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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 sediments, soils, and crops. Water quality can be directly affected through:

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

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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:

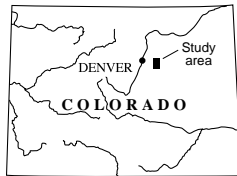
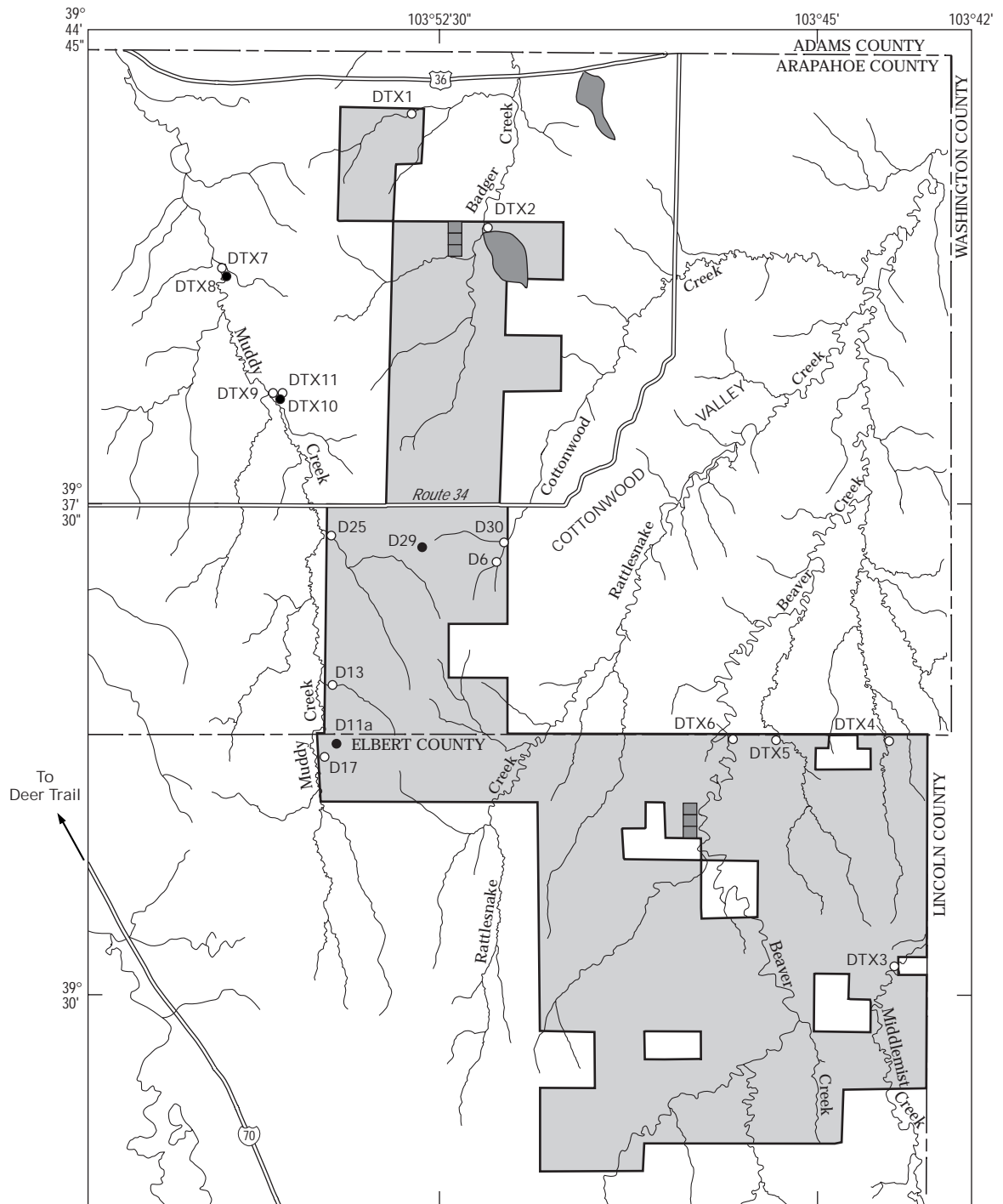
Internet address for precipitation data at wells DTX2, D25, DTX5 (South Platte River basin):

http://co.water.usgs.gov/rt-cgi/gen_tbl_pg_mt OR <http://nwis-colo.cr.usgs.gov/>

Internet address for quarterly reports:
<http://co.water.usgs.gov/projects>



USGS collected entire wheat plants for crop analysis at the USGS soil plots in Elbert County on June 7, 2000.



