LMS/DUP/S05773

# Verification Monitoring Report for the Durango, Colorado, Processing Site

September 2009

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# Office of Legacy Management

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# Abbreviations

| | |
|---|---|
| ACL | alternate concentration limit |
| DOE | U.S. Department of Energy |
| EPA | U.S. Environmental Protection Agency |
| ft | foot (feet) |
| $ft^3$/day | cubic foot (feet) per day |
| GCAP | Ground Water Compliance Action Plan |
| MCL | maximum concentration limit |
| mg/L | milligram(s) per liter |
| POC | point-of-compliance |
| UMTRA | Uranium Mill Tailings Remedial Action (Project) |

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# 1.0 Introduction

The Durango processing site is located in La Plata County, Colorado, approximately 0.25 mile southwest of the central business district of Durango, Colorado (Figure 1). The site consists of two separate areas: (1) the mill tailings area, which is the setting of former uranium-ore milling and storage of residual solid wastes (mill tailings), and (2) a raffinate ponds area where liquid process-wastes were impounded during milling operations. The former mill tailings area encompasses about 40 acres on a bedrock-supported river terrace between Smelter Mountain to the west, the Animas River to the east and south, and Lightner Creek to the north (Figure 2). The raffinate ponds area occupies about 20 acres on a separate river terrace located 1,500 feet (ft) south (downstream) of the mill tailings area (Figure 3).

The compliance strategy for groundwater cleanup at the former mill tailings area of the Durango site is natural flushing, institutional controls to prevent exposure to contaminated groundwater, water quality monitoring, and an alternate concentration limit (ACL) for selenium (DOE 2003). This strategy was based in part on groundwater flow and solute transport modeling that predicted acceptable cleanup times for each contaminant, except possibly cadmium, by natural flushing processes at the site, and in part on historical trends of decreasing contaminant concentrations, particularly since the completion of contaminant source removal in 1991. Baseline conditions of contaminant concentration in the model correspond to results of the June 2002 groundwater sampling. The groundwater model is fully documented in the Site Observational Work Plan (DOE 2002).

The primary purpose of this verification monitoring report is to evaluate the observed progress of passive groundwater restoration at the Durango mill tailings area and compare the observed progress to the model-predicted progress, based on the water quality data through June 2009. The goal is to confirm that natural flushing is progressing and remains a viable compliance strategy for the site.

The compliance strategy for the raffinate ponds area is no further action in conjunction with supplemental standards based on limited use (poor quality) groundwater. Groundwater monitoring is conducted as a best management practice. Monitoring results for the raffinate ponds area are also presented in this report.

# 2.0 Site Conditions

## 2.1 Hydrogeology

The uppermost aquifer at the mill tailings area consists of alluvial deposits associated with the Animas River and Lightner Creek, and poorly sorted colluvium derived from adjacent Smelter Mountain, rising steeply to the southwest. Approximately 70 ft of colluvium overlies bedrock along the base of the mountain. These deposits thin eastward and transition to sand and gravel deposits up to 15 ft thick closer to the Animas River. The portion of the aquifer underlying the site occupies a narrow fringe (at most, about 250 ft wide) along the Animas River. Depth to groundwater increases from about 5 ft on the river terrace to about 60 ft near the base of Smelter Mountain. The saturated zone is thin (less than 10 ft), unconfined, and directly underlain by

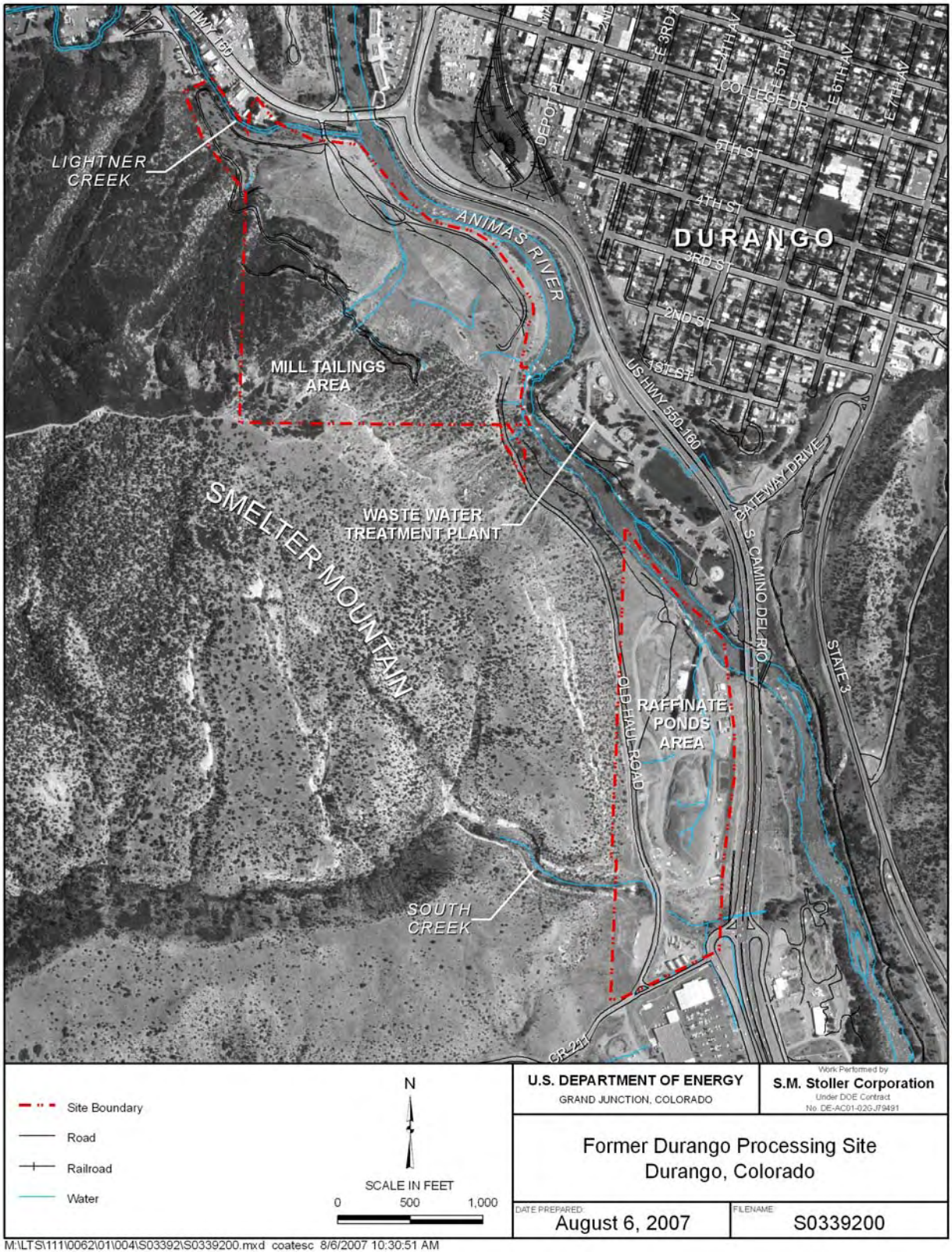


*Figure 1. Durango Processing Site*

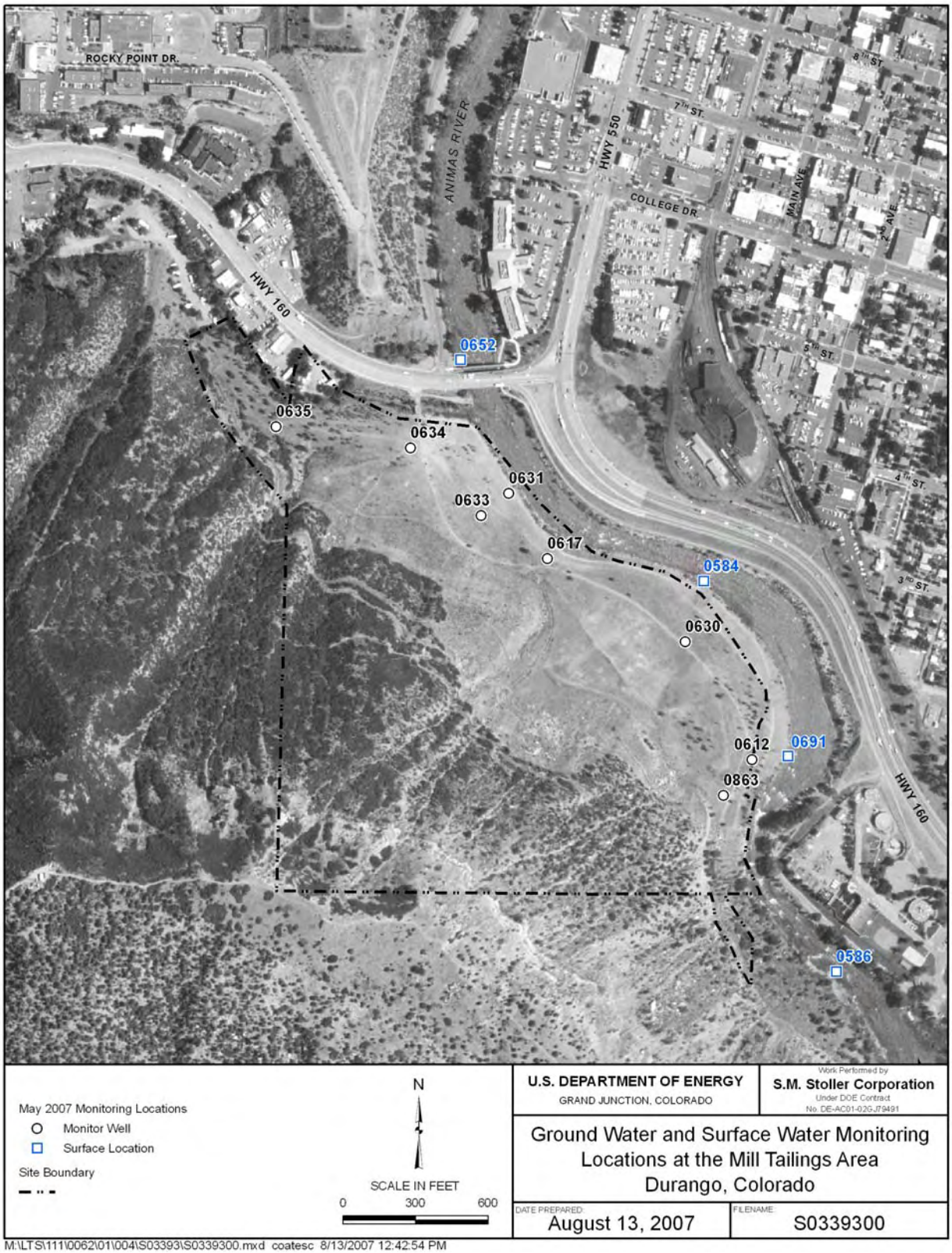


*Figure 2. Monitoring Network in the Mill Tailings Area at the Durango Site*

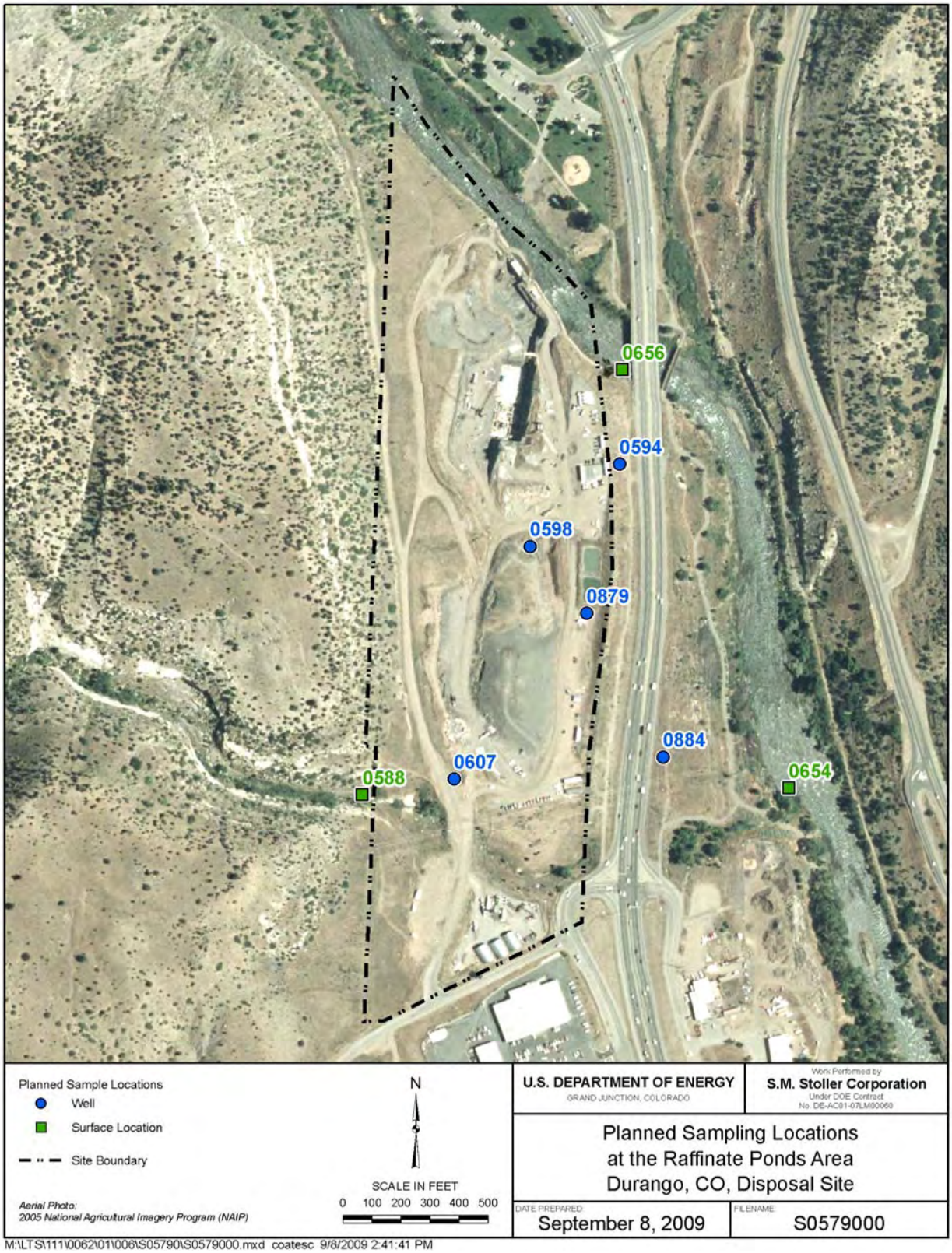


*Figure 3.Monitoring Locations for the Raffinate Ponds Area*

Mancos Shale bedrock. The surficial aquifer is of limited extent and has a low yield. Groundwater flow is generally to the southeast, parallel to the Animas River, at an average gradient of approximately 0.02 ft/ft. Hydraulic conductivity of the alluvium ranges from 10 to 70 ft/day.

The colluvium is recharged primarily by runoff and infiltrating precipitation, while the river alluvium receives water from Lightner Creek and from river loss along the upstream reach of the prominent meander. Groundwater discharges to the Animas River along the upper and lower thirds of the reach adjacent to the mill tailings area. Under average conditions, the estimated volume of groundwater discharge from the mill tailings area is 1,480 cubic feet per day ($ft^3$/day); approximately 840 $ft^3$/day enters the Animas River near the mouth of Lightner Creek, and the remaining 640 $ft^3$/day enters the Animas River east of the former east tailings pile (DOE 2002). The alluvial aquifer pinches out against bedrock cliffs near the southeast corner of the site, at which point groundwater discharge to the river is complete (DOE 2002).

Two bedrock units, both members of the Mesaverde Group, underlie the raffinate ponds area and are separated by a fault dissecting the site. The Point Lookout Sandstone is the basal formation of the Mesaverde Group and is divided into two members: a lower transitional member consisting of interbedded lenticular sandstones and shales, and an upper massive sandstone member. The Menefee Formation consists of massive sandstone and shale, with beds of carbonaceous shale and coal. The Bodo Fault (a normal fault) juxtaposes the Point Lookout Sandstone and the Menefee Formation and has downthrown the Point Lookout Sandstone approximately 200 ft. The Bodo fault trends northeast and dips to the southeast at approximately 55 degrees.

