



science for a changing world

Expanded Monitoring Program

Near Deer Trail, Colorado

Program Overview

Metro Wastewater Reclamation District (Metro District) applies biosolids to their properties near Deer Trail, Colorado. These biosolids applications could affect the quality of water in alluvial and bedrock aquifers, streambed sediment, soil, dust, and crops.

Water quality can be directly affected through:

- Contaminated recharge water, or
- Infiltration of water through contaminated soils or sediments (remobilization).

Water quality can be indirectly affected through:

- Tilling that mobilizes or changes subsurface chemical constituents, or
- Contributions to natural processes such as nitrification.

Contaminated ground water or surface water could contaminate:

- Other aquifers, such as bedrock water-supply aquifers or alluvial aquifers,
- Other surface-water bodies (ponds or streams), or
- Streambed sediments.

Biosolids must meet regulatory standards, and the biosolids chemical data need to be accurate or else agronomic loading rates will be incorrect and soils could be overloaded. Soil quality could either be improved by biosolids applications through increased nutrients and organic matter, or degraded through excessive nutrients or metals.

The U.S. Geological Survey (USGS) has a monitoring program to address concerns from a stakeholder group about the biosolids and the quality of the environment in the vicinity of the biosolids-application areas. The USGS monitoring program near Deer Trail is referred to as the "USGS Expanded Monitoring Program" and began in January 1999. The first phase of monitoring ended in 2003. All data and interpretive reports from the 1999-2003 monitoring period were published by January 2005 and are available to the public. An interim monitoring period (2004 through mid-2005) continued the monitoring while reports were completed, results were presented, and a new phase of the monitoring program was negotiated for 2005-2011.



USGS
The U.S. Geological Survey is a science organization that provides the Nation with reliable, impartial information to describe and understand the Earth. The national USGS home page: <http://www.usgs.gov>

This USGS Program:

The Internet address for this program, including links for data and reports, is:

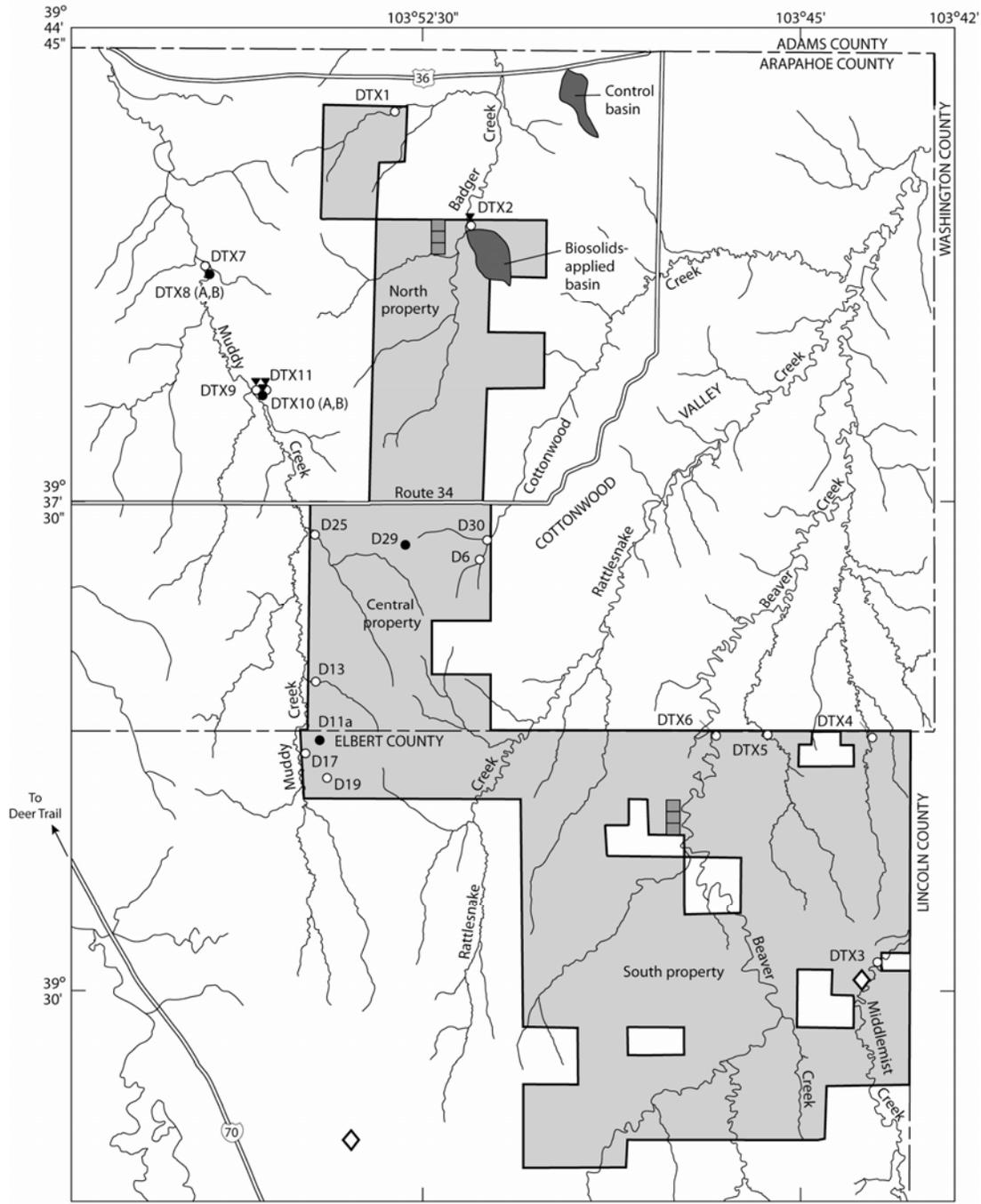
<http://co.water.usgs.gov/projects/CO406/CO406.html>

