company provided funding for the program from 2003 to 2006. Montana Board of Oil and Gas Conservation (MBOGC) has funded AMPP since November 1, 2006. (MBOGC is an agency of the DNRC.) MBOGC's administrator, Tom Richmond, broadened the project to include a hydrology study of the Tongue River. The resulting program is now called Tongue River Information Program (TRIP) and is managed for the MBOGC by HydroSolutions Inc of Billings.

During summer and fall of 2003, landowners who irrigated a minimum of 80 acres with Tongue River water were invited to become cooperators in AMPP. Thirteen landowners joined AMPP and continue to participate on a voluntary basis. Since spring 2004, twelve irrigated fields have been monitored within the TRD, running from the Wyoming Stateline to east of Miles City. Two additional AMPP fields are located in the Yellowstone and Big Horn River Valleys to monitor reference soils and crops outside the TRD.

The AMPP soil and crop testing program has provided agronomic assistance to participants, helped irrigators better understand potential effects of CBNG development on their irrigated fields, and has documented regional trends in irrigated soil characteristics. AMPP consists of three tiers of sampling and analysis, including:

- Tier 1: Assesses crop production factors, soil fertility, electrical conductivity (EC) and sodium adsorption ratio (SAR) in selected fields;
- Tier 2: Includes key Tier 1 components of EC and SAR along with detailed measurement of exchangeable sodium percentage (ESP), texture, bulk density, soil infiltration rate, clay mineralogy, and soil classification as well as determining crop yields, soil fertility, and forage quality (including sodium content);
- Tier 3: Consists of crop and forage test plots employing mixtures of Tongue River water and CBNG produced water.

Through December 2007, soil samples have been collected from AMPP sites on six occasions: Fall 2003, Spring & Fall 2004, and Fall of 2005, 2006, and 2007. Forage sample harvests have occurred prior to each harvest from every field throughout the 2004-2007 growing seasons. The purpose of the program is three-fold: (1) to measure baseline soil characteristics; (2) to identify potential changes in soil chemical and physical properties that could impair future crop yields, and the degree to which identified changes are related to CBNG development; and (3) to monitor changes in crop yields and sodium content in forages.

Detailed soil analysis were conducted on 533 samples collected from up to 16 fields from 6 sampling periods in Tier 2 AMPP. Statistical analysis showed no adverse changes in soil properties that could be attributed to CBNG development. Soil testing has demonstrated good overall quality of irrigated soils in the Tongue River basin. Key results are summarized below:

- **Crop Yields:** AMPP fields represent a wide variety of cropping systems including alfalfa, grass, hay & malt barley, wheat, sugar beets, and corn. Forage yields (grass, alfalfa, and alfalfa/grass) ranged from 1 to 6.5 tons/acre. Yields were comparable to average yields from Custer, Rosebud, and Big Horn Counties in 2003 through 2007. Variations in crop yields observed between AMPP fields were not correlated to differences in salinity and/or sodium levels, primary constituents of concern in water produced by CBNG operations. Other factors, especially crop and irrigation management as well as climatic factors, more strongly affected yields. Forage sodium contents are at or below 2003 levels. No trend exists in plant sodium content and proximity to CBNG water discharge points or field location in the river basin. However, sodium content varies greatly between plant species with barley containing the highest while corn has the lowest.
- **Irrigated Soil Properties:** At the outset of AMPP, there were concerns that Tongue River soils are high in clay and contain a preponderance of swelling clays. Irrigated soils with abundant swelling clays are known to be more susceptible to adverse effects of sodium in irrigation water. AMPP results showed that Tongue River soils are low in clay and contain mostly non-swelling clays. Therefore, irrigated Tongue River soils are **not** highly susceptible to damage by excessive sodium levels.
- **Salinity and Sodium Status of Soils:** Soils monitored in AMPP were non-saline and non-sodic to a depth of 3 feet according to criteria developed by the USDA-ARS George E. Brown, Jr. Salinity Laboratory in Riverside, California.
- **Trends in Irrigation Water Quality:** Irrigation water quality for 2003 through 2007 met the numerical standards adopted for EC and SAR throughout the entire irrigated reach of the Tongue River from the Wyoming Stateline to the T&Y Diversion. Small seasonal and yearly changes in EC and SAR were related to variations in flow, with higher levels occurring during low flow and drought years. These variations in stream chemistry were observed in the hydrologic record prior to CBNG development and are naturally-occurring. The average annual flows for the Tongue River at the State Line in Water Years 2000 through 2006 were all below normal, with four of these years among the five driest in 46 years of record.
- **Documented Changes in Soil Properties:** There were no statistically significant changes in pH, EC, or SAR through time in the AMPP soils. ESP levels showed a statistically significant decrease from Fall 2004 to Fall 2005, which may have been due to a greater quantity of rainfall and available irrigation water in 2005 than in previous years. ESP has increased slightly since Fall 2005. However, as of Fall 2007, ESP is below the Fall 2003 (initial) sampling levels.

For the full 2007 TRIP report (including the AMPP report and the hydrology report), please visit the MBOGC website:

<http://boqc.dnrc.state.mt.us/CoalBedMeth.asp>

*Authors: William M. Schafer, Ph.D., Neal Fehring, CPAg, Kevin Harvey CPSSc, & Thomas J. Osborne, P.H.*