Groundwater in the raffinate ponds area is assumed to be unconfined. It is recharged by infiltration of precipitation and runoff and by horizontal inflow from Smelter Mountain. Water enters the flow system at the intersection of the Bodo Fault with South Creek. This influx is intermittent because South Creek is an ephemeral stream. Hydraulic conductivity data indicate that the Point Lookout Sandstone is the least conductive material. In addition, the lower member (predominantly shale and siltstone) of the Point Lookout Sandstone is apparently an aquitard. The Menefee Formation consists of mostly low-conductivity sandstone but is relatively permeable where fractures or lenticular coal beds are present. The greatest hydraulic conductivity at the raffinate ponds area is in the Bodo Fault and in the coal beds.

## 2.2 Water Quality

Groundwater in the alluvial aquifer at the mill tailings area is contaminated as a result of uranium-ore processing and tailings storage. Although the primary source of groundwater contamination (mill tailings) was removed from the site by 1991, concentrations of arsenic, cadmium, lead, molybdenum, net alpha, radium-226+228, selenium, and uranium in the underlying aquifer remained in excess of Uranium Mill Tailings Remedial Action (UMTRA) Project maximum concentration limits (MCLs). Concentrations of arsenic, lead, and radium have since decreased to levels below the MCLs, and net alpha was detected only sporadically in a few wells. Monitoring for arsenic, lead, radium, and net alpha was discontinued in 2002 in accordance with provisions of the Ground Water Compliance Action Plan (GCAP) (DOE 2003).

Table 1 compares the maximum concentrations of the remaining site contaminants detected in June 2009 to the corresponding compliance goals for the mill tailings area. The compliance goals

for cadmium, molybdenum, and uranium are UMTRA Project MCLs. The compliance goal for selenium (0.05 milligram per liter [mg/L]) is adopted from the U.S. Environmental Protection Agency (EPA) Safe Drinking Water Act as an ACL (the MCL is 0.01 mg/L). An ACL was established for selenium because of naturally abundant selenium in groundwater above the MCL. There are no MCLs for manganese and sulfate. The compliance goal for manganese is the EPA Drinking Water Equivalent Level. This is a lifetime exposure concentration protective of adverse, non-cancer health effects; it assumes that all of the exposure to a contaminant is from drinking water (EPA 2004). The sulfate goal is equivalent to its average background concentration in groundwater.

*Table 1. Current Groundwater Contaminants and Compliance Goals for the Mill Tailings Area*

| Contaminant of Concern | Compliance Goal (mg/L) | Compliance Goal Source | Maximum Concentration Observed in June 2009 (mg/L) |
|---|---|---|---|
| Cadmium | 0.01 | UMTRA Project MCL | 0.042 |
| Manganese | 1.6 | DWEL (EPA 2004) | 4.2 |
| Molybdenum | 0.1 | UMTRA Project MCL | 0.096 |
| Selenium | 0.05 | ACL (DOE 2002) | 0.048 |
| Sulfate | 1,276 | Average Background (DOE 2002) | 3,000 |
| Uranium | 0.044 | UMTRA Project MCL | 1.10 |

DWEL = Drinking Water Equivalent Level

Bedrock groundwater at the raffinate ponds area qualifies for supplemental standards on the basis of limited use groundwater. Groundwater in the bedrock is of limited use because of widespread, elevated concentrations of naturally occurring selenium. Selenium concentrations exceed the MCL at background monitor well 0599 by a factor of nearly nine. Additional evidence of the natural presence of selenium at the raffinate ponds is presented in Section 5.4 of the Site Observational Work Plan (DOE 2002). Because supplemental standards apply to groundwater in the raffinate ponds area, no numerical compliance goals were established for that portion of the site.

Current monitoring of the Animas River verifies previous findings in the baseline risk assessment (DOE 1995) that past milling operations have negligible effect on surface water quality. Historical results indicate that constituent concentrations adjacent and downstream of the mill tailings area are indistinguishable from background.

## 2.3 Surface Remediation Activities

The U.S. Department of Energy (DOE) began surface cleanup of the mill tailings and raffinate ponds areas in November 1986 to meet the EPA standards for radium in soil. A total of 2.5 million cubic yards of contaminated material was relocated to the Bodo Canyon disposal cell several miles southwest of the Durango site. Supplemental cleanup standards were applied to steep slopes of Smelter Mountain and two regions along the banks of the Animas River. In addition, a small lens of uranium ore was left in place at the mill tailings area below layers of slag along portions of the river. The slag deposits, which are 10 to 15 ft thick in some areas (including the location of well 0612), are associated with a lead smelter that operated on the site from 1880 to 1930. To restore the site, approximately 230,000 cubic yards of uncontaminated

soil was backfilled, contoured, and seeded. Riprap was placed in some sensitive areas along the Animas River to prevent erosion. Remedial action was completed in May 1991.

## 2.4 Water and Land Use

The primary water source for the city of Durango is the Florida River upstream of its confluence with the Animas River. Additional water is withdrawn from the Animas River during high-demand periods (usually during the summer) from a location approximately 2 miles upstream of the mill tailings area. The Animas River bordering the mill tailings area of the Durango site is popular for seasonal boating and fishing. Development plans for the mill tailings area include municipal but not residential use (DOE 2002).

## 2.5 Institutional Controls

As part of the compliance strategy, public health will be protected at the mill tailings area during the natural flushing period through an environmental covenant between the State of Colorado and the City of Durango (landowner) that restricts access to contaminated alluvial groundwater. Additionally, deed restrictions (which serve as a notice to the public) for the mill tailings area prohibit access to groundwater without written permission from DOE and the Colorado Department of Public Health and Environment. Groundwater use in the raffinate ponds area is restricted in perpetuity through a deed restriction that also requires DOE permission before use of groundwater for any purpose. The State of Colorado is currently in the process of trying to obtain a signed environmental covenant agreement for the raffinate ponds area.

# 3.0 Monitoring Program

Annual groundwater and surface water monitoring of the processing site will continue through the first 5 years following U.S. Nuclear Regulatory Commission concurrence with the GCAP (DOE 2003). Monitoring for cadmium at the mill tailings area will continue annually for the first 10 years following concurrence because of the greater uncertainty of this constituent to naturally flush within the allotted 100-year period under the regulations. Monitoring data obtained through the initial 5-year period will measure the actual progress of natural flushing of the constituents listed in Table 1. After the 5-year annual monitoring period, the scope of subsequent monitoring will be addressed in a Long-Term Management Plan.

At the mill tailings area, monitor wells 0612, 0617, 0630, 0631, 0633, 0634, 0635, and 0863 have been established as point-of-compliance (POC) wells that will be used to monitor the progress of natural flushing in groundwater in the alluvial aquifer (Figure 2). In accordance with provisions of the GCAP (DOE 2003), natural flushing for a given analyte is complete when its concentration no longer exceeds the compliance goal at the POC wells for three consecutive annual sampling events. Monitoring for that constituent may then be discontinued.

Surface water locations 0652, 0584, 0691, and 0586, located along the Animas River, will be monitored on schedule with groundwater monitoring to verify continued protection of the aquatic environment (Figure 2). Compliance monitoring requirements and rationale for the mill tailings area are summarized in Table 2.

*Table 2. Annual Groundwater and Surface Water Compliance Monitoring Requirements for the Mill Tailings Area*

| Sampling Location | Monitoring Purpose | Analytes | Location |
|---|---|---|---|
| **Groundwater Monitoring** | | | |
| 0617, 0630, 0631, 0633, 0634, 0635 | POC/verify natural flushing | Manganese<br>Molybdenum<br>Selenium<br>Sulfate<br>Uranium | On site |
| 0612, 0863 | POC/verify natural flushing; verify cadmium flushing | Cadmium<br>Manganese<br>Molybdenum<br>Selenium<br>Sulfate<br>Uranium | On site downgradient |
| **Surface Water Monitoring** | | | |
| 0652 | Surface water background | Cadmium<br>Molybdenum<br>Selenium<br>Uranium | Off site upstream |
| 0584, 0691 | Verify no site-related increase above background | | Off site; site groundwater discharge area |
| 0586 | Verify no site-related increase above background | | Off site; downstream of site groundwater discharge |

Groundwater and surface water monitoring of the raffinate ponds area is being conducted only as a best management practice, and no POC wells have been established. Monitoring requirements are summarized in Table 3.

*Table 3. Summary of Monitoring Requirements at the Raffinate Ponds Area*

| Sampling Location | Monitoring Purpose | Analytes | Location |
|---|---|---|---|
| 0879, 0594 (replaced 0880) | Monitor concentrations in groundwater in the shallow bedrock. | Selenium<br>Uranium | On site |
| 0598 | Monitor concentrations in groundwater in the deep bedrock and Bodo Fault zone. | Selenium<br>Uranium | On site |
| 0607 | Monitor concentrations in groundwater entering the site. | Selenium<br>Uranium | On site |
| 0884 | Monitor off-site downgradient concentrations and migration. | Selenium<br>Uranium | Off site downgradient |
| 0588 | Surface water quality entering the site. | Selenium<br>Uranium | Off site upgradient |
| 0654, 0656 | Downgradient surface water concentrations. | Selenium<br>Uranium | Off site downgradient |

# 4.0 Results of 2009 Monitoring

Table 4 summarizes the amount of time the model predicts for natural flushing to achieve the compliance goals for cadmium, manganese, molybdenum, selenium, sulfate, and uranium in groundwater. The progress of each, based on water quality data through June 2009, is addressed separately in the following subsections. Important reference dates for comparing observed concentration trends to model-predicted trends include 1992 to 2009, when water quality was monitored after removal of the primary source of groundwater contamination, and June 2002,

which was established as the groundwater model baseline condition (time zero) for contaminant transport. The predicted compliance times listed in Table 4 differ because the contaminants initially were not distributed evenly and vary in degree of contamination above the respective compliance goal, and because each contaminant varies in its mobility in groundwater in the aquifer.

*Table 4. Model-Predicted Groundwater Restoration Times*

| Analyte | Compliance Goal (mg/L) | Predicted Compliance Time (year)[a] | Predicted Compliance Date[b] |
|---|---|---|---|
| Cadmium | 0.01 | >100 | >2102 |
| Manganese | 1.6 | 70 | 2072 |
| Molybdenum | 0.1 | 5 | 2007 |
| Selenium | 0.05 | 60 | 2062 |
| Sulfate | 1,276 | 100 | 2102 |
| Uranium | 0.044 | 80 | 2082 |

[a]Source: DOE 2002, Appendix G, Table 18.
[b]Model time zero (baseline) is June 2002.

Plots of predicted compliance time based on modeling continue to show mixed results; some 2009 sampling data show concentrations above those predicted by the model, while others are quite consistent with model predictions. Variation in concentrations in groundwater is to be expected on an annual basis, and the success of natural flushing needs to be assessed over an extended period. Even with some of the observed increases in concentrations for several of the constituents in 2009, linear trends of measured data since 1992 show that concentrations of all constituents, except cadmium at well 0612 and sulfate at some locations, are expected to naturally flush within the 100-year time frame allotted under EPA regulations.

## 4.1 Groundwater

### 4.1.1 Mill Tailings Area

Groundwater was sampled from the eight POC locations (Figure 2) and analyzed for constituents shown in Table 2. Sampling results for 2009 are provided in Appendix A and are discussed below by constituent.

#### 4.1.1.1 Cadmium

Figure 4 is a map view of the site showing the concentration of cadmium in groundwater at the compliance wells in June 2009. Figure 5 shows observed cadmium concentrations versus time at the compliance wells since completion of remedial action in 1992. Historically, and in June 2009, cadmium in excess of the MCL occurs only at well 0612, while the remaining monitor wells contained only trace levels of this constituent. Groundwater modeling predicted a flushing period of about 500 years for cadmium (Figure 6). This result is not consistent with historical trending at well 0612, which (if projected linearly from 1992 beyond June 2009) implies compliance for cadmium by about year 2021, or 19 years from the model baseline (Figure 6).Projecting this trend too far into the future may underestimate the actual restoration period because of nonlinear effects that lead to a long tail in the predicted concentrations at the


*Figure 4. Distribution of Cadmium at the Mill Tailings Area*

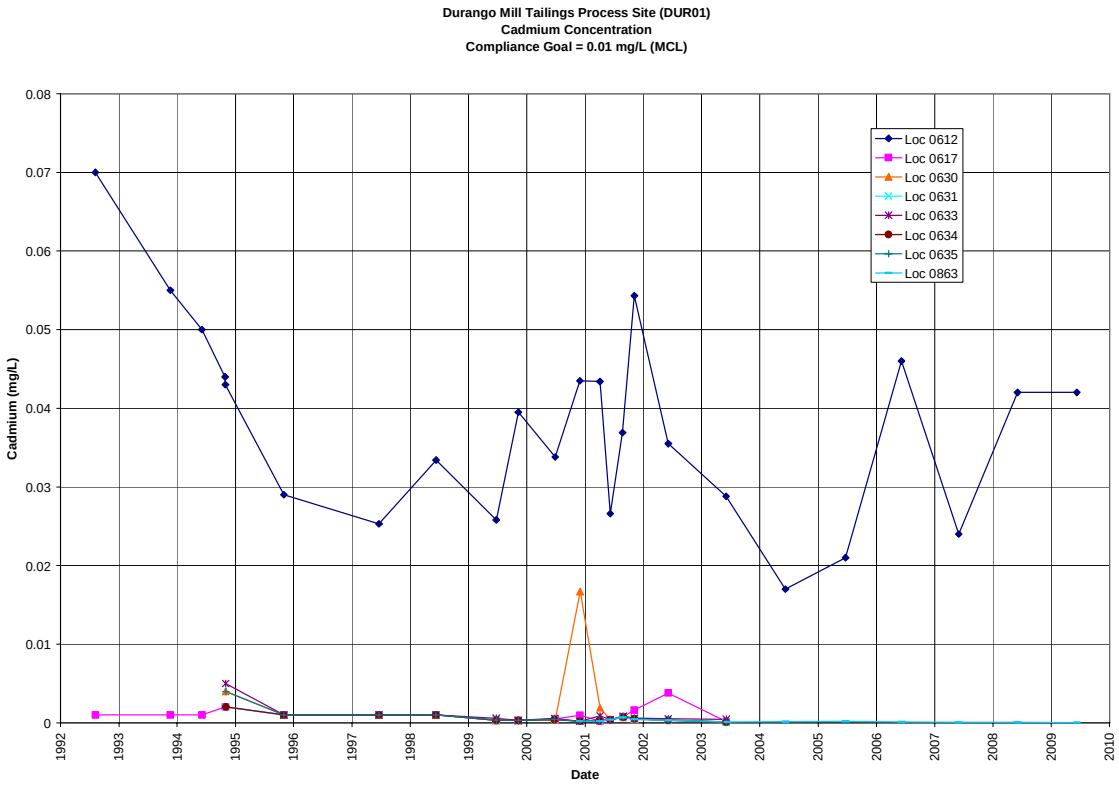


*Figure 5. Historical Cadmium Concentrations in Groundwater at the Mill Tailings Area*

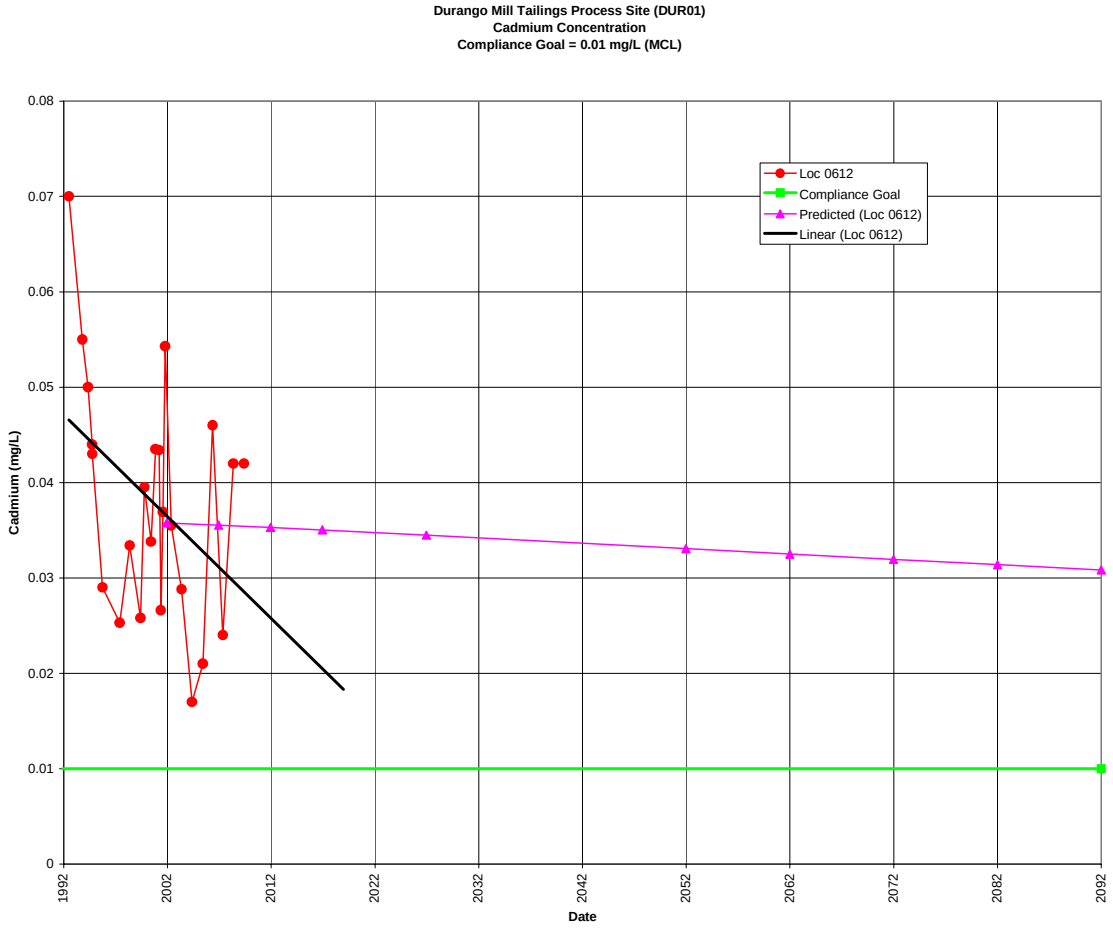


*Figure 6. Predicted and Measured Cadmium Concentrations at the Mill Tailings Area*

end of the process. This is commonly observed in nature and predicted by the solute transport models. Natural flushing of cadmium, however, remains a potential strategy because of the very limited distribution of cadmium at the site and the observed net decrease in concentration over time. Since it is early in the 100-year natural flushing time frame, DOE will continue to monitor cadmium concentrations in groundwater and will reevaluate the strategy later, if required.