The address for just the continuous-recorder data is:

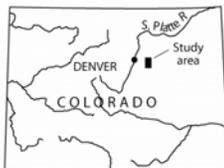
<http://co.water.usgs.gov/projects/CO406/data.html>

or

<http://water.usgs.gov/co/nwis>



Base from U.S. Geological Survey 1:50,000 quadrangles, Elbert County and Arapahoe County



EXPLANATION

- Metro Wastewater Reclamation District property
- DTX1 USGS alluvial-aquifer monitoring well and identifier
- D29 USGS bedrock-aquifer monitoring well and identifier
- DTX2 Monitoring well with continuous recorder and identifier
- Dust-sampling location
- Streambed-sediment sampling area
- Soil-sampling area

Location of study area and U.S. Geological Survey monitoring sites near Deer Trail, Colorado, 2005-2010. (Metro Wastewater Reclamation District property boundaries shown are from 1999.)

Continued from page 1

Each USGS monitoring program builds on the previous monitoring program. Results from the previous monitoring program are used to determine priorities for the next phase of study. The USGS Expanded Monitoring Program is distinct from, but builds on, another USGS program that monitored shallow ground-water quality on the Metro District central property from 1993–98. The newer program (1999–2011) considers environmental-quality issues for shallow and deep ground water, surface water (streambed sediment), biosolids, soil, and crops. The expanded monitoring program includes all three Metro District properties (north, central, and south) and related private-property locations. Both programs, however, are supported by the Metro District and USGS. The first phase of the newer monitoring program also was supported by the North Kiowa Bijou Groundwater Management District in 1999. Both programs are designed, carried out, and interpreted independently by the USGS, and quality-assured USGS data and reports will be released to the public and the Metro District at the same time. By definition and design, all USGS monitoring programs are independent and unbiased.

The objectives of the USGS Expanded Monitoring Program are to:

- (1) Evaluate the combined effects of biosolids applications, land use, and natural processes on alluvial aquifers, the bedrock aquifer, streambed sediment, soil, dust, and crops by comparing chemical data to
 - State or Federal regulatory limits,
 - Data from a site where biosolids are not applied (a control site), or
 - Earlier data from the same site (trends).
- (2) Monitor biosolids for chemistry, and compare the concentrations with regulatory limits.
- (3) Determine the aquifer hydrology in this area.
- (4) Develop a biosolids signature for water and soil.

The approach is unique for each component of the monitoring program. However, appropriate USGS methods and technologies will be applied to each component.

Progress reports such as this one were prepared quarterly for the first 2.5 years of the program and now are prepared approximately once each year and distributed to the stakeholders and other concerned people, as well as available to the general public on the Internet (<http://co.water.usgs.gov>). Each progress report summarizes progress from the previous period and plans for the current period; chemical data are included when available. USGS reports will document all methods and data for the monitoring program. A comprehensive USGS report is planned for completion after 2010 that includes complete statistical analyses and interpretations. In addition, the USGS will meet with the stakeholders once a year to discuss the USGS Expanded Monitoring Program results and to consider possible changes to the Expanded Monitoring Program.