- EXPLANATION**
- Metro Wastewater Reclamation District property
 - USGS alluvial monitoring well
 - USGS bedrock monitoring well
 - Streambed-sediment sampling area
 - Soil-sampling area

USGS Expanded Monitoring Program sites and Metro District's biosolids-application properties near Deer Trail, Colorado

Program Overview

Continued from page 1

Water quality can be indirectly affected through:

- Plowing 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 metals and radioactivity regulations, 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 designed and begun a new 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 new USGS monitoring program near Deer Trail is referred to as the "USGS Expanded Monitoring Program" and began in January 1999.

This monitoring program is distinct from, but builds on, another

USGS program that monitored shallow ground-water quality on the Metro District Central Farm from 1993-1998. The new program (1999-2005) considers environmental-quality issues for shallow and deep ground water, surface water (bed sediments), soils, crops, and the biosolids. The new expanded monitoring program includes all three Metro District properties (North, Central, and South Farms) and related private-property locations. Both programs, however, use USGS and Metro District funds. In addition, the new monitoring program also uses funds from the North Kiowa Bijou Ground Water Management District. Both programs are designed, carried out, and interpreted independently by 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 new 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 sediments, soils, 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 metals and radioactivity, and compare the concentrations with regulatory limits.
(3) Determine the aquifer hydrology in this area.

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

Quarterly reports such as this one will be distributed to the stakeholders and other concerned people, as well as available to the general public on the internet (<http://webserver.cr.usgs.gov>).

Each quarterly report will summarize progress from the previous quarter and plans for the current quarter; chemical data will be included every other quarter. A USGS report will be prepared annually and made available after each year of the monitoring program: the reports will include data for that year, any interpretations for that year, and statistical analysis for the data to date. A comprehensive USGS report will be prepared and available after five years of monitoring that includes complete statistical analyses and interpretations. In addition, the USGS will meet with the stakeholders once a year to discuss the Expanded Monitoring Program results and to consider possible changes to the Expanded Monitoring Program.

Questions & Answers

Q: Why is there no information about the USGS work at the Lowry Landfill Superfund Site in this report?

A: The work described in this report is only for the USGS Expanded Monitoring Program near Deer Trail, Colorado. The USGS work at the Lowry Landfill Superfund Site is a separate USGS project with separate objectives and separate funding. Although both projects had the same USGS project manager (Tracy Yager) during October 1999-February 2000, the USGS Lowry project is now managed by Cecil Slaughter. You may contact Cecil for more information about the USGS Lowry project by telephoning 303-236-4882, ext. 244 (*email: cslaught@usgs.gov*).

Q: Why are negative activity concentrations reported for the radionuclide data?

A: Radionuclide data are produced from instruments that detect radioactive decay (disintegrations) in a sample as counts per minute. Negative activity concentrations mean the sample counts were less than the laboratory background counts that day, so activity concentrations are negligible. Background counts are subtracted from the sample counts, then the resulting value is converted to activity-concentration units of picocuries per liter.

Alluvial Ground Water

Approach

Six new monitoring wells were installed near the Metro District property boundaries in the major alluvial aquifers. These six wells plus five existing USGS monitoring wells will be sampled approximately quarterly for full inorganic chemistry and annually for radioactivity. Data will be reviewed and statistically tested for exceedance of regulations and for trends.