### 4.1.1.2 Manganese

Figures 7 and 8, respectively, illustrate the distribution of manganese concentrations in groundwater in June 2009 and the historical variations of manganese concentrations at the compliance wells. The June 2009 results are typical for manganese in that the compliance goal was exceeded only at well 0612 (Figure 8), where the concentration was slightly down from 2008. Projecting the linear trend of the observed concentration at well 0612 implies that natural flushing will be complete at that location in about the year 2046, well within the 100-year time allotment and in close agreement with the model prediction (Figure 9).

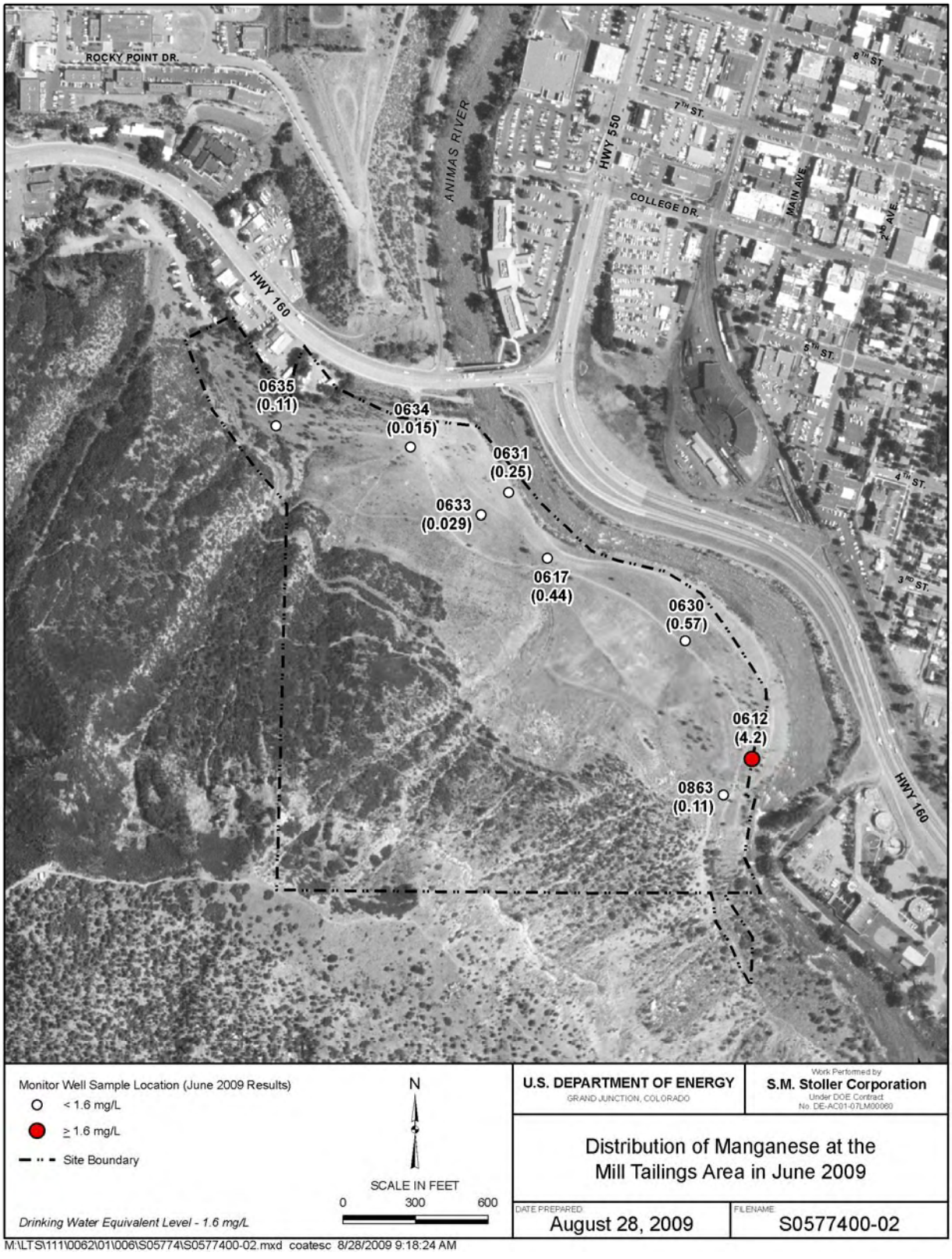


*Figure 7. Distribution of Manganese at the Mill Tailings Area*

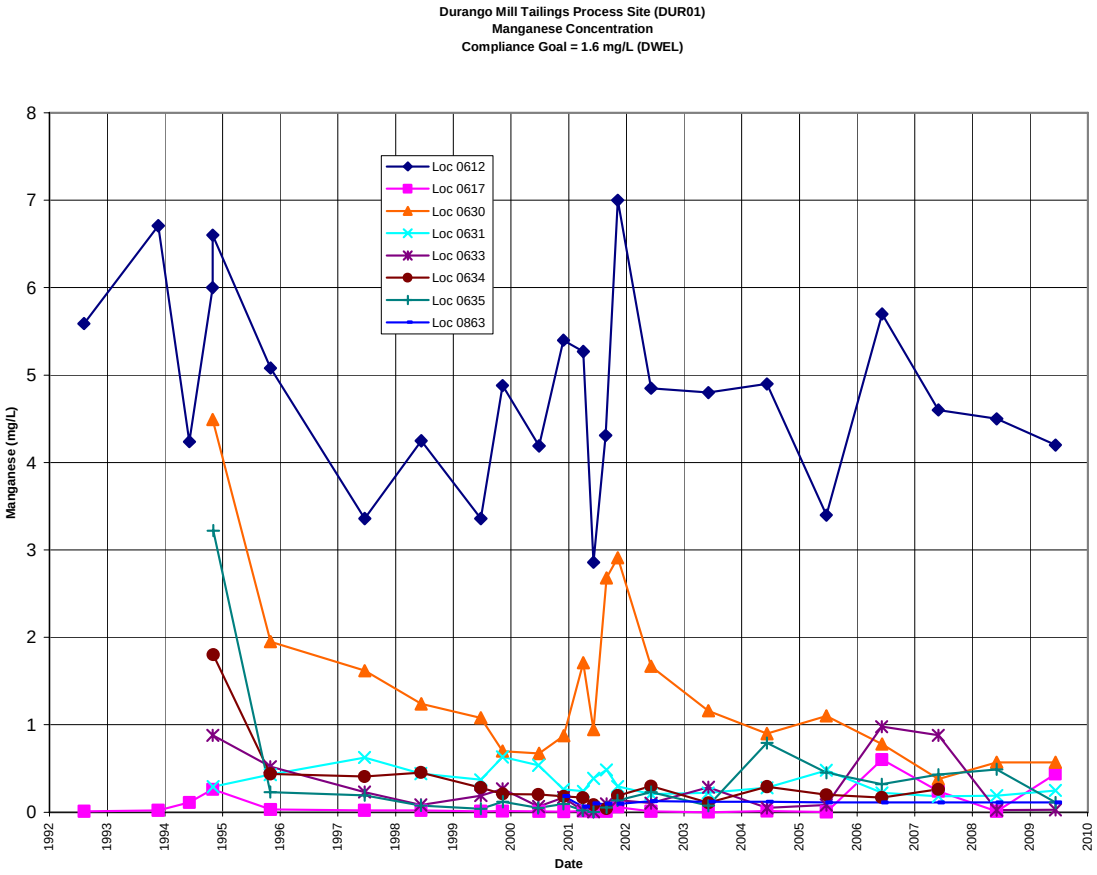


*Figure 8. Historical Concentrations of Manganese at the Mill Tailings Area*

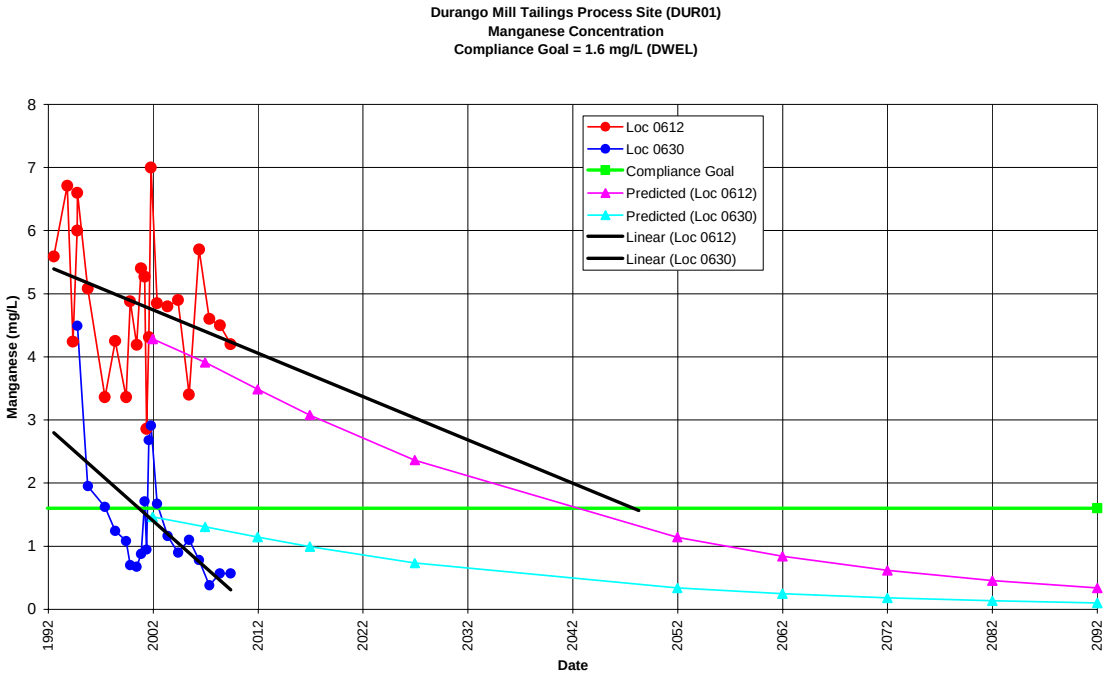


*Figure 9. Predicted and Measured Manganese Concentrations at the Mill Tailings Area*

The net variation in the concentration of manganese observed through the relatively brief period since 2002 is not inconsistent with the model prediction for this location. Because well 0612 is very close to the downgradient discharge boundary of the aquifer, contaminant migration from that area will not affect other regions of the aquifer. The flushing period for well 0612, therefore, represents a sitewide maximum for manganese because the compliance goal is not exceeded at any other location.

#### 4.1.1.3 Molybdenum

Molybdenum concentrations in June 2009 were less than the compliance goal of 0.1 mg/L at all locations. Concentrations at well 0612, which remained slightly above the compliance goal in 2008, declined slightly to 0.096 mg/L in 2009 (Figures 10 and 11). If all wells remain below the standard for two more sampling rounds, compliance will be achieved and monitoring for molybdenum can be discontinued. The linear trend of observed concentrations at well 0612 forecasts molybdenum flushing to be complete in 2009 (Figure 12); observations bear out this prediction.