Progress Last Period (July 2005--December 2006)

The annual stakeholder meetings were held September 28, 2005, and September 14, 2006, at the Metro District shop building near Deer Trail, Colo. The USGS also participated in multi-agency discussions about organic wastewater compounds (emerging contaminants) during this period. A poster about the USGS work on organic wastewater compounds in biosolids was prepared and presented at the South Platte Forum in Loveland, Colo., October 26–27, 2005. A presentation about the USGS work on organic wastewater compounds in biosolids was prepared and presented at the Rocky Mountain Water Environment Association workshop in Aurora, Colo., November 17, 2005. The USGS also made presentations to the Deer Trail Conservation District (January 18, 2006), the Metro District (October 18, 2006), and the Agate Conservation District (November 27, 2006).

Plans for the Current Period (January--December 2007)

An annual stakeholder meeting will be planned, likely for sometime in the fall. The USGS will provide updates on progress and findings at this meeting. A USGS data report will be prepared for the 2004 through 2006 data. The USGS plans to continue research on organic wastewater compounds (emerging contaminants) in biosolids and to participate in multi-agency discussions about this topic. Presentations are planned for the Colorado Wastewater Utilities Council on May 9, 2007, and the American Water Resources Association summer conference on June 26, 2007.

Questions & Answers

Q: What is the status of USGS reports for the study area near Deer Trail?

A: Four data reports (1999-2003 data) are published and available. An interpretive report about the effects of biosolids on soil, crops, ground water, and streambed sediment (1999-2003) is published and available. Also published and available is an interpretive hydrogeology report that includes the structure maps done as part of the bedrock ground-water monitoring component. Visit the website (see page 1) or contact Tracy Yager at the USGS to obtain copies. A USGS report for the 2004 through 2006 data will be prepared this year. An interpretive water-quality report for 1993–99 has been written and is in preparation for further review.

Q: Is the USGS still monitoring near Deer Trail?

A: Yes, the USGS began a new phase of the monitoring program in May 2005 in cooperation with the Metro District. Monitoring is scheduled for 2005 through 2010. An interpretive report will be prepared in 2011.

Q: What was the reporting period of the previous USGS Progress Report for this program?

A: The previous USGS Progress Report was for July 2004--June 2005 and was released in November 2005.



Ground Water

Approach

Five USGS monitoring wells installed near the Metro District property boundaries in some of the major alluvial aquifers are sampled approximately quarterly for full inorganic chemistry. These wells also were sampled in 2005 for organic wastewater compounds. One of these wells (D6) and three upgradient wells were sampled in 2005 for nitrogen isotopes. Possible nitrogen source materials such as biosolids, soil, and rock, also were analyzed in 2005 for nitrogen isotopes. Additional USGS monitoring wells in the study area also will be sampled each year when streambed-sediment samples are not available. Two USGS monitoring wells installed downgradient from the Metro District property in the bedrock aquifer are sampled annually for full inorganic chemistry. Depth to water is measured approximately monthly at about 20 of the USGS monitoring wells. At two sites, depth to ground water, precipitation, and other related parameters are recorded hourly. Chemical data will be reviewed and statistically tested for exceedance of regulatory limits and for trends. Data also will be evaluated for a possible biosolids signature and for ground-water hydrology.

Progress Last Period (July 2005--December 2006)

Depth to ground water was measured monthly, except for December 2006. Ground water was sampled for chemistry quarterly. Ground-water data were compiled and reviewed. The continuous-recorder instrumentation was calibrated each year. Flood debris had to be removed from around wells on the Metro District central and south properties after summer 2006 storms (see photograph above).

Plans for the Current Period (January--December 2007)

Depth to ground water will be measured approximately monthly. Ground water at selected sites will be sampled and analyzed quarterly. Data will be compiled and reviewed.

