**Sediment Sampling, Stewart Lake, Utah**
**April 1 through April 5, 2002**

From April 1 through April 5, 2002, USBR and USGS personnel collected sediment samples from 22 sites throughout Stewart Lake, placed exploratory borings at 15 sites in an upland area adjacent the lake, and tilled quicklime into a 3 acre test plot. Participants were: USGS, Ryan Rowland: USBR, Willie Forest, Jack Jibson, Del Smith, Billy Cummins, and Steven Hoffman. All of the sites have been sampled in previous years.

The lake was drained, but water was flowing in all of the drain ditches throughout the lake. Some sites in the northeast quarter of the lake were saturated to ground surface. Most of the rest of the lake bed surface was dry, although the ground was moist to the surface along either side of the main north-south ditch. The level of the nearby Green River was below the height of the Stewart Lake inlet channel.

Quicklime was tilled into site S21, to raise the pH to 9 or higher in the top six inches of sediment. A description of the lime application is included at the end of this report, under the heading **Lime Application**. The tilled areas at sites S1, S7, S10 and S15 were tilled, to depths of approximately 6 inches, but no lime was added to those sites.

Exploratory borings were placed throughout the area in which the irrigation J2 drain formerly daylighted. Significant seepage from that area still contributes selenium-contaminated water to Stewart Lake, and the borings were placed to investigate the feasibility of installing a subsurface drain to intercept that water. A description of that activity is included under the heading **Exploratory Borings**.

A new site, S22 was established and sampled immediately east of S15, in the area identified in 2001 as the S15 Vegetative Treatment Plot. Site S22 is under consideration as the location for a sediment removal test area.

**April 1**

**Site S21** was sampled on April 1. Sediment samples were collected from each of the individual quadrants at the site, NE, NW, SE, and SW, at depth intervals of zero to 6 inches, 6 to 12 inches, and 12 to 18 inches, to test for total levels of selenium. Additional sediment samples were collected at the same depth intervals, to test for selenium speciation.

Samples from zero to 6 inches were composites of ten subsamples collected randomly across each quadrant. Samples below 6 inches were composites of 3 subsamples, collected at random locations across each quadrant.

**April 2**

The tilled plot at **S15** was sampled, to test for total levels of selenium. Samples were collected from 6 inch intervals, to a depth of 36 inches, with the same sampling method used at S21.

A sample was also collected in the tilled plot for speciation testing, from the zero to 6 inch interval. The sample was a composite of 10 randomly selected subsamples.

The control plot at **S15** was sampled for total levels of selenium. The subareas previously separately identified as "control" and "vegetative control" were sampled together, as a single unit. Samples were collected from 6 inch intervals, to a depth of 42 inches, with the same sampling method used at S21.

The depth to water in the observation well at S15 was 21.5 inches below ground surface. The stream of water in the drain ditch adjacent S15 was 4 inches deep and 7 feet wide.

The tilled plots and control plots at **sites S1, S7, and S10** were sampled for total selenium at 6 inch depth intervals, to 30 inches, with the same sampling method used at S21. Speciation samples were also collected at the tilled plots, from zero to 6 inches, with the same sampling method used at S15.

Water in the observation well at S1 was 42.5 inches below ground surface.

Saturated soil was encountered at 30 inches while sampling at S7. With the sample hole left open for 30 minutes, water was observed at 22.5 inches. It was noted that the area had been mowed with a brush mower. The sparse growth of forbs and scattered tamarisk and cottonwood saplings in the area were cut to a height of around 4 inches.

Water in the observation well at S10 was 12.5 inches below ground surface. The area had been mowed. The stream of water observed in the drain ditch adjacent S10 was 3 to 4 inches deep and 4 feet wide.

**Site S22** was established immediately east of the till plot at S15, in the area previously identified as the "Vegetative Treatment Plot". Samples were collected for total selenium testing from 6 inch depth intervals, to 36 inches. Samples were collected with the same method as at S15.

**April 3**

**Sites S2, S3, S4, S5, S6, S8, S9, S11, S12, S13, S14, S17, and S18** were sampled, to test for total levels of selenium. The samples were composites of five subsamples collected randomly within a 2 meter radius of the pole marking each site.

At S14 the ground was very moist, to the surface. The ground surface at S18 was saturated, and intermittent areas at the site had frozen soil at varying depths, from 2 inches to 10 inches beneath the surface.

**Stewart Lake, Utah Activities, April 1 - 5, 2002**

An unsuccessful attempt was made to sample sediments at S16. The site was covered with ice several inches deep. The area around S16 was saturated or submerged beneath several inches of water. The approach to S16 was hazardous, with water covering the ice in places.

**At Site S15** a second observation well was installed beside the existing well. The new well was made with a 10 foot length of PVC pipe, 2 inches in diameter, inserted into a 9.5 foot deep auger boring, and covered with a PVC cap. The pipe is solid sided, not slotted.