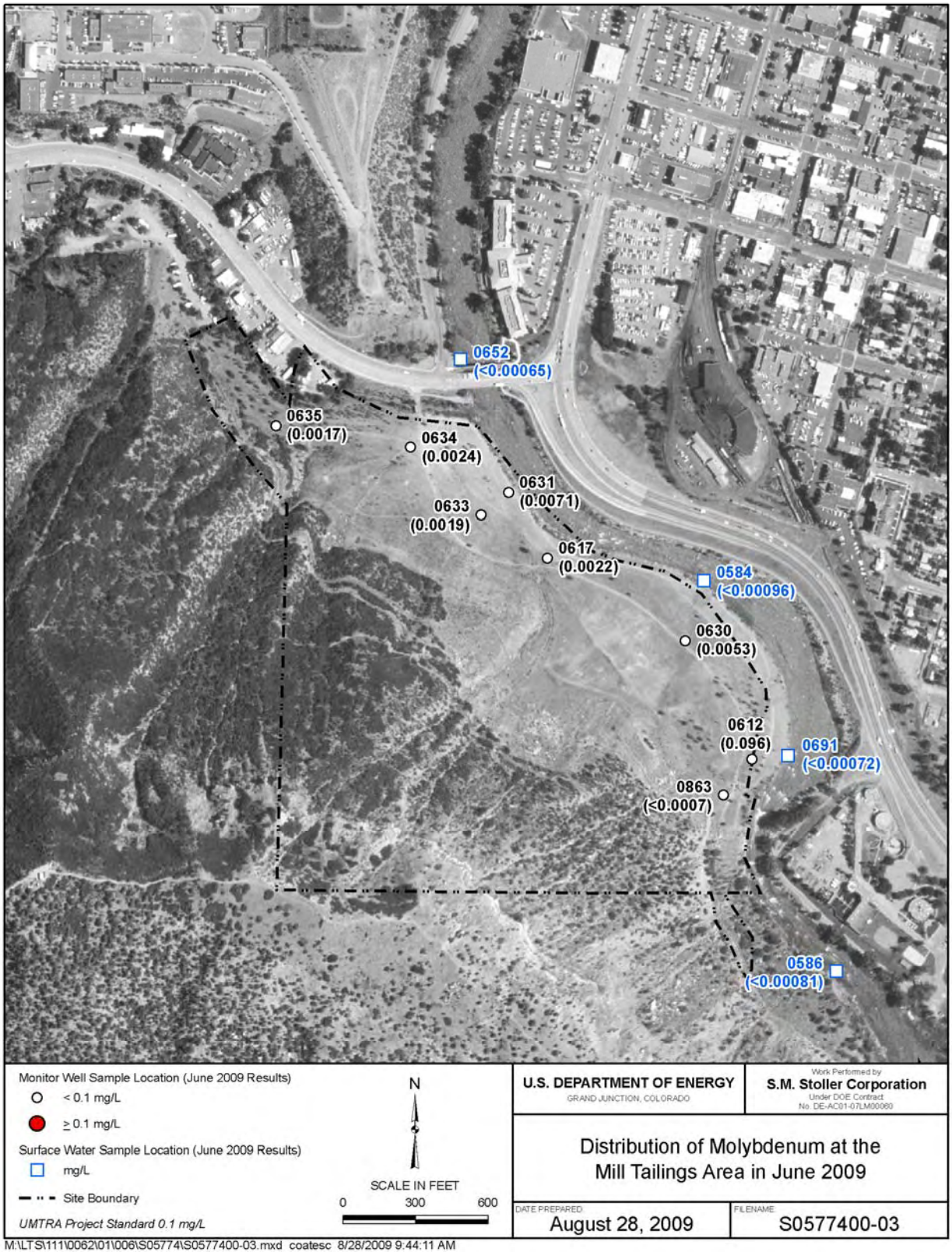


*Figure 10. Distribution of Molybdenum at the Mill Tailings Area*

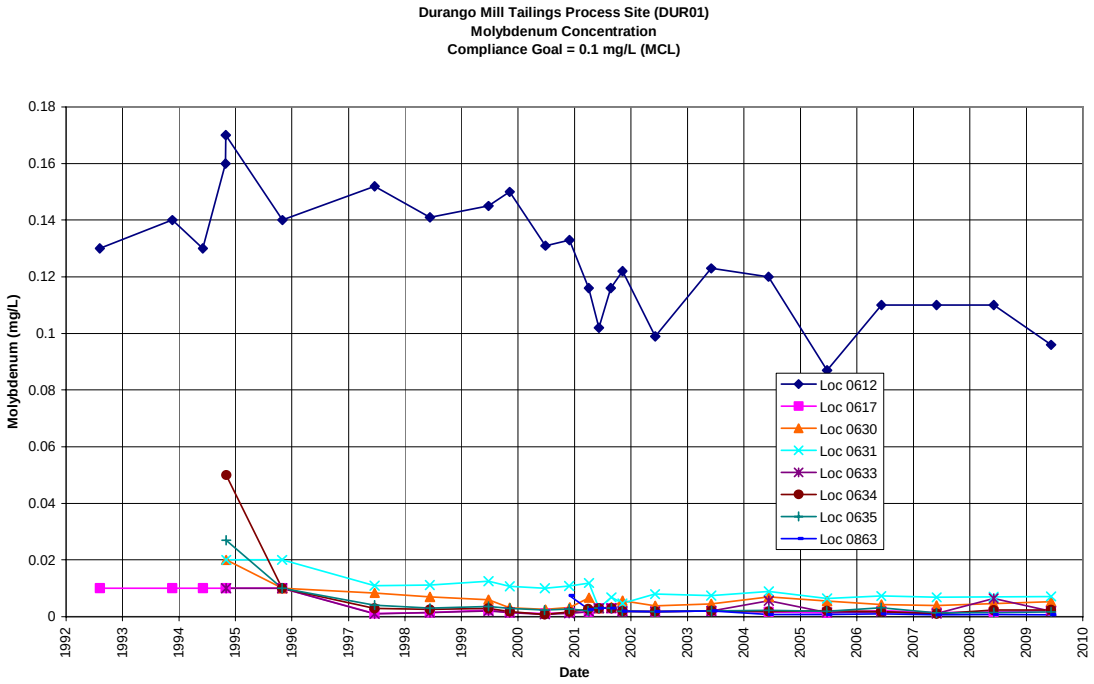


*Figure 11. Historical Concentrations of Molybdenum at the Mill Tailings Area*

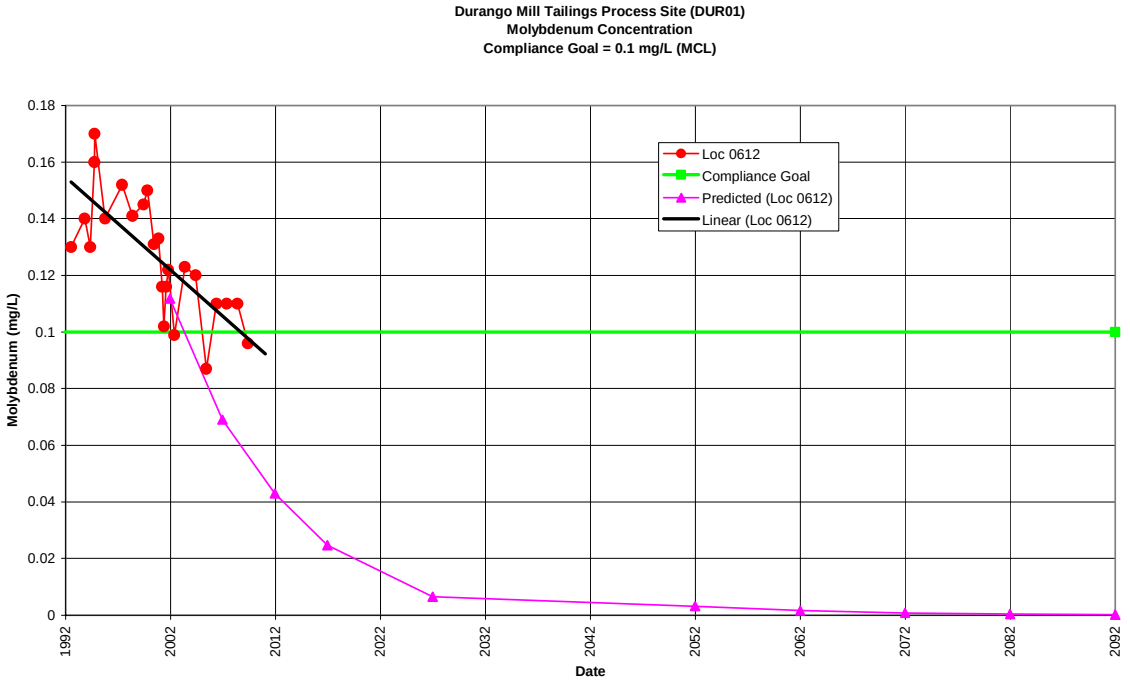


*Figure 12. Predicted and Measured Molybdenum Concentrations at the Mill Tailings Area*

#### 4.1.1.4 Selenium

Figure 13 shows, in map view, that the compliance goal for selenium (0.05 mg/L) was met at all wells in 2009. Selenium levels in well 0617, which had commonly been elevated above the standard in the past (Figure 14), have continued to remain below the compliance goal for 4 years. The model predicted that selenium concentrations would drop below the ACL by 2017 at this location (Figure 15). Observations bear this out.

Concentrations in well 0633 declined from 0.083 mg/L in 2008 to 0.048 mg/L in 2009 (Figure 14). Well 0633 is screened 90 percent in Mancos Shale, a recognized source of readily mobilized selenium (DOE 2002). The low-level selenium contamination at the site may in part be site-related; however, some contribution from natural sources is likely, as evidenced by concentrations greater than 0.01 mg/L at background well 0622 (not shown in figures) (see DOE 2002). While the linear trend line, based on the measured concentrations at well 0633, indicates that the compliance goal should have been reached last year, achievement of compliance this year is probably within the margin of error for model predictions. If all wells remain below the standard for selenium for the next two sampling rounds, compliance will be met and analysis for selenium can be discontinued.

#### 4.1.1.5 Sulfate

Sulfate concentrations that exceed background levels are related to the former use of sulfuric acid in the milling process. In June 2009, sulfate exceeded the average background concentration at each compliance well except wells 0631, 0863, and 0635 (Figures 16 and 17). Most wells showed a decline compared to 2008; however well 0633 increased to 3,000 mg/L after decreasing sharply the year before. Observed concentrations since 1992 fluctuate considerably at a given well and generally do not show any obvious trending. However, projecting best-fit lines to the data reveals that sulfate flushing will be complete at most locations by about 2092 (Figure 18). Linear trend projection of data from well 0612 shows that concentrations for that well should be below the compliance goal by about 2015. Sulfate concentrations predicted by the model decrease linearly throughout the flushing period.

#### 4.1.1.6 Uranium

The uranium compliance goal was exceeded at all locations except wells 0635 and 0863 in June 2009 (Figures 19 and 20). This is consistent with previous monitoring results. The four wells with the most elevated uranium concentrations (0612, 0617, 0631, and 0633) have shown a generally decreasing concentration trend since source removal, though concentrations at well 0633 increased about 50 percent over 2008 concentrations. Groundwater model predictions indicate that sitewide uranium flushing will be complete by about 80 years after June 2002 (Figure 21). To date, observed concentrations at the two wells that have the highest uranium concentrations (wells 0612 and 0633) are in close agreement with the model results (Figure 21). These wells are widely separated in the aquifer. The predicted flushing period for these two wells differs from the predicted sitewide flushing time because the last area to flush is south of the downgradient-most monitor well (well 0612). Linear projection of the observed concentration trends implies sitewide uranium flushing by about 2031. The model predicts similar rates of flushing initially, followed by a period of much less rapid flushing and marginal levels of contamination (concentration tailing) until the goal is attained. Uranium concentrations may remain slightly above the compliance goal during the period of reduced flushing.

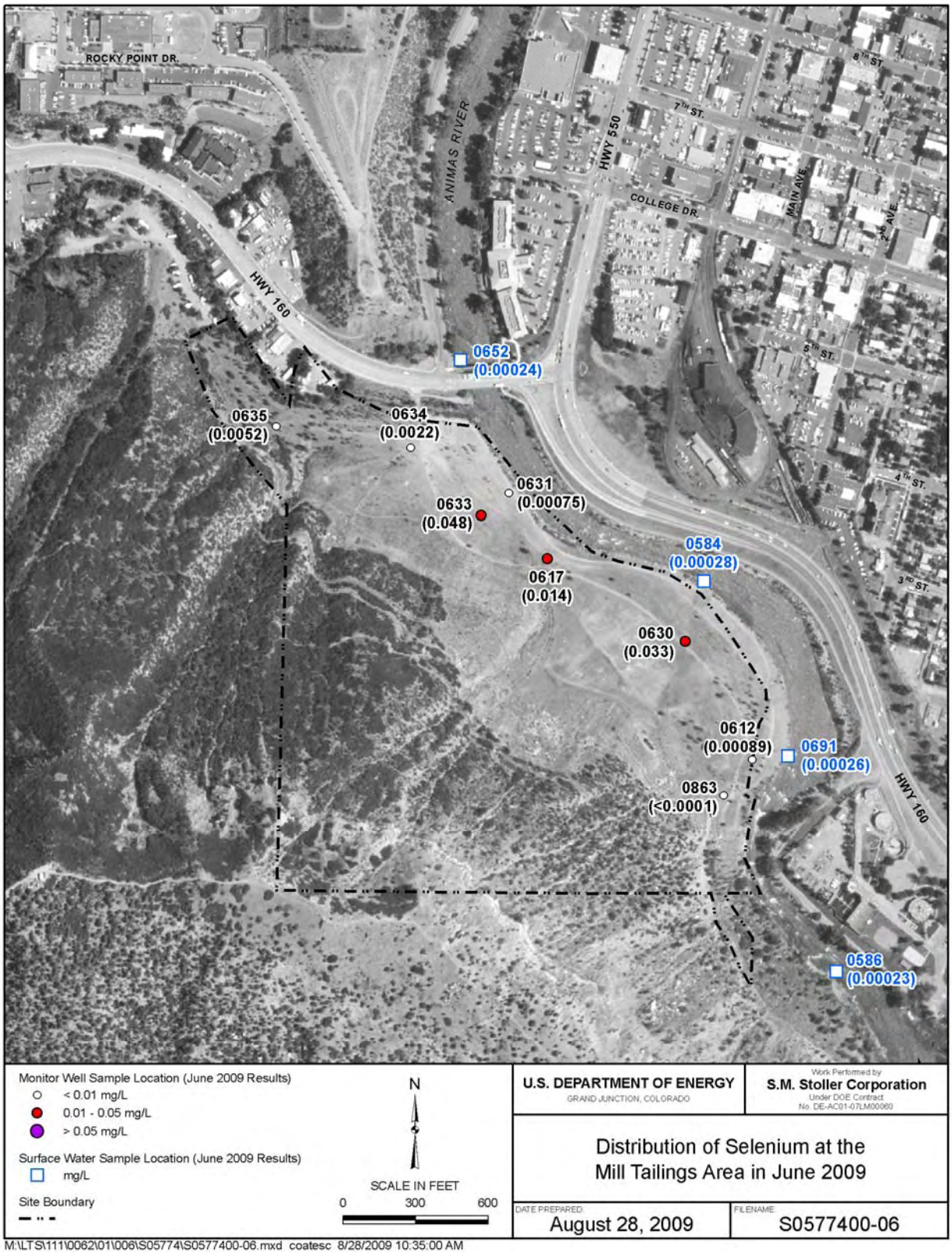


*Figure 13. Distribution of Selenium at the Mill Tailings Area*

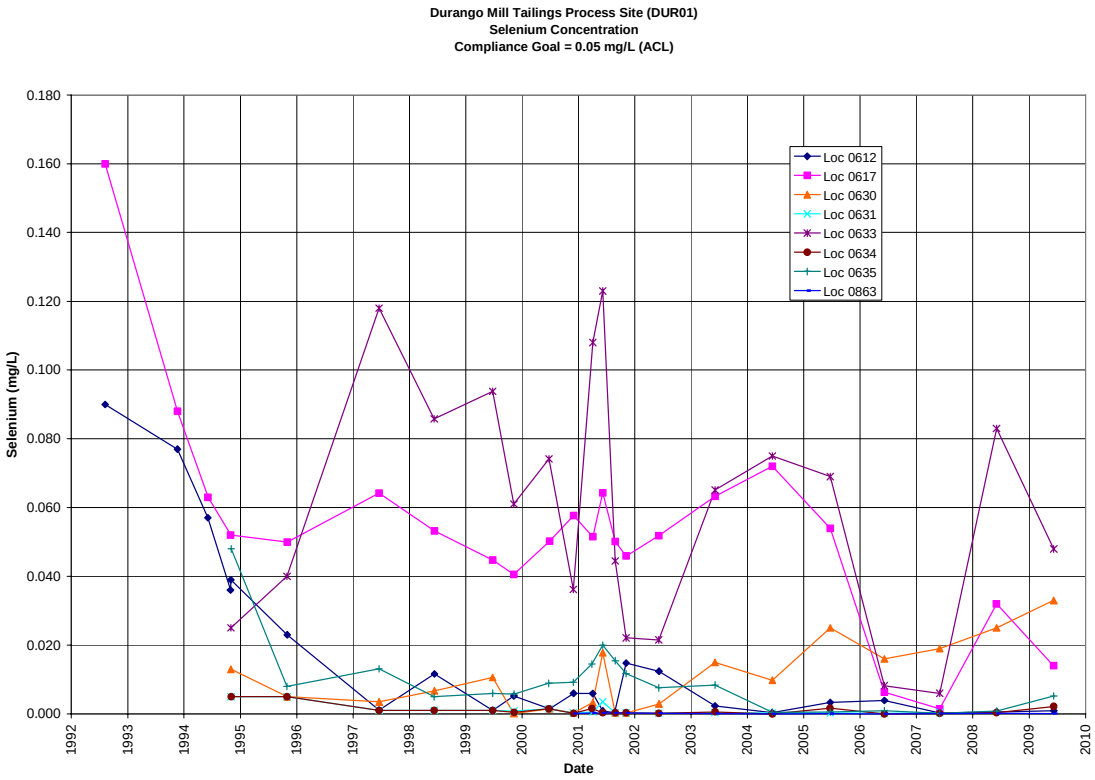


*Figure 14. Historical Selenium Concentrations in Groundwater at the Mill Tailings Area*