USGS ground-water data for samples collected July 2005 through December 2006

[Data are preliminary and subject to revision. Standards from Colorado Department of Public Health and Environment, 1997, Basic standards for ground water, 5CCR 1002-41: July 14, 1997, 56 p. All data from filtered samples; mg/L, milligrams per liter; µg/L, micrograms per liter; <, less than; E, value estimated by laboratory]

Well	Sample date	Nitrate + nitrite as nitrogen, mg/L	Arsenic, µg/L	Cadmium, µg/L	Chromium, µg/L	Copper, µg/L	Lead, µg/L	Mercury, µg/L	Molybdenum, µg/L	Nickel, µg/L	Selenium, µg/L	Zinc, µg/L
DTX1	07/05/2005	1.17	2.3	0.14	1.0	5.9	<0.16	<0.01	6.4	27.1	15.0	5.5
DTX1	11/08/2005	1.47	1.7	.14	.11	9.8	<.16	<.01	6.0	31.8	5.2	5.7
DTX1	01/05/2006	1.62	1.9	.15	.07	7.0	<.16	<.01	5.5	28.2	3.0	6.0
DTX1	04/05/2006	2.24	1.6	.16	.34	6.5	<.16	<.01	5.1	42.7	2.2	3.9
DTX1	06/26/2006	2.59	1.7	.17	.04	.68	E.04	<.01	4.6	48.3	4.0	7.9
DTX1	11/14/2006	2.84	1.4	.20	<.24	E.58	<.24	<.01	4.9	18.1	2.0	<1.2
DTX2	07/05/2005	<.04	1.4	.08	.05	5.6	<.16	<.01	1.8	13.8	.14	6.6
DTX2	11/08/2005	<.04	.82	E.04	E.02	9.9	<.16	<.01	1.6	36.4	.12	5.0
DTX2	01/05/2006	<.04	.96	E.05	.11	11.7	<.16	<.01	1.7	17.3	.14	7.3
DTX2	04/05/2006	E.03	.63	E.04	.32	6.8	<.16	<.01	1.7	31.3	E.14	5.4
DTX2	06/27/2006	<.04	.30	E.05	E.02	<.40	<.16	<.01	1.7	33.2	.08	8.3
DTX2	11/14/2006	<.04	.46	E.04	<.24	.91	E.14	<.01	1.6	4.7	E.14	<1.8
DTX5	11/07/2005	.48	.14	E.04	E.02	4.8	<.16	<.01	1.1	35.6	.17	3.5
DTX6	11/07/2005	1.03	.18	<.08	E.03	10.0	<.16	<.01	E.8	13.7	4.2	5.1
DTX8A	07/07/2005	<.04	.20	<.04	<.8	1.7	E.07	<.01	.6	4.18	.41	2.6
DTX8A	06/27/2006	<.04	E.10	<.04	.25	3.5	<.08	<.01	.7	6.50	<.08	3.3
DTX10A	07/08/2005	<.04	.51	<.08	<.8	4.7	<.16	<.01	1.2	19.8	1.8	3.0
DTX10A	06/26/2006	<.04	E.07	<.08	.26	<.8	<.16	<.01	1.3	.89	<.16	6.6
D6	07/06/2005	31.5	1.3	<.28	<1.6	44.6	<.56	<.01	3.6	17.9	57.2	32.4
D6	11/08/2005	32.3	1.1	<.28	<.12	48.6	<.56	<.01	3.5	25.0	51.5	34.7
D6	01/04/2006	32.3	1.4	<.32	.18	34.7	<.64	<.01	3.5	23.2	42.8	35.1
D6	04/04/2006	33.6	E1.0	E.14	<.40	37.5	<.56	<.01	4.2	8.8	48.7	28.7
D6	06/28/2006	35.4	.18	<.28	<.04	.41	<.56	<.01	3.6	42.1	45.1	<6.0
D6	11/15/2006	38.1	.96	E.16	<.96	E2.9	<.96	<.01	3.3	7.1	50.2	<4.8
D17	07/06/2005	.89	1.8	E.02	<.8	E.34	<.08	<.01	5.5	2.00	8.0	E.3
D17	11/08/2005	.77	1.5	E.02	<.04	.69	<.08	<.01	6.2	3.56	6.6	<.6
D17	01/04/2006	.80	1.3	E.02	.08	1.0	<.08	<.01	5.6	1.91	6.2	E.4
D17	04/04/2006	.79	1.4	<.04	.06	.62	<.08	<.01	5.5	2.77	6.2	<.6
D17	06/27/2006	.79	1.4	<.04	E.02	.68	<.08	<.01	5.8	2.33	7.1	E.3
D17	11/15/2006	.75	1.5	E.03	<.12	<.4	<.12	<.01	5.7	.62	<.08	<.6
D25	07/05/2005	1.48	2.8	.21	.15	6.8	<.16	<.01	8.6	19.2	6.0	5.8
D25	11/09/2005	<.04	1.3	.17	E.02	10.7	<.16	<.01	7.3	28.1	.25	5.6
D25	01/04/2006	<.04	1.5	.20	.09	11.8	<.16	<.01	7.2	21.8	.20	6.4
D25	04/05/2006	E.02	1.1	.18	.29	7.6	<.16	<.01	6.8	36.3	.24	4.4
D25	06/27/2006	.33	1.3	<.08	.06	.66	<.08	<.01	7.1	4.2	.74	1.4
D25	11/14/2006	.66	1.5	<.08	<.24	E.48	<.24	<.01	7.7	4.0	2.0	1.3
Human Health or Drinking Water Standard		10	50	5	100	1,000	50	2	None	100	50	5,000
Agricultural Standard		100	100	10	100	200	100	10	None	200	20	2,000