Progress Last Quarter (April -June 2000)

Ground-water levels were measured April 5, May 8, and June 2, 2000. Ground water was sampled for chemistry April 10-17, 2000. Rain gages at the DCP sites were checked and calibrated. Pressure transducers and rain gages were installed at the recharge-evaluation site on the Weisensee ranch (wells DTX9, DTX10, DTX11). A meeting was held in Kiowa, Colo. May 4, 2000, with the stakeholders to discuss USGS radionuclide data for this program. Ground-water data were compiled and reviewed. Work on the annual report continued.

Plans for the Current Quarter (July-September 2000)

Ground-water levels will be measured the first week of each month. Ground water will be sampled in early July, weather permitting. All data obtained from the program to date will be compiled, reviewed, and evaluated. The first annual report will be completed. USGS will meet with stakeholders

September 21 to discuss the program.

Bedrock Ground Water

Approach

A structure map of the base of the bedrock aquifer was compiled and used to determine locations for two sets of new, paired wells (one alluvial well and one nearby dual-completion bedrock well comprise each pair). The well pairs were installed where both the Muddy Creek alluvial aquifer and the Laramie-Fox Hills aquifer are present (along the margin of the bedrock aquifer) near the Metro District properties. Water-level data from each well pair will be used to determine aquifer hydrology and interaction at those two loca-

tions. The two new bedrock wells (DTX8, DTX10), along with an existing USGS bedrock well (D29), will be sampled approximately quarterly for full inorganic chemistry and annually for radioactivity. Data will be reviewed and statistically tested for exceedance of regulations and trends.

Progress Last Quarter (April-June 2000)

Ground-water levels were measured April 5, May 8, and June 2, 2000. Ground water was sampled for chemistry April 10-17, 2000. Pressure transducers and rain gages were installed at the recharge-evaluation site on the Weisensee Ranch (wells DTX9, DTX10,

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An "equipment blank" sample is prepared at the USGS preparatory lab in Denver after ground-water sampling at Deer Trail by using the large submersible pump and all the equipment routinely used at the field site. This blank does not represent wind-born contamination at the field site.

Bedrock Ground Water

Continued from page 4

DTX11). A meeting was held in Kiowa, Colo. May 4, 2000, with the stakeholders to discuss USGS radi-nuclide data for this program. Ground-water data were compiled and reviewed.



The water used for “blank” ground-water samples is certified, ultra-pure bottled water from the USGS Ocala, Fla., lab. Each bottle is rinsed and bagged before using.

Plans for the Current Quarter (July-September 2000)

Ground-water levels will be measured the first week of each month. Ground water will be sampled in early July, weather permitting. All data obtained from the program to date will be compiled, reviewed, and evaluated. The first annual report will be completed. USGS will meet with stakeholders September 21 to discuss the program.



After each field use, the submersible ground-water sampling pump is taken apart, cleaned, and serviced at the USGS preparatory lab in Denver. This work is done in Denver instead of at the field site to facilitate access to supplies and to increase the efficiency of sampling.



“Blank” ground-water samples are prepared by the same people that take the regular ground-water samples using the same equipment. “Field blanks” are prepared in the field; “equipment blanks” are prepared at the USGS preparatory lab in Denver.

Surface-Water Sediments

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 will

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Surface-Water Sediments

Continued from page 5

be evaluated by sampling streambed sediments soon after storms. Two small drainage basins were selected for similar characteristics but different land use—one drainage in a biosolids-application field and another drainage in a farmed field (not on the Metro District properties) that does not receive biosolids. A downstream location in each of the two drainage basins will be sampled after the same storms, three to four times per year for inorganic constituents (including metals, total nitrogen, and total phosphorous) and organic carbon, and one time per year for radioactive constituents. Data will be reviewed and statistically tested to determine if concentrations are significantly different between the two drainage basins.

Progress Last Quarter (April–June 2000)

The site was carefully monitored for runoff-producing rainfall. Despite substantial rainfall on May 8, 2000, runoff did not occur in the biosolids basin, so no samples were collected.