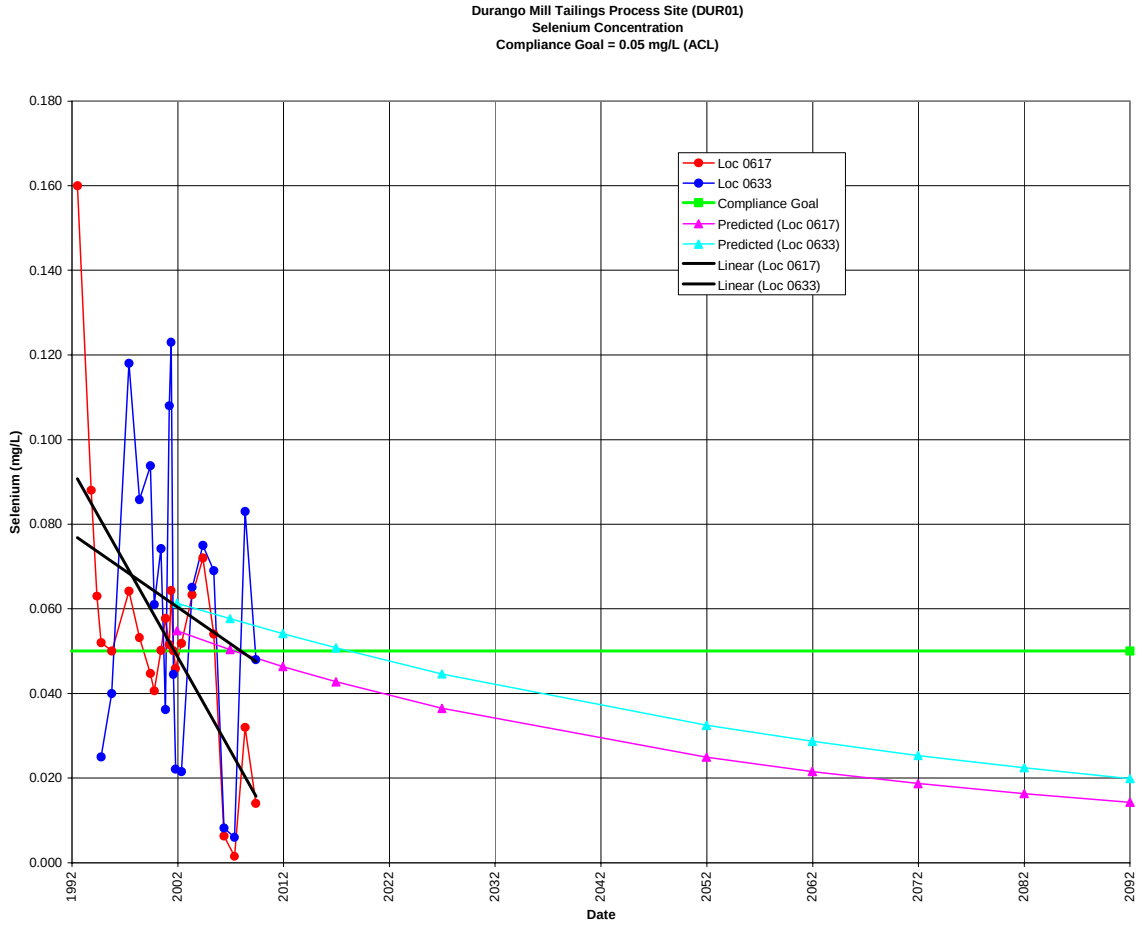


*Figure 15. Predicted and Measured Selenium Concentrations at the Mill Tailings Area*


*Figure 16. Distribution of Sulfate at the Mill Tailings Area*

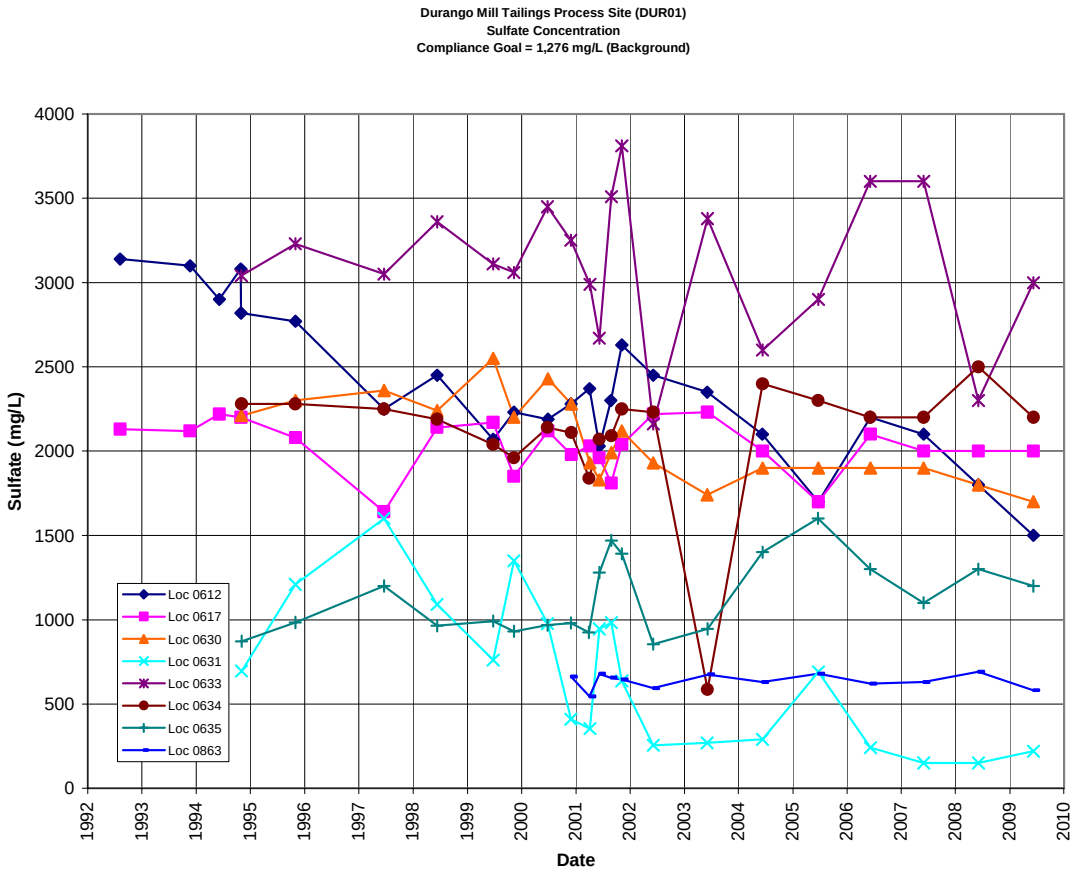


*Figure 17. Historical Concentrations of Sulfate at the Mill Tailings Area*

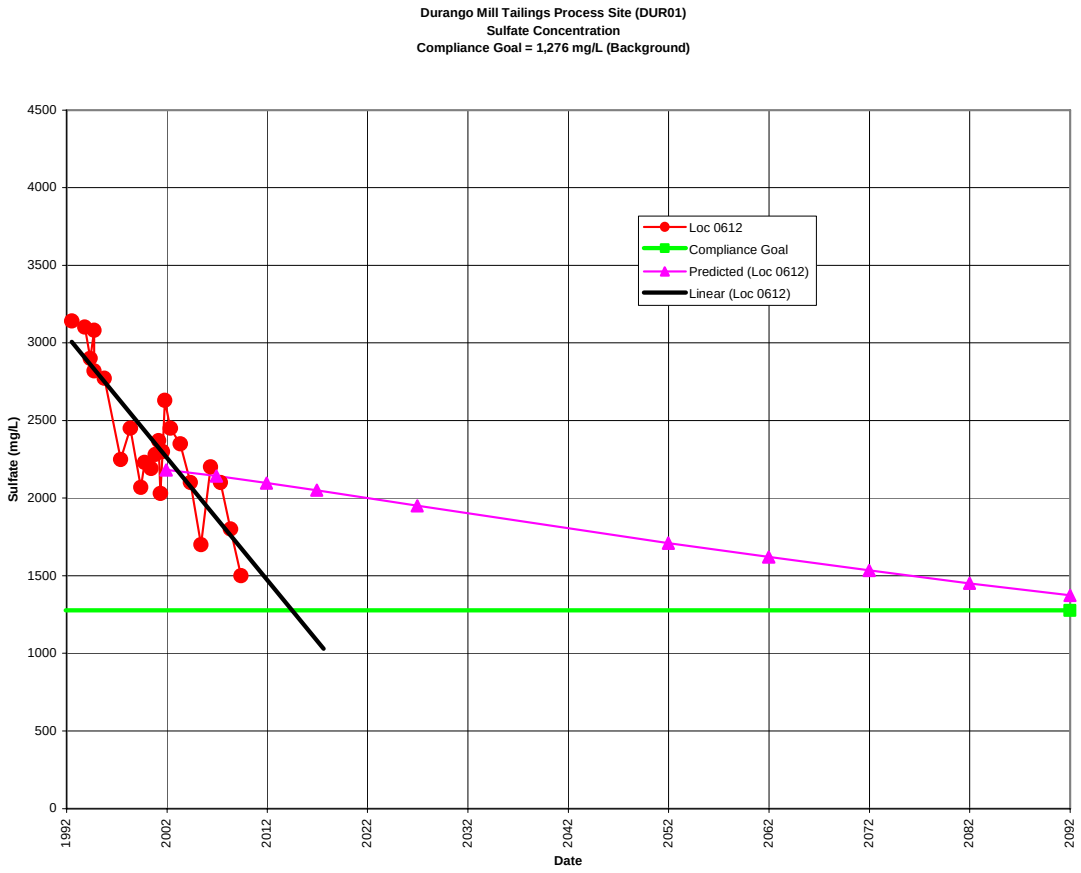


*Figure 18. Predicted and Measured Sulfate Concentrations at the Mill Tailings Area*

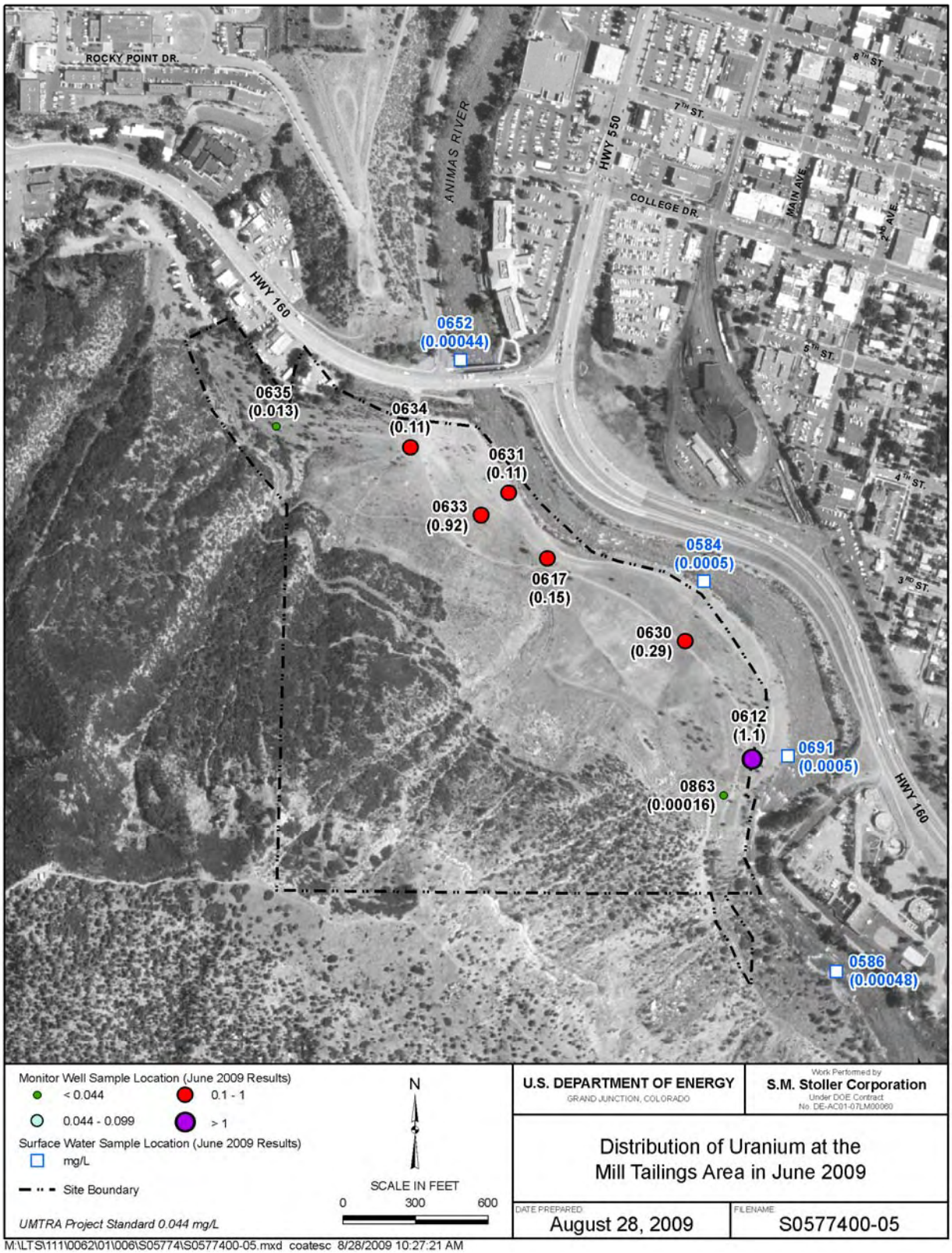


*Figure 19. Distribution of Uranium at the Mill Tailings Area*

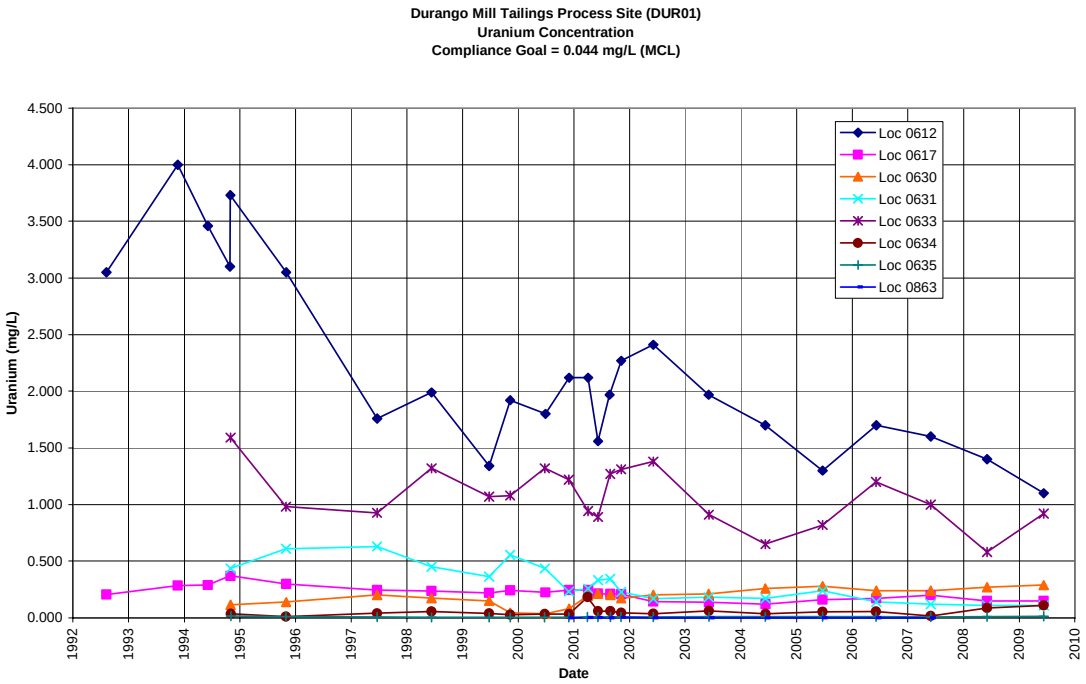


*Figure 20. Historical Concentrations of Uranium at the Mill Tailings Area*

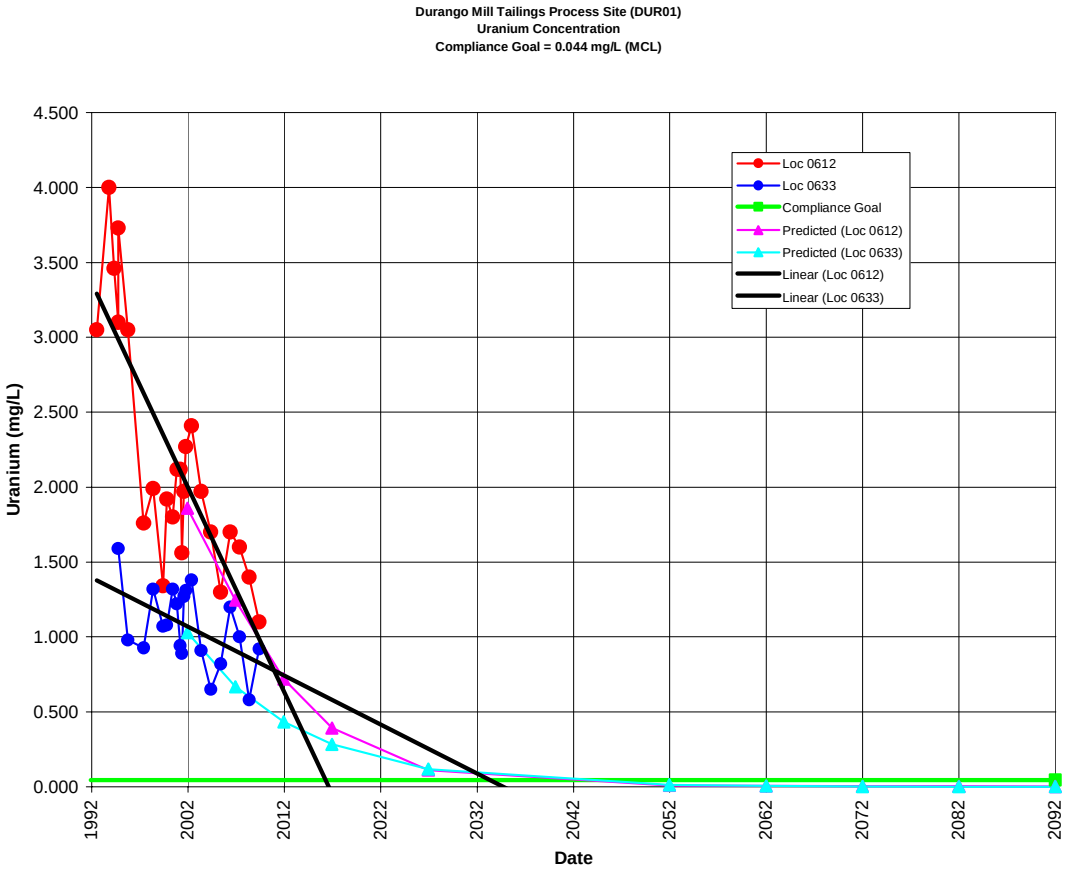


*Figure 21. Predicted and Measured Uranium Concentrations at the Mill Tailings Area*

### 4.1.2 Raffinate Ponds Area

Groundwater in the raffinate ponds area is being monitored as a best management practice. Bedrock groundwater at the raffinate ponds area qualifies for supplemental standards on the basis of limited use groundwater due to widespread elevated concentrations of naturally occurring selenium. Because there are naturally occurring sources of both selenium and uranium in the area, groundwater is not expected to naturally flush. Therefore no modeling was done for the raffinate ponds area.