Surface Water (Streambed Sediment)



Approach

Surface-water contamination is a concern for the stakeholders, but streams flow off the Metro District properties only during runoff when surface-water sampling is impractical. Therefore, possible surface-water contamination from metals is evaluated by sampling streambed sediments soon after storms. Two small drainage basins were selected for similar characteristics but different land use—one drainage basin in a biosolids-application field and another drainage basin in a farmed field (not on the Metro District properties) that does not receive biosolids. A downstream part of each of the two drainage basins will be sampled after the same storms once each year (if samples can be collected) for inorganic constituents (including metals, total nitrogen, and total phosphorous) and organic carbon. Data will be reviewed and statistically tested to determine if concentrations are significantly different between the two drainage basins.

Progress Last Period (July 2005--December 2006)

The site was carefully monitored for runoff-producing rainfall. Runoff in the monitoring locations (see page 2) was not sufficient to enable streambed-sediment sampling during this period. However, substantial runoff in the central and south parts of the study area caused flooding and road damage during the summer of 2006.

Plans for the Current Period (January--December 2007)

The site will be monitored for runoff-producing rainfall. Sampling may take place, depending on the weather.

Biosolids

Approach

Biosolids samples are collected as one- to two-day composites from the centrifuges at the Metro District plant and analyzed for trace elements through the USGS. The material is placed in one-gallon plastic or glass bottles and transported to the USGS in Denver. There, the samples are air-dried then ground to less than 150 micrometers. Biosolids are sampled and analyzed at least monthly. Data will be reviewed and compared to Federal and State regulatory limits.

Progress Last Period (July 2005--December 2006)

Biosolids samples were collected each month. Each sample was a 24-hour composite from the centrifuges at the Metro District facility. Chemical analyses were completed and compiled for all biosolids samples collected through December 2006. Biosolids and other manure samples were collected in 2005 and leached with pure water, then the leachates were filtered and analyzed for organic wastewater compounds. Selected biosolids samples were submitted for organic wastewater compound analyses.

Plans for the Current Period (January--December 2007)

The 2007 biosolids samples will be collected and submitted for inorganic chemical analysis. The selected 2006 biosolids samples will be analyzed for organic wastewater compounds.

USGS biosolids data for samples collected January 2005 through December 2006

[Data are preliminary and subject to revision. Table 1 and Table 3 standards from Colorado Department of Public Health and Environment, 1993, Biosolids regulation, 5CCR 1002-64: April 14, 2003; ppm, parts per million; %, percent]