The soils observed during auguring were: 0 - 58 inches clay, 58 - 60 inches fine sandy loam, 60 - 76 inches clay, 76 - 108 inches very fine sandy loam, 108 - 114 inches very fine sandy clay. Free water was observed in the soil at a depth of 28 inches.

**April 4**

**Sites S16, S19, and S20** were sampled for total selenium. The samples were collected in the same manner as those on the previous day. An additional sample was collected at S16, zero to 6 inches, to test for selenium speciation. The ground around S16 was saturated or submerged, but the ice had melted. The ground surface at S19 was saturated.

Water levels were measured in the observation wells at S15. The new well had water at 19 inches below ground surface. The original well had water at 23 inches.

**April 5**

**At site S21** samples were collected in each of the four quadrants, from depth intervals of zero to 6 inches, to test for total levels of selenium. Samples were composites of 10 subsamples collected randomly in each quadrant.

Speciation samples were collected from each quadrant in the same manner as the total selenium samples. Additional speciation samples were collected in two quadrants, to send to a second laboratory.

Staff transported the samples to Reclamation's soil and water quality laboratory at the Denver TSC. Throughout the sampling period and during transport, all samples were stored on ice in coolers. At the laboratory, the speciation samples were transferred from the coolers to a refrigerator.

On Thursday, April 11, the speciation samples were placed on Blue Ice in coolers, and shipped to the University of California, Riverside and to the University of Cincinnati, for laboratory testing.

**Lime Application**

From Tuesday, April 2, through Friday, April 5, quicklime was applied and tilled into site S21. The quicklime was delivered to the site in 1,000 pound bags, referred to as Supersacks. The

bags were emptied onto a plastic tarp, from which a front end loader transferred it into a drop spreader. The spreader was towed across the site, distributing the quicklime evenly. The quicklime was then tilled into the sediment, to a depth of around 6 inches, with a hydraulically powered tiller mounted on a Caterpillar tracked all surface vehicle. A total of 40,420 pounds of quicklime were applied and tilled into the sediment, for an average of 0.62 pounds of quicklime per cubic foot of sediment, or 1.03 percent by weight, lime to sediment.

**Exploratory Borings**

On Tuesday and Wednesday April 2 and 3, exploratory borings were placed in 15 locations throughout a pasture on the uplands at the northwest corner of Stewart Lake. Before they were intercepted and rerouted to the Green River in 1998, the agricultural drain J2 discharged in the pasture, and the J3 drain daylighted at the bottom of the pasture, at the edge of the lake and flowing in. Uncontrolled seeps still enter Stewart Lake from the pasture, and the borings were placed to characterize that flow to help determine the feasibility of an interceptor drain.

The borings were placed with the use of a truck-mounted, hydraulically powered Giddings Soil Probe. A solid walled steel push tube, 1.75 inches in diameter, was pushed into the ground until refusal was met. Soil logs were prepared, depth to water table was noted, and the boring locations were identified with a GPS unit. Soil samples were not collected.

Boring depths varied from 1.0 foot to 10.3 feet. Water tables were observed at depths ranging from 0.9 foot to greater than 10 feet. The shallowest water tables were encountered within a shallow swale in the vicinity of the old J2 and J3 drain lines. Soil profiles were typically loam, and clay loams, atop sand and loamy sand. Water was typically encountered in the sandy strata.

**Stewart Lake, Utah Activities, June 12-22, 2002**

The purpose of the activities was to surround sampling site S21 and a newly established Flood Plot with berms, connect 8 inch diameter plastic irrigation pipe (PIP) to the existing drought relief pipeline at the lake's north overlook, connect the 8 inch PIP to 10 inch diameter gated irrigation pipe within the bermed S21, and connect 4 inch diameter irrigation pipe (IPS) between the gated pipe and the Flood Plot. The gated pipe will be used to flood irrigate S21. The 4 inch IPS will direct water into the Flood Plot. The Flood Plot is near previously established sampling sites S12 and S14.

On June 12, 2002 Del Smith, USBR, arrived at Stewart Lake with a tracked Caterpillar front-loading all surface vehicle (ASV), to begin building earthen berms around S21 and the Flood Plot.
On June 13, Steve Hoffman, USBR, arrived, to assist in berm construction while Smith coordinated the purchase and delivery of irrigation pipe and associated fittings. It was noted that ground water at S21 and the Flood Plot was 18 inches below ground surface.

On June 14, Jack Lytle, Utah Division of Wildlife Resources, joined Smith and Hoffman, and assisted in distributing the PIP between the north overlook and S21. The berm around the Flood Plot was completed on June 14. Lytle, Smith, and Hoffman left the lake that mid-afternoon.