Groundwater was sampled from four of the five well locations in the monitoring network (Figure 3) in 2009 and analyzed for uranium and selenium. Well 0879 could not be sampled because it was covered with two feet of water from heavy rains during the June 2009 sampling event. Sampling results for 2009 are provided in Appendix A and are discussed below by constituent.

#### 4.1.2.1 Selenium

Historical concentrations of selenium since completion of remedial action in 1992 are shown in Figure 22. It appears that something caused increases in selenium in most wells from 2000 to 2005; concentrations have been declining over the last few years. It is not clear what caused the selenium increases or if such behavior can be expected in the future. Naturally elevated levels of selenium form the basis for the application of supplemental standards for the raffinate ponds area.

#### 4.1.2.2 Uranium

Historical concentrations of uranium are shown in Figure 23. Concentrations of uranium in most wells have fluctuated over the last several years but have showed no overall increasing or decreasing trends. Supplemental standards were applied to soils in the raffinate ponds area (DOE 2002), and those soils may contain residual uranium contamination that influences groundwater quality. Subpile soil analyses indicate the presence of uranium in soils remaining at the site (DOE 2002).

## 4.2 Surface Water

Surface water was sampled from six locations in the Animas River adjacent to both the mill tailings and raffinate ponds areas during June 2009 and analyzed for cadmium, molybdenum, selenium, and uranium (Figures 2 and 3 and Tables 2 and 3). In addition, a sample was collected from South Creek (location 0588), upgradient from the raffinate ponds area, to assess the quality of water entering the area. The sample from location 0588 had detectable levels of selenium and uranium that were higher than those from any other surface location (0.0005 and 0.018 mg/L, respectively). However, discharge of the creek to the Animas River had no discernible impact. Concentrations of constituents at all locations along the river were well below the respective compliance goals and remain indistinguishable from background levels (Appendix B).

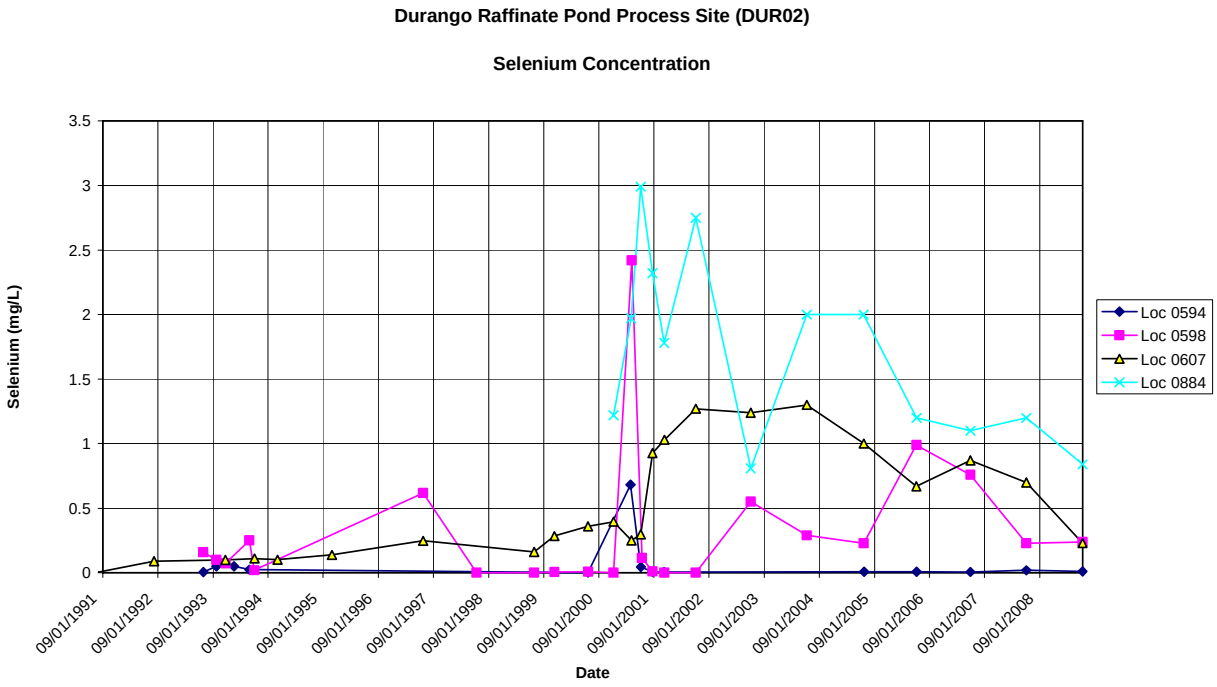


*Figure 22. Historical Selenium Concentrations in Groundwater at the Raffinate Ponds Area*

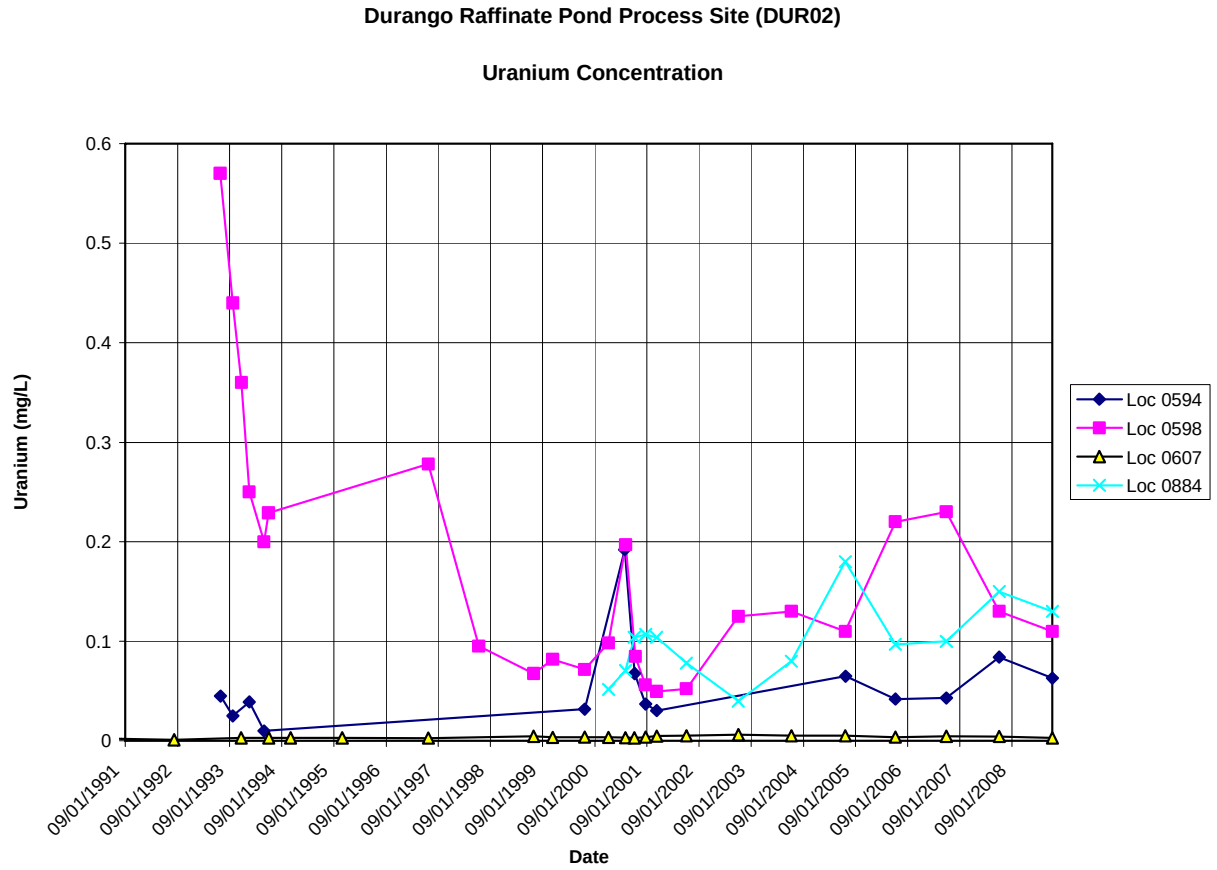


*Figure 23. Historical Uranium Concentrations in Groundwater at the Raffinate Ponds Area*

# 5.0 Natural Flushing Assessment

As of June 2008, the observed rate of contaminant flushing is generally consistent with groundwater model predictions, given that the validation period to date (June 2002 to June 2009) is short compared to predicted flushing periods (60 to 100 years) for the various contaminants. Only cadmium was identified in the modeling as potentially incapable of flushing to acceptable levels within 100 years. However, at the single location (well 0612) where cadmium is present above the compliance goal (0.01 mg/L), concentrations have decreased more rapidly than predicted by the model. The linear trend suggests the compliance goal will be reached by about 2021. For the remaining contaminants (with the possible exception of sulfate), modeling predictions and concentration trends imply that the respective compliance goals will likely be attained within 100 years; therefore, natural flushing remains a valid compliance strategy for these constituents as well. The impact on surface water quality from site-related contamination remains negligible.

# 6.0 Conclusions

Based on the assessment of the June 2009 water sampling data at the mill tailings area of the Durango site, observed concentration trends, particularly since the completion of source removal, confirm that natural flushing is measurably reducing contaminant concentrations in groundwater at the site. Overall, it is too early in the 100-year natural flushing time frame to draw definitive conclusions.

Based on these results, recommendations for ongoing monitoring at the mill tailings area include:

- Continued monitoring of groundwater and surface water quality at the currently established compliance network.
- Analysis of all water samples for the same suite of constituents for each sampling event to assist in evaluating contaminant migration trends.

It is also recommended that best management practice monitoring of the raffinate ponds area continue for the foreseeable future.

# 7.0 References

DOE (U.S. Department of Energy), 1995. *Baseline Risk Assessment of Ground Water Contamination at the Uranium Mill Tailings Site Near Durango, Colorado,* Rev. 1, DOE/AL/62350–175, U.S. Department of Energy UMTRA Project Office, Albuquerque, New Mexico, September.

DOE (U.S. Department of Energy), 2002. *Site Observational Work Plan for the Durango, Colorado, UMTRA Project Site,* GJO-2001-272-TAR/MAC-GW DUR 1.1, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, January.

DOE (U.S. Department of Energy), 2003. *Preliminary Final Ground Water Compliance Action Plan for the Durango, Colorado, UMTRA Project Site 2003,* GJO–2003-463-TAC/GWDUR 1.9, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, July.

EPA (U.S. Environmental Protection Agency), 2004. *2004 Edition of the Drinking Water Standards and Health Advisories,* EPA822-R-04-005.

# Appendix A

# Durango Mill Tailings Process Site (DUR01)
# Groundwater Quality Data

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CLASSIC GROUND WATER QUALITY DATA BY PARAMETER WITH ZONE (USEE201) FOR SITE DUR01, Durango Mill Tailings Process Site
REPORT DATE: 9/8/2009 1:07 pm

| PARAMETER | UNITS | LOCATION ID | LOCATION TYPE | SAMPLE: DATE | ID | ZONE COMPL. | FLOW REL. | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alkalinity, Total (As CaCO3 | mg/L | 0612 | WL | 06/10/2009 | N001 | AL | D | 398 | | F | # | - | - |
| | mg/L | 0617 | WL | 06/09/2009 | N001 | AL | D | 441 | | F | # | - | - |
| | mg/L | 0630 | WL | 06/10/2009 | 0001 | AL | D | 331 | | FQ | # | - | - |
| | mg/L | 0631 | WL | 06/09/2009 | N001 | AL | D | 387 | | F | # | - | - |
| | mg/L | 0633 | WL | 06/09/2009 | N001 | KM | D | 557 | | F | # | - | - |
| | mg/L | 0634 | WL | 06/09/2009 | N001 | AL | D | 528 | | FQ | # | - | - |
| | mg/L | 0635 | WL | 06/10/2009 | N001 | AL | D | 436 | | F | # | - | - |
| | mg/L | 0863 | WL | 06/09/2009 | N001 | CV | | 548 | | F | # | - | - |
| Cadmium | mg/L | 0612 | WL | 06/10/2009 | 0001 | AL | D | 0.042 | | F | # | 0.00063 | - |
| | mg/L | 0863 | WL | 06/09/2009 | N001 | CV | | 0.00003 | U | F | # | 3.2E-05 | - |
| Manganese | mg/L | 0612 | WL | 06/10/2009 | 0001 | AL | D | 4.200 | | F | # | 0.00023 | - |
| | mg/L | 0617 | WL | 06/09/2009 | N001 | AL | D | 0.440 | | F | # | 0.00023 | - |
| | mg/L | 0630 | WL | 06/10/2009 | 0001 | AL | D | 0.570 | | FQ | # | 0.00023 | - |
| | mg/L | 0631 | WL | 06/09/2009 | N001 | AL | D | 0.250 | | F | # | 0.00012 | - |
| | mg/L | 0633 | WL | 06/09/2009 | N001 | KM | D | 0.029 | | F | # | 0.00058 | - |
| | mg/L | 0634 | WL | 06/09/2009 | N001 | AL | D | 0.015 | B | FQ | # | 0.00058 | - |
| | mg/L | 0635 | WL | 06/10/2009 | N001 | AL | D | 0.110 | | F | # | 0.00023 | - |
| | mg/L | 0863 | WL | 06/09/2009 | N001 | CV | | 0.110 | | F | # | 0.00023 | - |
| Molybdenum | mg/L | 0612 | WL | 06/10/2009 | 0001 | AL | D | 0.096 | | F | # | 0.0014 | - |
| | mg/L | 0617 | WL | 06/09/2009 | N001 | AL | D | 0.0022 | | F | # | 0.00014 | - |
| | mg/L | 0630 | WL | 06/10/2009 | 0001 | AL | D | 0.0053 | | FQ | # | 0.00035 | - |
| | mg/L | 0631 | WL | 06/09/2009 | N001 | AL | D | 0.0071 | | F | # | 0.00014 | - |
| | mg/L | 0633 | WL | 06/09/2009 | N001 | KM | D | 0.0019 | | F | # | 0.00007 | - |
| | mg/L | 0634 | WL | 06/09/2009 | N001 | AL | D | 0.0024 | | FQ | # | 0.00007 | - |
| | mg/L | 0635 | WL | 06/10/2009 | N001 | AL | D | 0.0017 | | F | # | 0.00007 | - |
| | mg/L | 0863 | WL | 06/09/2009 | N001 | CV | | 0.0007 | B | UF | # | 0.00007 | - |