Sample Date	Arsenic ppm	Cadmium, ppm	Copper, ppm	Mercury, ppm	Molybdenum, ppm	Nickel, ppm	Lead, ppm	Selenium, ppm	Sulphur, %	Zinc, ppm
January 2005	1.4	2.1	633	1.1	28.6	23.9	49.8	8.2	1.38	772
February 2005	1.4	2.1	563	1.0	24.8	20.3	48.1	7.6	1.46	675
March 2005	1.5	2.0	577	1.1	25.2	20.5	49.5	8.2	1.35	673
April 2005	1.4	1.7	553	1.0	25.4	17.9	42.4	8.2	1.49	656
May 2005	1.5	1.7	600	0.85	22.4	19.9	43.2	9.4	1.55	679
June 2005	1.6	1.6	606	2.3	22.4	19.8	45.6	10	1.42	664
July 2005	2.4	2.1	622	1.3	25.4	20.6	56.2	11	1.73	811
August 2005	2.4	2.0	643	2.4	31.1	23.4	49.3	10	1.74	794
September 2005	2.4	2.0	633	1.4	33.6	19.7	44.3	9.5	1.74	803
October 2005	2.3	2.0	632	1.3	35.7	19.7	44.1	9.6	1.62	750
November 2005	2	2.0	621	1.4	34.0	18.5	48.4	9.4	1.64	772
December 2005	1.9	1.8	566	0.87	24.3	16.7	41.4	7.9	1.51	702
January 2006	1.6	1.7	653	0.81	25.4	19.3	45	8.0	1.47	684
February 2006	1.5	1.8	708	1.1	22.7	18.8	44	8.2	1.41	696
March 2006	1.7	1.8	709	0.81	21.9	18.5	47	6.9	1.45	716
April 2006	1.4	1.8	784	0.90	23.9	20.4	52	7.4	1.44	794
May 2006	1.9	1.8	845	5.2	32.2	22.1	47	8.8	1.54	819
June 2006	2.1	1.7	815	1.1	44.1	23.4	52	9.1	1.59	831
July 2006	1.9	1.8	661	0.79	40.7	21.1	52	10	1.59	769
August 2006	1.8	1.4	554	0.91	28.6	21.4	72	7.4	1.34	609
September 2006	2.0	1.8	641	0.83	35.1	19.6	51	10	1.72	728
October 2006	1.9	1.8	670	0.96	30.0	21.0	51	11	1.65	787
November 2006	1.9	1.9	681	0.81	26.4	22.2	52	9.6	1.57	750
December 2006	1.5	1.7	617	0.66	22.1	17.3	46	9.4	1.49	690
Table 3 Standard	41	39	1,500	17	75 (Table 1 Standard)	420	300	100	None	2,800

USGS plutonium data for biosolids samples collected February 2004 through January 2006

[Data are preliminary and subject to revision; Ci/g, picouries per gram; +/-, plus or minus the analytical uncertainty; analytical uncertainty is the 1-sigma total combined standard uncertainty provided by the laboratory]

Sample Date	Plutonium 238, pCi/g	Plutonium 238, minimum detectable concentration, pCi/g	Plutonium 239+240, pCi/g	Plutonium 239+240, minimum detectable concentration, pCi/g
February 2004	0.017 +/- 0.017	0.10	-0.0042 +/- 0.0085	0.10
August 2004	0.004 +/- 0.014	0.10	0 +/- 0.0070	0.10
February 2005	0.004 +/- 0.012	0.10	0 +/- 0.0040	0.10
January 2006	0.016 +/- 0.012	0.10	0 +/- 0.0080	0.10

Soil

Approach

One site was selected for characterizing and monitoring the chemical composition of soil on the Metro District property in Arapahoe County, and one site was selected on the Metro District property in Elbert County. Each site consists of three 20-acre (933 feet by 933 feet) fields separated by 100-foot buffer zones. The center 20-acre field at each site receives biosolids applications. The other two 20-acre fields at each site will not have biosolids applied and will be used as “control” fields to monitor the natural variability of soil composition for the duration of the study. All three 20-acre fields at each site will be farmed in the normal fashion and have crops planted and harvested. Soils from each of the six fields will be sampled in 2010. Samples will be analyzed for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. Data will be examined to determine if concentrations have changed with time.

Progress Last Period (July 2005--December 2006)

No soil samples were collected by the USGS during this period.

Plans for the Current Period (January--December 2007)

No soil samples will be collected by the USGS during this period, but the sampling fields should be maintained as described in the approach.

Crops



Approach

Crops from each of the six 20-acre soil-monitoring fields will be chemically analyzed after harvest. Analyses will include arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc.

Progress Last Period (July 2005--December 2006)

Wheat was harvested from the Arapahoe County fields and only biosolids-applied fields in Elbert County in early summer 2006. The USGS received samples of harvested wheat grain in July 2006 and harvested corn grain (from a biosolids-applied field) in October 2006. The wheat samples were processed and analyzed.

Plans for the Current Period (January--December 2007)

The corn sample will be analyzed.