Vegetation throughout the northeastern quadrant of Stewart Lake was denser, more lush than in other areas across the lake. A significant portion of the northeastern quadrant is heavily overgrown with tamarisk. The tamarisk is approximately 18 inches tall on average, and the growth is very dense. Some form of control will be necessary. The cattails and bulrush in S21 are regrowing vigorously, apparently unaffected by the quicklime applied there earlier this year.

It seems likely that the shallow ground water supplied by seeps across the northern perimeter of the lake is providing the moisture to support the plant growth in the northeastern quadrant. The central north-south ditch and the large east-west ditch that meets the central ditch apparently intercept the seep water and drain it away from the rest of the lake bed. Vegetation west of the central ditch and south of the east-west ditch is significantly sparser and less vigorous than that in the northeastern quadrant.

On June 17, Willie Forest and Steve Hoffman, both USBR, arrived at Stewart Lake to continue the construction of the berm around S21 and the installation of the irrigation pipe. A surveying transit was used to ensure a uniform berm height. Ryan Rowland and Dave Naftz, both USGS, arrived to sample water and monitor ground water levels in the Stewart Lake area, and to install shallow ground water monitoring wells in the Flood Plot.

Rowland and Naftz completed their observations and sampling on June 19, and installed observation wells in the Flood Plot. They indicated additional observation wells will be installed there at a later date. They returned to Salt Lake City on June 20.

**Stewart Lake, Utah Activities, June 12-22, 2002**

By noon, June 20, the S21 berm was completed, and Wheeler Machinery removed the ASV from the lake that afternoon. The berm around the Flood Plot was covered with a heavy plastic membrane. A staff gauge was installed. A GPS reading, datum GS 84, indicated the location of the Flood Plot is N 40E 21.514', W109E 21.854'.

By the evening of June 21, the pipelines were in place and S21 and the Flood Plot were ready to be inundated. It is anticipated that they will be inundated in July, by which time it is hoped that the ground water level will have lowered significantly. Ground water was observed at 26 inches below the ground surface at the Flood Plot. Ground water was at 22 inches in the observation well at S15.

On June 22, Forest and Hoffman returned to Denver.

**Stewart Lake, Utah Activities, August 26 – September 2, 2002**

On **Monday, August 26**, Dave Naftz, USGS, Steve Noyes, USBR, and Steve Hoffman, USBR, met at Stewart Lake to participate in sampling, flooding, and monitoring site S21 and the Flood Plot. Inspection of the irrigation pipeline installed in June of this year revealed two points at which the water delivery pipes had pulled apart. At one of the points it was necessary to install a repair coupling to prevent future separation. At the second point, the separated pipes were simply reconnected. Steve Noyes coordinated with the water district for permission to apply water to S21 and the Flood Plot. Dave Naftz readied his monitoring and sampling equipment. Dave advised that the ground water table was 4 feet below ground level at the Flood Plot.

On **Tuesday, August 27**, Steve Noyes and Steve Hoffman collected pre-flood sediment samples from S21 and the Flood Plot. Samples were stored on ice in a cooler. It was noted that the ground was moist below 2 inches in both S21 and the Flood plot. Saturated soils were encountered at 36 inches.

The main valve at the water district siphon was turned on at 15:20 and water began flowing to S21 and the Flood Plot. It took approximately 1 hour ( from 15:20 to 16:10 ) to fill the Flood Plot to a depth of 1 foot. Mike Enright, USGS, visited the site and assisted Dave Naftz in installing a Clampitron on a section of the 10 inch gated pipe, to determine the rate of flow to the Flood Plot. The flow was measured as 285 gallons per minute (gpm).

At 16:10 the 4 inch gated valve controlling inflow into the Flood Plot was closed, and all the slots in the gated pipe in S21 were opened. There was very little flow through most of the slots in the 330 feet of gated pipe ( 11 sections of pipe, each 30 feet long. Each pipe section has 12 slots, for a total of 132 slots. ) The flow from the main valve was gradually increased to the point where some water flowed from most of the slots in the gated pipe. There is no meter at the main valve, so the rate of flow was not known.

At 18:11, refilling of the Flood Plot began, as the water level there had decreased to a depth of 6 inches. The water volume was adjusted to leave a small flow running into the Flood Plot, with 18 slots open on the gated pipe in S21.

On **Wednesday, August 28,** Steve Noyes, Dave Naftz, and Steve Hoffman arrived on site at 8:00. It became apparent that the 8 inch diameter pipe failed during the night, and the water had flowed down the drainage ditches in Stewart Lake rather than into the Flood Plot or S21. The slip joint below the first elbow in the 8 inch pipe had pulled apart. The water was turned off at the main valve. By 9:00 the pipe was pushed back together and the connection was braced firmly with stones. At 10:00 the water master, Verlin Vincent, arrived to assist in determining the flow volume when the water was turned on again at the main valve. Estimated flow was 3 second feet (3 cfs).