CLASSIC GROUND WATER QUALITY DATA BY PARAMETER WITH ZONE (USEE201) FOR SITE DUR01, Durango Mill Tailings Process Site
REPORT DATE: 9/8/2009 1:07 pm

| PARAMETER | UNITS | LOCATION ID | LOCATION TYPE | SAMPLE: DATE | ID | ZONE COMPL. | FLOW REL. | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oxidation Reduction Potent | mV | 0612 | WL | 06/10/2009 | N001 | AL | D | 49.3 | | F | # | - | - |
| | mV | 0617 | WL | 06/09/2009 | N001 | AL | D | 51.5 | | F | # | - | - |
| | mV | 0630 | WL | 06/10/2009 | N001 | AL | D | 18.0 | | FQ | # | - | - |
| | mV | 0631 | WL | 06/09/2009 | N001 | AL | D | -115.7 | | F | # | - | - |
| | mV | 0633 | WL | 06/09/2009 | N001 | KM | D | 10.8 | | F | # | - | - |
| | mV | 0634 | WL | 06/09/2009 | N001 | AL | D | 171.9 | | FQ | # | - | - |
| | mV | 0635 | WL | 06/10/2009 | N001 | AL | D | -29.5 | | F | # | - | - |
| | mV | 0863 | WL | 06/09/2009 | N001 | CV | | -8.5 | | F | # | - | - |
| pH | s.u. | 0612 | WL | 06/10/2009 | N001 | AL | D | 7.03 | | F | # | - | - |
| | s.u. | 0617 | WL | 06/09/2009 | N001 | AL | D | 6.90 | | F | # | - | - |
| | s.u. | 0630 | WL | 06/10/2009 | N001 | AL | D | 6.94 | | FQ | # | - | - |
| | s.u. | 0631 | WL | 06/09/2009 | N001 | AL | D | 7.25 | | F | # | - | - |
| | s.u. | 0633 | WL | 06/09/2009 | N001 | KM | D | 6.81 | | F | # | - | - |
| | s.u. | 0634 | WL | 06/09/2009 | N001 | AL | D | 6.92 | | FQ | # | - | - |
| | s.u. | 0635 | WL | 06/10/2009 | N001 | AL | D | 6.94 | | F | # | - | - |
| | s.u. | 0863 | WL | 06/09/2009 | N001 | CV | | 6.97 | | F | # | - | - |
| Selenium | mg/L | 0612 | WL | 06/10/2009 | 0001 | AL | D | 0.00089 | | F | # | 1.8E-05 | - |
| | mg/L | 0617 | WL | 06/09/2009 | N001 | AL | D | 0.014 | | F | # | 1.8E-05 | - |
| | mg/L | 0630 | WL | 06/10/2009 | 0001 | AL | D | 0.033 | | FQ | # | 9.1E-05 | - |
| | mg/L | 0631 | WL | 06/09/2009 | N001 | AL | D | 0.00075 | | F | # | 1.8E-05 | - |
| | mg/L | 0633 | WL | 06/09/2009 | N001 | KM | D | 0.048 | | F | # | 0.00018 | - |
| | mg/L | 0634 | WL | 06/09/2009 | N001 | AL | D | 0.0022 | | FQ | # | 1.8E-05 | - |
| | mg/L | 0635 | WL | 06/10/2009 | N001 | AL | D | 0.0052 | | F | # | 1.8E-05 | - |
| | mg/L | 0863 | WL | 06/09/2009 | N001 | CV | | 0.0001 | | UF | # | 1.8E-05 | - |
| Specific Conductance | umhos/cm | 0612 | WL | 06/10/2009 | N001 | AL | D | 3416 | | F | # | - | - |

CLASSIC GROUND WATER QUALITY DATA BY PARAMETER WITH ZONE (USEE201) FOR SITE DUR01, Durango Mill Tailings Process Site
REPORT DATE: 9/8/2009 1:07 pm

| PARAMETER | UNITS | LOCATION ID | LOCATION TYPE | SAMPLE: DATE | ID | ZONE COMPL. | FLOW REL. | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specific Conductance | umhos/cm | 0617 | WL | 06/09/2009 | N001 | AL | D | 3361 | | F | # | - | - |
| | umhos/cm | 0630 | WL | 06/10/2009 | N001 | AL | D | 2967 | | FQ | # | - | - |
| | umhos/cm | 0631 | WL | 06/09/2009 | N001 | AL | D | 1143 | | F | # | - | - |
| | umhos/cm | 0633 | WL | 06/09/2009 | N001 | KM | D | 5031 | | F | # | - | - |
| | umhos/cm | 0634 | WL | 06/09/2009 | N001 | AL | D | 3963 | | FQ | # | - | - |
| | umhos/cm | 0635 | WL | 06/10/2009 | N001 | AL | D | 2381 | | F | # | - | - |
| | umhos/cm | 0863 | WL | 06/09/2009 | N001 | CV | | 2111 | | F | # | - | - |
| Sulfate | mg/L | 0612 | WL | 06/10/2009 | 0001 | AL | D | 1500 | | F | # | 25 | - |
| | mg/L | 0617 | WL | 06/09/2009 | N001 | AL | D | 2000 | | F | # | 25 | - |
| | mg/L | 0630 | WL | 06/10/2009 | 0001 | AL | D | 1700 | | FQ | # | 25 | - |
| | mg/L | 0631 | WL | 06/09/2009 | N001 | AL | D | 220 | | F | # | 5 | - |
| | mg/L | 0633 | WL | 06/09/2009 | N001 | KM | D | 3000 | | F | # | 25 | - |
| | mg/L | 0634 | WL | 06/09/2009 | N001 | AL | D | 2200 | | FQ | # | 25 | - |
| | mg/L | 0635 | WL | 06/10/2009 | N001 | AL | D | 1200 | | F | # | 10 | - |
| | mg/L | 0863 | WL | 06/09/2009 | N001 | CV | | 580 | | F | # | 10 | - |
| Temperature | C | 0612 | WL | 06/10/2009 | N001 | AL | D | 12.84 | | F | # | - | - |
| | C | 0617 | WL | 06/09/2009 | N001 | AL | D | 11.89 | | F | # | - | - |
| | C | 0630 | WL | 06/10/2009 | N001 | AL | D | 12.18 | | FQ | # | - | - |
| | C | 0631 | WL | 06/09/2009 | N001 | AL | D | 12.18 | | F | # | - | - |
| | C | 0633 | WL | 06/09/2009 | N001 | KM | D | 13.91 | | F | # | - | - |
| | C | 0634 | WL | 06/09/2009 | N001 | AL | D | 11.98 | | FQ | # | - | - |
| | C | 0635 | WL | 06/10/2009 | N001 | AL | D | 10.42 | | F | # | - | - |
| | C | 0863 | WL | 06/09/2009 | N001 | CV | | 12.38 | | F | # | - | - |
| Turbidity | NTU | 0612 | WL | 06/10/2009 | N001 | AL | D | 336 | | F | # | - | - |
| | NTU | 0617 | WL | 06/09/2009 | N001 | AL | D | 1.91 | | F | # | - | - |
| | NTU | 0630 | WL | 06/10/2009 | N001 | AL | D | 72 | | FQ | # | - | - |

CLASSIC GROUND WATER QUALITY DATA BY PARAMETER WITH ZONE (USEE201) FOR SITE DUR01, Durango Mill Tailings Process Site
REPORT DATE: 9/8/2009 1:07 pm

| PARAMETER | UNITS | LOCATION ID | LOCATION TYPE | SAMPLE: DATE | ID | ZONE COMPL. | FLOW REL. | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turbidity | NTU | 0631 | WL | 06/09/2009 | N001 | AL | D | 2.02 | | F | # | - | - |
| | NTU | 0633 | WL | 06/09/2009 | N001 | KM | D | 0.53 | | F | # | - | - |
| | NTU | 0634 | WL | 06/09/2009 | N001 | AL | D | 6.88 | | FQ | # | - | - |
| | NTU | 0635 | WL | 06/10/2009 | N001 | AL | D | 3.29 | | F | # | - | - |
| | NTU | 0863 | WL | 06/09/2009 | N001 | CV | | 9.5 | | F | # | - | - |
| Uranium | mg/L | 0612 | WL | 06/10/2009 | 0001 | AL | D | 1.100 | | F | # | 0.00009 | - |
| | mg/L | 0617 | WL | 06/09/2009 | N001 | AL | D | 0.150 | | F | # | 9E-06 | - |
| | mg/L | 0630 | WL | 06/10/2009 | 0001 | AL | D | 0.290 | | FQ | # | 2.2E-05 | - |
| | mg/L | 0631 | WL | 06/09/2009 | N001 | AL | D | 0.110 | | F | # | 9E-06 | - |
| | mg/L | 0633 | WL | 06/09/2009 | N001 | KM | D | 0.920 | | F | # | 4.5E-05 | - |
| | mg/L | 0634 | WL | 06/09/2009 | N001 | AL | D | 0.110 | | FQ | # | 2.2E-05 | - |
| | mg/L | 0635 | WL | 06/10/2009 | N001 | AL | D | 0.013 | | F | # | 4.5E-06 | - |
| | mg/L | 0863 | WL | 06/09/2009 | N001 | CV | | 0.00016 | | F | # | 4.5E-06 | - |

CLASSIC GROUND WATER QUALITY DATA BY PARAMETER WITH ZONE (USEE201) FOR SITE DUR01, Durango Mill Tailings Process Site
REPORT DATE: 9/8/2009 1:07 pm

| PARAMETER | UNITS | LOCATION ID | LOCATION TYPE | SAMPLE: DATE | ID | ZONE COMPL. | FLOW REL. | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

RECORDS: SELECTED FROM USEE200 WHERE site_code='DUR01' AND (data_validation_qualifiers IS NULL OR data_validation_qualifiers NOT LIKE '%N%' AND data_validation_qualifiers NOT LIKE '%R%' AND data_validation_qualifiers NOT LIKE '%X%' ) AND DATE_SAMPLED >= #1/1/2009#

SAMPLE ID CODES: 000X = Filtered sample (0.45 µm). N00X = Unfiltered sample. X = replicate number.

LOCATION TYPES: WL WELL

ZONES OF COMPLETION:

AL ALLUVIUM CV COLLUVIUM KM MANCOS SHALE

FLOW CODES: D DOWN GRADIENT

LAB QUALIFIERS:

* Replicate analysis not within control limits.
\+ Correlation coefficient for MSA < 0.995.
> Result above upper detection limit.
A TIC is a suspected aldol-condensation product.
B Inorganic: Result is between the IDL and CRDL. Organic & Radiochemistry: Analyte also found in method blank.
C Pesticide result confirmed by GC-MS.
D Analyte determined in diluted sample.
E Inorganic: Estimate value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS.
H Holding time expired, value suspect.
I Increased detection limit due to required dilution.
J Estimated
M GFAA duplicate injection precision not met.
N Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: Tentatively identified compund (TIC).
P > 25% difference in detected pesticide or Arochlor concentrations between 2 columns.
S Result determined by method of standard addition (MSA).
U Analytical result below detection limit.
W Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
X Laboratory defined (USEPA CLP organic) qualifier, see case narrative.
Y Laboratory defined (USEPA CLP organic) qualifier, see case narrative.
Z Laboratory defined (USEPA CLP organic) qualifier, see case narrative.

DATA QUALIFIERS:

F Low flow sampling method used.
G Possible grout contamination, pH > 9.
J Estimated value.
L Less than 3 bore volumes purged prior to sampling.
N Presumptive evidence that analyte is present. The analyte is "tentatively identified".
Q Qualitative result due to sampling technique
R Unusable result.
U Parameter analyzed for but was not detected.
X Location is undefined.

QA QUALIFIER: # = validated according to Quality Assurance guidelines.

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CLASSIC GROUND WATER QUALITY DATA BY PARAMETER WITH ZONE (USEE201) FOR SITE DUR02, Durango Raffinate Pond Process Site
REPORT DATE: 9/8/2009 1:08 pm

| PARAMETER | UNITS | LOCATION ID | LOCATION TYPE | SAMPLE: DATE | ID | ZONE COMPL. | FLOW REL. | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alkalinity, Total (As CaCO3 | mg/L | 0594 | WL | 06/10/2009 | N001 | MF | O | 427 | | FQ | # | - | - |
| | mg/L | 0598 | WL | 06/10/2009 | N001 | FM | O | 432 | | F | # | - | - |
| | mg/L | 0607 | WL | 06/10/2009 | 0001 | AL | U | 312 | | FQ | # | - | - |
| | mg/L | 0884 | WL | 06/10/2009 | N001 | MF | | 378 | | F | # | - | - |
| Cadmium | mg/L | 0598 | WL | 06/10/2009 | N002 | FM | O | 0.0036 | | F | # | 3.2E-05 | - |
| Molybdenum | mg/L | 0598 | WL | 06/10/2009 | N002 | FM | O | 0.0013 | | F | # | 0.00007 | - |
| Oxidation Reduction Potent | mV | 0594 | WL | 06/10/2009 | N001 | MF | O | 12.1 | | FQ | # | - | - |
| | mV | 0598 | WL | 06/10/2009 | N001 | FM | O | 6.1 | | F | # | - | - |
| | mV | 0607 | WL | 06/10/2009 | N001 | AL | U | 71.2 | | FQ | # | - | - |
| | mV | 0884 | WL | 06/10/2009 | N001 | MF | | 40.6 | | F | # | - | - |
| pH | s.u. | 0594 | WL | 06/10/2009 | N001 | MF | O | 6.98 | | FQ | # | - | - |
| | s.u. | 0598 | WL | 06/10/2009 | N001 | FM | O | 7.11 | | F | # | - | - |
| | s.u. | 0607 | WL | 06/10/2009 | N001 | AL | U | 7.32 | | FQ | # | - | - |
| | s.u. | 0884 | WL | 06/10/2009 | N001 | MF | | 7.18 | | F | # | - | - |
| Selenium | mg/L | 0594 | WL | 06/10/2009 | N001 | MF | O | 0.010 | | FQ | # | 1.8E-05 | - |
| | mg/L | 0598 | WL | 06/10/2009 | N001 | FM | O | 0.240 | | F | # | 0.00091 | - |
| | mg/L | 0598 | WL | 06/10/2009 | N002 | FM | O | 0.230 | | F | # | 0.00091 | - |
| | mg/L | 0607 | WL | 06/10/2009 | 0001 | AL | U | 0.230 | | FQ | # | 0.00091 | - |
| | mg/L | 0884 | WL | 06/10/2009 | N001 | MF | | 0.840 | | F | # | 0.0018 | - |
| Specific Conductance | umhos/cm | 0594 | WL | 06/10/2009 | N001 | MF | O | 4156 | | FQ | # | - | - |
| | umhos/cm | 0598 | WL | 06/10/2009 | N001 | FM | O | 7792 | | F | # | - | - |
| | umhos/cm | 0607 | WL | 06/10/2009 | N001 | AL | U | 1601 | | FQ | # | - | - |
| | umhos/cm | 0884 | WL | 06/10/2009 | N001 | MF | | 4006 | | F | # | - | - |
| Temperature | C | 0594 | WL | 06/10/2009 | N001 | MF | O | 13.47 | | FQ | # | - | - |
| | C | 0598 | WL | 06/10/2009 | N001 | FM | O | 11.21 | | F | # | - | - |

CLASSIC GROUND WATER QUALITY DATA BY PARAMETER WITH ZONE (USEE201) FOR SITE DUR02, Durango Raffinate Pond Process Site
REPORT DATE: 9/8/2009 1:08 pm

| PARAMETER | UNITS | LOCATION ID | LOCATION TYPE | SAMPLE: DATE | ID | ZONE COMPL. | FLOW REL. | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | C | 0607 | WL | 06/10/2009 | N001 | AL | U | 11.38 | | FQ | # | - | - |
| | C | 0884 | WL | 06/10/2009 | N001 | MF | | 15.19 | | F | # | - | - |
| Total Dissolved Solids | mg/L | 0598 | WL | 06/10/2009 | N002 | FM | O | 7800 | | F | # | 200 | - |
| | mg/L | 0884 | WL | 06/10/2009 | N001 | MF | | 3900 | | F | # | 80 | - |
| Turbidity | NTU | 0594 | WL | 06/10/2009 | N001 | MF | O | 4.83 | | FQ | # | - | - |
| | NTU | 0598 | WL | 06/10/2009 | N001 | FM | O | 4.16 | | F | # | - | - |
| | NTU | 0607 | WL | 06/10/2009 | N001 | AL | U | 12.9 | | FQ | # | - | - |
| | NTU | 0884 | WL | 06/10/2009 | N001 | MF | | 8.41 | | F | # | - | - |
| Uranium | mg/L | 0594 | WL | 06/10/2009 | N001 | MF | O | 0.063 | | FQ | # | 4.5E-06 | - |
| | mg/L | 0598 | WL | 06/10/2009 | N001 | FM | O | 0.110 | | F | # | 4.5E-06 | - |
| | mg/L | 0598 | WL | 06/10/2009 | N002 | FM | O | 0.110 | | F | # | 2.2E-05 | - |
| | mg/L | 0607 | WL | 06/10/2009 | 0001 | AL | U | 0.0029 | | FQ | # | 4.5E-06 | - |
| | mg/L | 0884 | WL | 06/10/2009 | N001 | MF | | 0.130 | | F | # | 9E-06 | - |

CLASSIC GROUND WATER QUALITY DATA BY PARAMETER WITH ZONE (USEE201) FOR SITE DUR02, Durango Raffinate Pond Process Site
REPORT DATE: 9/8/2009 1:08 pm

| PARAMETER | UNITS | LOCATION ID | LOCATION TYPE | SAMPLE: DATE | ID | ZONE COMPL. | FLOW REL. | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

RECORDS: SELECTED FROM USEE200 WHERE site_code='DUR02' AND (data_validation_qualifiers IS NULL OR data_validation_qualifiers NOT LIKE '%N%' AND data_validation_qualifiers NOT LIKE '%R%' AND data_validation_qualifiers NOT LIKE '%X%' ) AND DATE_SAMPLED >= #1/1/2009#

SAMPLE ID CODES: 000X = Filtered sample (0.45 µm). N00X = Unfiltered sample. X = replicate number.