Plans for Current Quarter (July–September 2000)

The site will be monitored for runoff-producing rainfall. Sampling may take place, depending on the weather. All data obtained from the program to date will be compiled, reviewed, and evaluated. The first annual report will be completed. USGS will meet with stakeholders September 21 to discuss the program.

Biosolids

Approach

Biosolids samples will be taken as a 24-hour composite from the Metro District plant and analyzed by USGS. Biosolids will be sampled and analyzed once each quarter during most of the program, and once each month for six months when the Lowry Landfill Superfund Site water transfer begins. Data will be reviewed and compared to Federal regulatory limits.

Progress Last Quarter (April–June 2000)

The quarterly composite sample of biosolids was received from the Metro District on June 21, 2000. The sample was a 24-hour composite from the conveyor belt at the Metro facility. The material was placed in two acid-washed, one-gallon plastic bottles and transport-

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Metro District had a camera crew tape parts of the USGS monitoring program in the field and at USGS laboratory facilities on April 13, 2000. The videotape includes an overview of the monitoring program by Tracy Yager and actual footage of the ground-water sampling.

Biosolids

Continued from page 6

ed to the USGS in Denver. There the sample was air-dried and then ground to particles smaller than 150 micrometers. Chemical analyses were completed on the March 2000 biosolids sample. The biosolids data were compiled and reviewed.

Plans for Current Quarter (July–September 2000)

The June biosolids sample will be submitted to the USGS laboratories for chemical analysis. A quarterly sample of biosolids material will be collected, dried, and prepared for analysis. All data obtained from the program to date will be compiled, reviewed, and evaluated. The first annual report will be completed. USGS will meet



Each capsule filter is preconditioned for ground-water sampling in the USGS preparatory lab and used only once (only one filter per site). Samples are filtered in preparation for analysis of dissolved constituents.

with stakeholders September 21 to discuss the program.

Soils

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 will have biosolids applied after the initial soil sampling. 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 before biosolids are applied to the two center fields and then again after each harvest. Samples will be analyzed for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and beta activity. Data will be examined after 5 years to determine if concentration has changed with time.

Progress Last Quarter (April–June 2000)

Chemical analyses were compiled and reviewed for soil samples collected in August 1999.

Plans for Current Quarter (July–September 2000)

After harvest, the soil will be sampled from the Arapahoe and Elbert county monitoring sites. The first annual report will be completed. USGS will meet with stakehold-

ers September 21 to discuss the program.

Crops

Approach

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

Progress Last Quarter (April–June 2000)

USGS sampled entire wheat plants from the soil-monitoring sites June 7, 2000. All three fields of the Elbert County site had crops growing and were sampled. The Arapahoe County site had recently been disked and was sampled, but had few wheat plants growing. Sampling was done at random sites by collecting the entire wheat plant from about three inches above the ground surface throughout each field. The samples were dried, milled, and ashed at the USGS laboratories in Denver, then submitted for analysis.

Plans for Current Quarter (July–September 2000)

Crops (wheat heads, only) will be sampled from the soil-monitoring sites just before harvest in July. The samples of wheat heads will be processed and submitted for analysis.

If you have questions about the Expanded Monitoring Program, please contact Tracy Yager (see page 12). Commonly asked questions will be included in each Quarterly Report.