USGS data for harvested wheat-grain samples collected summer 2006

[Data are preliminary and subject to revision; reported as dry weight basis; %, percent; ppm, parts per million; <, less than]

Sample description	Arsenic, ppm	Cad- mium, ppm	Cop- per, ppm	Lead, ppm	Mercury, ppm	Molyb- denum, ppm	Nickel, ppm	Selen- ium, ppm	Sul- phur, %	Zinc, ppm
Arapahoe County, north control field	<0.05	0.001	0.12	<0.008	<0.03	0.017	0.02	0.83	0.21	0.44
Arapahoe County, biosolids-applied field	<0.05	0.001	0.07	<0.008	<0.03	0.021	0.02	0.80	0.22	0.51
Arapahoe County, south control field	<0.05	0.001	0.05	<0.008	<0.03	0.017	0.02	0.93	0.20	0.44
Elbert County, biosolids-applied field	0.05	0.001	0.05	<0.008	<0.03	0.033	0.05	0.28	0.22	1.06



Dust

Approach

A monitoring component for dust was added to the program in 2006 because dust quantities and contamination from biosolids-applied farmland are concerns for some stakeholders. The USGS met with selected stakeholders on January 13, 2006, to evaluate dust-sampling sites. Two farmed fields were selected for similar characteristics—one field in a biosolids-applied area and another farmed field (not on the Metro District properties) upwind that does not receive biosolids. Dust traps were installed adjacent to each field. The dust traps at both fields will be sampled at the same time for dust quantity and inorganic constituents. Dust samples will be collected approximately monthly during late winter through spring (the reported windiest time of the year) for two consecutive years.

Progress Last Period (July 2005--December 2006)

The dust traps were installed at both fields on February 3, 2006. Dust samples were collected in February, March, April, and May 2006. Samples were analyzed for dust quantity and various inorganic constituents.

Plans for the Current Period (January--December 2007)

Dust samples will be collected and analyzed for dust quantity and various inorganic constituents.

Definitions

Analytical uncertainty—The possible range of the true value or error term contributed by bias and variability of the laboratory measurement technique. All laboratory data have associated uncertainty. Each sample value should be thought of as a range in concentration defined by the reported value plus or minus the analytical uncertainty. The true concentration usually is somewhere in this range, but is not a precisely known point. For most analyses, the analytical uncertainty is not calculated for each sample but is estimated from bias and variability data derived from analyses of quality-assurance samples like blanks and replicates. For plutonium data, the analytical uncertainty is calculated individually for each sample for each analyte based on analytical and statistical variables.

Biosolids—Solid organic matter recovered from a sewage-treatment process that meets regulatory criteria for beneficial use, such as for fertilizer. Metro District applies Table 3, Class B biosolids near Deer Trail. Regulations require that land-applied biosolids must meet or exceed Table 1, Class B requirements. Table 3 Ceiling Concentration Limits are stricter than Table 1 Ceiling Concentration Limits.

Less than (<)—A designation for analytical results to indicate that a constituent was not present or was present at very low levels that the laboratory could not reliably determine. Note that the actual amount of this constituent in that sample is unknown and could be any amount between zero and the “less than” value.

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Organic wastewater compounds—Chemicals that are used every day in homes, industry, and agriculture that may be found in small concentrations in biosolids, in water released from wastewater treatment plants, or in other water impacted by humans. These chemicals include detergents, disinfectants, fragrances, fire retardants, pharmaceuticals, hormones, and pesticides.

Picocurie (pCi)—A unit of measurement of radioactivity. One curie is defined as the amount of a radionuclide in which the decay rate is 37 billion (37,000,000,000) disintegrations per second. One picocurie is one trillionth (1/1,000,000,000,000) of a curie.

Runoff—The water from precipitation that flows over the land surface into valleys instead of infiltrating into the soil. Runoff can wash particles of soil, rock, plants, and biosolids from the land surface into the streambeds of the valleys.

Stakeholder—Any person or group (including the Metro District) interested or concerned about the Expanded Monitoring Program.

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Elbert County Environmental Health Officer: 303-621-3144
(*email*: elconurse@bewellnet.com)
State Biosolids Contact: Wes Carr, 303-692-3613
U.S. Environmental Protection Agency: Bob Brobst, 303-312-6129

***Eighth annual
stakeholder meeting
was held September 14, 2006,
at the Metro Wastewater
Reclamation District property
near Deer Trail, Colorado***

*Prepared by Tracy Yager, Dave Smith,
and Jim Crock (USGS), in cooperation
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