LOCATION TYPES: WL WELL

ZONES OF COMPLETION:

AL ALLUVIUM FM FAULT - CRETACEOUS MENEFEE FORMATION MF CRETACEOUS MENEFEE FORMATION

FLOW CODES: O ON-SITE U UPGRADIENT

LAB QUALIFIERS:

| | |
|---|---|
| * | Replicate analysis not within control limits. |
| + | Correlation coefficient for MSA < 0.995. |
| > | Result above upper detection limit. |
| A | TIC is a suspected aldol-condensation product. |
| B | Inorganic: Result is between the IDL and CRDL. Organic & Radiochemistry: Analyte also found in method blank. |
| C | Pesticide result confirmed by GC-MS. |
| D | Analyte determined in diluted sample. |
| E | Inorganic: Estimate value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS. |
| H | Holding time expired, value suspect. |
| I | Increased detection limit due to required dilution. |
| J | Estimated |
| M | GFAA duplicate injection precision not met. |
| N | Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: Tentatively identified compund (TIC). |
| P | > 25% difference in detected pesticide or Arochlor concentrations between 2 columns. |
| S | Result determined by method of standard addition (MSA). |
| U | Analytical result below detection limit. |
| W | Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance. |
| X | Laboratory defined (USEPA CLP organic) qualifier, see case narrative. |
| Y | Laboratory defined (USEPA CLP organic) qualifier, see case narrative. |
| Z | Laboratory defined (USEPA CLP organic) qualifier, see case narrative. |

DATA QUALIFIERS:

| | | | | | |
|---|---|---|---|---|---|
| F | Low flow sampling method used. | G | Possible grout contamination, pH > 9. | J | Estimated value. |
| L | Less than 3 bore volumes purged prior to sampling. | N | Presumptive evidence that analyte is present. The analyte is "tentatively identified". | Q | Qualitative result due to sampling technique |
| R | Unusable result. | U | Parameter analyzed for but was not detected. | X | Location is undefined. |

QA QUALIFIER: # = validated according to Quality Assurance guidelines.

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# Appendix B

# Durango Mill Tailings Process Site (DUR01)
# Surface Water Quality Data

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SURFACE WATER QUALITY DATA BY PARAMETER (USEE800) FOR SITE DUR02, Durango Raffinate Pond Process Site
REPORT DATE: 9/8/2009 1:09 pm

| PARAMETER | UNITS | LOCATION ID | SAMPLE: DATE | ID | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| Alkalinity, Total (As CaCO3 | mg/L | 0588 | 06/11/2009 | N001 | 275 | | | # | - | - |
| | mg/L | 0654 | 06/10/2009 | N001 | 71 | | | # | - | - |
| | mg/L | 0656 | 06/10/2009 | N001 | 67 | | | # | - | - |
| Cadmium | mg/L | 0588 | 06/11/2009 | N001 | 0.0000 U | | | # | 3.2E-05 | - |
| | mg/L | 0654 | 06/10/2009 | N001 | 0.0001 B | | | # | 3.2E-05 | - |
| | mg/L | 0656 | 06/10/2009 | N001 | 0.0001 B | | | # | 3.2E-05 | - |
| Molybdenum | mg/L | 0588 | 06/11/2009 | N001 | 0.0012 | | U | # | 0.00007 | - |
| | mg/L | 0654 | 06/10/2009 | N001 | 0.0006 B | | | # | 0.00007 | - |
| | mg/L | 0656 | 06/10/2009 | N001 | 0.0006 B | | U | # | 0.00007 | - |
| Oxidation Reduction Potent | mV | 0588 | 06/11/2009 | N001 | -0.1 | | | # | - | - |
| | mV | 0654 | 06/10/2009 | N001 | 22.2 | | | # | - | - |
| | mV | 0656 | 06/10/2009 | N001 | 56.3 | | | # | - | - |
| pH | s.u. | 0588 | 06/11/2009 | N001 | 8.13 | | | # | - | - |
| | s.u. | 0654 | 06/10/2009 | N001 | 7.62 | | | # | - | - |
| | s.u. | 0656 | 06/10/2009 | N001 | 7.40 | | | # | - | - |
| Selenium | mg/L | 0588 | 06/11/2009 | N001 | 0.0005 | | | # | 1.8E-05 | - |
| | mg/L | 0654 | 06/10/2009 | N001 | 0.0002 | | | # | 1.8E-05 | - |
| | mg/L | 0656 | 06/10/2009 | N001 | 0.0002 | | | # | 1.8E-05 | - |
| Specific Conductance | umhos/cm | 0588 | 06/11/2009 | N001 | 1501 | | | # | - | - |
| | umhos/cm | 0654 | 06/10/2009 | N001 | 252 | | | # | - | - |
| | umhos/cm | 0656 | 06/10/2009 | N001 | 237 | | | # | - | - |
| Temperature | C | 0588 | 06/11/2009 | N001 | 16.25 | | | # | - | - |
| | C | 0654 | 06/10/2009 | N001 | 10.58 | | | # | - | - |
| | C | 0656 | 06/10/2009 | N001 | 10.46 | | | # | - | - |
| Turbidity | NTU | 0588 | 06/11/2009 | N001 | 4.53 | | | # | - | - |
| | NTU | 0654 | 06/10/2009 | N001 | 7.84 | | | # | - | - |
| | NTU | 0656 | 06/10/2009 | N001 | 6.39 | | | # | - | - |
| Uranium | mg/L | 0588 | 06/11/2009 | N001 | 0.018 | | J | # | 4.5E-06 | - |
| | mg/L | 0654 | 06/10/2009 | N001 | 0.0005 | | | # | 4.5E-06 | - |
| | mg/L | 0656 | 06/10/2009 | N001 | 0.0005 | | J | # | 4.5E-06 | - |

SURFACE WATER QUALITY DATA BY PARAMETER (USEE800) FOR SITE DUR02, Durango Raffinate Pond Process Site
REPORT DATE: 9/8/2009 1:09 pm

| PARAMETER | UNITS | LOCATION ID | SAMPLE: DATE | ID | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|

RECORDS: SELECTED FROM USEE800 WHERE site_code='DUR02' AND (data_validation_qualifiers IS NULL OR data_validation_qualifiers NOT LIKE '%N%' AND data_validation_qualifiers NOT LIKE '%R%' AND data_validation_qualifiers NOT LIKE '%X%' ) AND DATE_SAMPLED >= #1/1/2009#

SAMPLE ID CODES: 000X = Filtered sample (0.45 µm). N00X = Unfiltered sample. X = replicate number.

LAB QUALIFIERS:

| | |
|---|---|
| * | Replicate analysis not within control limits. |
| + | Correlation coefficient for MSA < 0.995. |
| > | Result above upper detection limit. |
| A | TIC is a suspected aldol-condensation product. |
| B | Inorganic: Result is between the IDL and CRDL. Organic & Radiochemistry: Analyte also found in method blank. |
| C | Pesticide result confirmed by GC-MS. |
| D | Analyte determined in diluted sample. |
| E | Inorganic: Estimate value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS. |
| H | Holding time expired, value suspect. |
| I | Increased detection limit due to required dilution. |
| J | Estimated |
| M | GFAA duplicate injection precision not met. |
| N | Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: Tentatively identified compund (TIC). |
| P | > 25% difference in detected pesticide or Arochlor concentrations between 2 columns. |
| S | Result determined by method of standard addition (MSA). |
| U | Analytical result below detection limit. |
| W | Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance. |
| X | Laboratory defined (USEPA CLP organic) qualifier, see case narrative. |
| Y | Laboratory defined (USEPA CLP organic) qualifier, see case narrative. |
| Z | Laboratory defined (USEPA CLP organic) qualifier, see case narrative. |

DATA QUALIFIERS:

| | |
|---|---|
| F | Low flow sampling method used. |
| J | Estimated value. |
| N | Presumptive evidence that analyte is present. The analyte is "tentatively identified". |
| R | Unusable result. |
| X | Location is undefined. |
| G | Possible grout contamination, pH > 9. |
| L | Less than 3 bore volumes purged prior to sampling. |
| Q | Qualitative result due to sampling technique |
| U | Parameter analyzed for but was not detected. |

QA QUALIFIER: # = validated according to Quality Assurance guidelines.

SURFACE WATER QUALITY DATA BY PARAMETER (USEE800) FOR SITE DUR01, Durango Mill Tailings Process Site
REPORT DATE: 9/8/2009 1:09 pm

| PARAMETER | UNITS | LOCATION ID | SAMPLE: DATE | ID | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| Alkalinity, Total (As CaCO3 | mg/L | 0584 | 06/09/2009 | N001 | 75 | | | # | - | - |
| | mg/L | 0586 | 06/10/2009 | N001 | 70 | | | # | - | - |
| | mg/L | 0652 | 06/10/2009 | N001 | 60 | | | # | - | - |
| | mg/L | 0691 | 06/10/2009 | N001 | 58 | | | # | - | - |
| Cadmium | mg/L | 0584 | 06/09/2009 | N001 | 0.0001 | B | | # | 3.2E-05 | - |
| | mg/L | 0586 | 06/10/2009 | N001 | 0.0001 | B | | # | 3.2E-05 | - |
| | mg/L | 0652 | 06/10/2009 | 0002 | 0.0000 | B | | # | 3.2E-05 | - |
| | mg/L | 0652 | 06/10/2009 | N001 | 0.0001 | B | | # | 3.2E-05 | - |
| | mg/L | 0691 | 06/10/2009 | N001 | 0.0001 | B | | # | 3.2E-05 | - |
| Molybdenum | mg/L | 0584 | 06/09/2009 | N001 | 0.0009 | B | U | # | 0.00007 | - |
| | mg/L | 0586 | 06/10/2009 | N001 | 0.0008 | B | U | # | 0.00007 | - |
| | mg/L | 0652 | 06/10/2009 | 0002 | 0.0006 | B | U | # | 0.00007 | - |
| | mg/L | 0652 | 06/10/2009 | N001 | 0.0007 | B | U | # | 0.00007 | - |
| | mg/L | 0691 | 06/10/2009 | N001 | 0.0007 | B | U | # | 0.00007 | - |
| Oxidation Reduction Potent | mV | 0584 | 06/09/2009 | N001 | 37.1 | | | # | - | - |
| | mV | 0586 | 06/10/2009 | N001 | 119.4 | | | # | - | - |
| | mV | 0652 | 06/10/2009 | N001 | 29.5 | | | # | - | - |
| | mV | 0691 | 06/10/2009 | N001 | 8.6 | | | # | - | - |
| pH | s.u. | 0584 | 06/09/2009 | N001 | 7.47 | | | # | - | - |
| | s.u. | 0586 | 06/10/2009 | N001 | 7.06 | | | # | - | - |
| | s.u. | 0652 | 06/10/2009 | N001 | 7.79 | | | # | - | - |
| | s.u. | 0691 | 06/10/2009 | N001 | 7.74 | | | # | - | - |
| Selenium | mg/L | 0584 | 06/09/2009 | N001 | 0.0002 | | | # | 1.8E-05 | - |
| | mg/L | 0586 | 06/10/2009 | N001 | 0.0002 | | | # | 1.8E-05 | - |
| | mg/L | 0652 | 06/10/2009 | 0002 | 0.0002 | | | # | 1.8E-05 | - |
| | mg/L | 0652 | 06/10/2009 | N001 | 0.0002 | | | # | 1.8E-05 | - |
| | mg/L | 0691 | 06/10/2009 | N001 | 0.0002 | | | # | 1.8E-05 | - |
| Specific Conductance | umhos/cm | 0584 | 06/09/2009 | N001 | 1 | | | # | - | - |
| | umhos/cm | 0586 | 06/10/2009 | N001 | 241 | | | # | - | - |
| | umhos/cm | 0652 | 06/10/2009 | N001 | 243 | | | # | - | - |
| | umhos/cm | 0691 | 06/10/2009 | N001 | 245 | | | # | - | - |
| Temperature | C | 0584 | 06/09/2009 | N001 | 15.91 | | | # | - | - |
| | C | 0586 | 06/10/2009 | N001 | 9.27 | | | # | - | - |
| | C | 0652 | 06/10/2009 | N001 | 10.89 | | | # | - | - |
| | C | 0691 | 06/10/2009 | N001 | 11.52 | | | # | - | - |
| Turbidity | NTU | 0584 | 06/09/2009 | N001 | 4.15 | | | # | - | - |
| | NTU | 0586 | 06/10/2009 | N001 | 9.87 | | | # | - | - |

SURFACE WATER QUALITY DATA BY PARAMETER (USEE800) FOR SITE DUR01, Durango Mill Tailings Process Site
REPORT DATE: 9/8/2009 1:09 pm

| PARAMETER | UNITS | LOCATION ID | SAMPLE: DATE | ID | RESULT | QUALIFIERS: LAB | DATA | QA | DETECTION LIMIT | UN-CERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| Turbidity | NTU | 0652 | 06/10/2009 | N001 | 6.69 | | | # | - | - |
| | NTU | 0691 | 06/10/2009 | N001 | 7.18 | | | # | - | - |
| Uranium | mg/L | 0584 | 06/09/2009 | N001 | 0.0005 | | J | # | 4.5E-06 | - |
| | mg/L | 0586 | 06/10/2009 | N001 | 0.0004 | | J | # | 4.5E-06 | - |
| | mg/L | 0652 | 06/10/2009 | 0002 | 0.0004 | | | # | 4.5E-06 | - |
| | mg/L | 0652 | 06/10/2009 | N001 | 0.0005 | | J | # | 4.5E-06 | - |
| | mg/L | 0691 | 06/10/2009 | N001 | 0.0005 | | J | # | 4.5E-06 | - |

RECORDS: SELECTED FROM USEE800 WHERE site_code='DUR01' AND (data_validation_qualifiers IS NULL OR data_validation_qualifiers NOT LIKE '%N%' AND data_validation_qualifiers NOT LIKE '%R%' AND data_validation_qualifiers NOT LIKE '%X%' ) AND DATE_SAMPLED >= #1/1/2009#

SAMPLE ID CODES: 000X = Filtered sample (0.45 µm). N00X = Unfiltered sample. X = replicate number.

LAB QUALIFIERS:

- * Replicate analysis not within control limits.
- + Correlation coefficient for MSA < 0.995.
- > Result above upper detection limit.
- A TIC is a suspected aldol-condensation product.
- B Inorganic: Result is between the IDL and CRDL. Organic & Radiochemistry: Analyte also found in method blank.
- C Pesticide result confirmed by GC-MS.
- D Analyte determined in diluted sample.
- E Inorganic: Estimate value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS.
- H Holding time expired, value suspect.
- I Increased detection limit due to required dilution.
- J Estimated
- M GFAA duplicate injection precision not met.
- N Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: Tentatively identified compund (TIC).
- P > 25% difference in detected pesticide or Arochlor concentrations between 2 columns.
- S Result determined by method of standard addition (MSA).
- U Analytical result below detection limit.
- W Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
- X Laboratory defined (USEPA CLP organic) qualifier, see case narrative.
- Y Laboratory defined (USEPA CLP organic) qualifier, see case narrative.
- Z Laboratory defined (USEPA CLP organic) qualifier, see case narrative.

DATA QUALIFIERS:

- F Low flow sampling method used.
- J Estimated value.
- N Presumptive evidence that analyte is present. The analyte is "tentatively identified".
- R Unusable result.
- X Location is undefined.
- G Possible grout contamination, pH > 9.
- L Less than 3 bore volumes purged prior to sampling.
- Q Qualitative result due to sampling technique
- U Parameter analyzed for but was not detected.

QA QUALIFIER: # = validated according to Quality Assurance guidelines.