USGS ground-water data, January-April 2000

[Standards from Colorado Department of Public Health and Environment, 1997, Basic standards for ground water, 5CCR 1002-41: July 14, 1997, 56 p. Data are preliminary and subject to revision. 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	Time	Nitrate plus 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
DTX3	01-10-00	1035	2.8	<2	<1	E0.6	3	<1	<.2	<1	4	8	2
DTX3	04-11-00	1015	3.8	<2	<1	<.8	3	<1	<.2	<1	6	14	3
D17	01-07-00	1500	2.3	E1	<1	<.8	<1	<1	<.2	6	2	8	<1
D17	04-10-00	1415	3.5	E1	<1	<.8	<1	<1	<.2	6	<1	9	<1
DTX4	01-06-00	0955	0.33	E1	<2	<.8	5	<2	<.2	<2	40	E2	3
DTX4	04-11-00	1145	.15	E1	<2	<1.0	6	<2	<.2	<2	20	3	11
DTX5	01-06-00	1310	<.037	<2	<2	.9	6	<2	<.2	<2	46	2	3
DTX5	04-11-00	1345	<.037	<2	<2	<1.0	6	<2	<.2	<2	25	<2	14
DTX6	01-06-00	1530	.26	E1	<2	<.8	7	<2	<.2	<2	40	4	5
DTX6	04-14-00	1000	.26	2	<1	.8	16	<1	<.2	<1	<1	6	11
D13	01-12-00	1005	<.037	<2	<1	.9	3	<1	<.2	1	10	<2	2
D13	04-17-00	1115	<.037	<2	<1	<.8	2	<1	<.2	1	4	<2	3
D29	01-07-00	1130	E.021	<2	<2	<1.0	6	<2	<.2	<2	11	<2	8
D29	04-10-00	1135	<.037	E1	<1	<1.0	10	<1	<.2	1	7	E2	19
D6	01-11-00	1355	12	2	<1	2.4	5	<1	<.2	<1	6	11	5
D6	04-13-00	1400	13	3	<1	<.8	61	<1	<.2	3	9	11	63
D30	01-11-00	1600	<.037	E1	<1	1.8	5	<1	<.2	2	15	<2	4
D30	04-13-00	1200	<.037	3	<1	0.9	18	<1	<.2	3	2	5	16
D25	01-12-00	1245	2.2	3	<1	2.6	9	<1	<.2	10	38	3	8
D25	04-10-00	1615	2.2	3	<1	<1.0	11	<1	<.2	9	4	2	10
DTX10A	01-11-00	1130	<.037	<2	<1	1.5	3	<1	<.2	<1	9	<2	2
DTX10A	04-17-00	1415	<.037	<2	<2	<1.0	6	<2	<.2	<2	21	<2	12
DTX8A	01-13-00	1315	<.037	<2	<1	E.8	2	<1	<.2	<1	6	<2	2
DTX8A	04-13-00	1415	<.037	<2	<1	<.8	4	<1	<.2	<1	<1	<2	3
DTX2	01-10-00	1520	.05	<2	<2	.9	6	<2	<.2	<2	15	<2	7
DTX2	04-14-00	1345	<.037	E2	<1	<.8	11	<1	<.2	2	2	4	10
DTX1	01-10-00	1345	2.8	E1	<2	1.6	8	<2	<.2	6	22	<2	7
DTX1	04-14-00	1220	1.4	4	<1	<.8	14	<1	<.2	6	4	6	14
Human Health 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

USGS radionuclide data for monitoring wells, 2000

[Standards from Colorado Department of Public Health and Environment, 1997, Basic standards for ground water, 5CCR 1002-41: July 14, 1997, 56 p. Data are preliminary and subject to revision. All data from unfiltered samples; pCi/L, picocuries per liter; <, less than; analytical uncertainty (defined on page 12) reported is the two-sigma total propagated analytical uncertainty]

Well	Sample Date	Plutonium 238, pCi/L	Plutonium 238, analytical uncertainty, pCi/L	Plutonium 238 minimum detectable concentration, pCi/L	Plutonium 239+240, pCi/L	Plutonium 239+240, analytical uncertainty, pCi/L	Plutonium 239+240 minimum detectable concentration, pCi/L
DTX3	01-10-00	0	0.0040	0.0045	0.0010	0.0036	0.0094
D17	01-07-00	-0.0006	.0012	.0086	0	.0037	.0041
DTX4	01-06-00	-.0029	.0078	.0268	.0058	.0082	.0078
DTX5	01-06-00	0	.013	.014	.003	.012	.030
DTX6	01-06-00	-.0030	.0060	.0422	0	.018	.020
D13	01-12-00	-.0015	.0021	.0126	.0004	.0042	.0126
D29	01-07-00	-.0024	.0049	.0343	.006	.012	.016
D6	01-11-00	.005	.020	.051	-.0036	.0073	.0514
D30	01-11-00	0	.019	.021	.008	.016	.021
D25	01-12-00	-.0039	.0056	.0337	.001	.011	.034
DTX10A	01-11-00	.003	.012	.030	.003	.012	.030
DTX8A	01-13-00	0	.0059	.0060	-.0019	.0028	.017
DTX2	01-10-00	.008	.016	.022	0	.020	.022
DTX1	01-10-00	0	.012	.013	-.0019	.0038	.0270
Human Health Standard		none found			.15		
Agricultural Standard		none found			none found		

Streambed-sediment trace-element data collected from the biosolids basin August 31, 1999

[µg/g, microgram per gram; <, less than]

Constituent	Units	Concentration
Aluminum	µg/g	14,400.
Arsenic	µg/g	2.
Cadmium	µg/g	<1.
Chromium	µg/g	12.
Copper	µg/g	14.
Lead	µg/g	15.
Mercury	µg/g	.01
Molybdenum	µg/g	.1
Nickel	µg/g	17.
Selenium	µg/g	<1.
Zinc	µg/g	53.

USGS trace-element data for Metro District biosolids, mg/kg, dry weight basis

[Standards from Colorado Department of Public Health and Environment, 1998, Biosolids regulation (Regulation no. 64): January 12, 1998, 53 p.; mg/kg, milligram per kilogram, dry-weight basis]

	December 1999	March 2000	Maximum allowable for Grade I biosolids, (see Definitions, p. 12)
Arsenic	6.6	1.7	41
Cadmium	2.6	2.6	39
Copper	470	720	1500
Lead	56	64	300
Mercury	1.7	1.6	17
Molybdenum	20	28	No standard set for Grade I. 75 for Grade II
Nickel	36	44	420
Selenium	13	9.8	100
Zinc	480	610	2800

USGS radionuclide data for Metro District biosolids, pCi/g

[Standards from Colorado Department of Public Health and Environment, 1998, Biosolids regulation (Regulation no. 64): January 12, 1998, 53 p.; pCi/g, picocurie per gram]

	December 1999	March 1999	Maximum allowable for Grade I biosolids, (see Definitions, p. 12)
Gross alpha	27 +/- 12	23 +/- 14	40
Gross beta	21 +/- 6	26 +/- 5	No standard set
Plutonium 238	0.01 +/- 0.02	0.00 +/- 0.01	No standard set
Plutonium 239+240	0.00 +/- 0.02	0.00 +/- 0.01	No standard set



The recharge-evaluation site on the Weisensee Ranch was completed in April 2000 by the addition of pressure transducers in each well to continuously monitor water levels, a fenced enclosure, a data logger, and rain gages. USGS monitoring wells DTX9, DTX10, and DTX11 are part of this site. Data from this site are downloaded manually from the data logger and are therefore not available on the Internet.



Pressure transducers were installed in USGS monitoring wells DTX9, DTX10, and DTX11 through the well caps. The cable comes from the pressure transducer (inside the white PVC casing) through the steel wall of the well cover to the data logger at this site. This cable configuration enables the steel well cover to be closed and locked to protect the well.

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 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 radionuclide 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 Grade I, Class B biosolids at Deer Trail. Regulations require that land-applied biosolids must meet or exceed Grade II, Class B. Grade I exceeds Grade II.

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.

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.

Radionuclide—A radioactive atom characterized by a given number of neutrons and protons in its nucleus. For example, plutonium concentrations include plutonium-238 or plutonium-239, which are specific isotopes.

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

Contacts

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Contact Mary Sue for all changes to the mailing list.

State Biosolids Coordinator: Lori Tucker, 303-692-3613

U.S. Environmental Protection Agency: Bob Brobst, 303-312-6129

*Second annual
stakeholder meeting
is scheduled for September 21,
2000, at the High School in
Agate.*

*Prepared by Tracy Yager, Dave Smith,
and Jim Crock (USGS) in cooperation
with Metro Wastewater Reclamation
District, August 2000*

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