**Stewart Lake, Utah Activities, August 26 – September 2, 2002**

By 11:00 water was flowing again to the Flood Plot, with only 11 slots open on the gated pipe in S21. That provided a flow of 30 gallons per minute (gpm) into the Flood Plot. Steve Noyes left the site at 15:00, to return to his office in Provo.

By 18:30 almost all of S21 was wet, though some high points were still dry. We left the site at 18:30, with a minimum flow of approximately 10 gpm into the Flood Plot and 11 slots open on the gated pipe.

On **Thursday, August 29,** Dave Naftz and Steve Hoffman arrived on site at 7:30. Site S21 was completely inundated and the Flood Plot held 0.9 foot of water. At 8:30 water depth in S21 was measured; Southwest corner, 8 inches. Southeast corner, 11.5 inches. Northeast corner, 8 inches. Northwest corner, 6 inches. Center, 9 inches.

Seepage was noted outside S21 on all sides. It did not appear that the levee was saturated, but that water was moving laterally underground and daylighting outside S21. In an attempt to adjust inflow to the Flood Plot, flow from the main valve was repeatedly reduced, until it was completely shut off. An approaching storm, with lightning, ended activities in the Flood Plot and S21 for a portion of the afternoon. Rainfall and hail were particularly intense from 15:00 to15:40.

The main valve was opened incrementally after the storm, to provide a flow into the Flood Plot and S21. Water level in S21 was measured again at 16:00; Southwest corner, 11 inches. Southeast corner, 13 inches. Northeast corner, 12 inches. Northwest corner, 7 inches. Center, 9 inches.

By late afternoon, seepage through cracks, and the threat of overtopping at some low points along the levee around S21, required repairs with a shovel.

Naftz and Hoffman left the site at 19:15, with a minimum inflow of 10 gpm to the Flood Plot and very low flow into S21, with only 2 slots in the gated pipe left open. Flow into the manhole atop the North Overlook was estimated at somewhat less than 0.5 cfs. Observing the flow through the manhole is the only method of estimating total flow from the main valve.

On **Friday, August 30,** Naftz and Hoffman arrived on site at 7:45. Seepage had collected around all sides of S21. Seepage was observed in excavations 25 feet from S21 also, suggesting that water was moving laterally underground from S21.

Water depth was measured in the east well at site S15. Depth to ground water was 2.25 feet.

Water levels in S21 were measured at 9:20; Southwest corner, 8 inches. Southeast corner, 12.5 inches. Northeast corner, 9.5 inches. Northwest corner, 7.5 inches. Center, 8 inches.

**Stewart Lake, Utah Activities, August 26 – September 2, 2002**

The perimeter of the S21 levee was roughly measured by pacing around it. The interior area of S21 was calculated as 2.6 acres.

Water levels were measured at sites S10 and S21. Ground water depth at S10 was 3.56 feet. The observation well at S21 was dry. That well is 4.3 feet deep.

The flow from the main valve was increased, and the level in S21 gradually crept higher over the course of the day. Water depth in S21 was measured again at 16:05; Southwest corner, 11.5 inches. Southeast corner, 14 inches. Northeast corner, 12 inches. Northwest corner, 10.5 inches. Center, 9.5 inches. The depth in the Flood Plot was maintained at approximately 1 foot during the day.

In the evening, flow from the main valve was turned down to approximately 0.5 cfs. That provided approximately 10 gpm into the Flood plot, with only 8 slots left open in the gated pipe in S21. Naftz and Hoffman left the site at 18:45.

On **Saturday, August 31,** Naftz and Hoffman arrived on site at 8:00. Water level was measured in S21 at 8:10; Southwest corner, 11 inches. Southeast corner, 14 inches. Northeast corner, 12.5 inches. Northwest corner, 10.5 inches. Center, 10 inches.

Seepage from the S21 levee was observed at the points where the 8 inch and the 4 inch pipes penetrate it. It was noted that some points along the levee were completely saturated, raising the question of how much longer the levee would hold.

Naftz and Hoffman measured the velocity, depth, and temperature in flows from the J1/J1A drain, the central drain ditch at the Stewart Lake outlet, and the J2/J3/J4 drain.

Water levels in S21 were measured at 17:30; Southwest corner, 11 inches. Southeast corner, 14 inches. Northeast corner, 12 inches, Northwest corner, 11 inches. Center, 10 inches.

At the end of the day, the inflow to the Flood Plot was adjusted, using the gated valve there to provide 10 gpm. Only 5 slots were left open in the S21 gated pipe. Spray paint was used to mark the current level of flow into the manhole atop the North Overlook. The paint marks the level that provides a maintenance level, keeping both S21 and the Flood Plot at proper levels.

Naftz and Hoffman left the site at 19:30.

On **Sunday, September 1,** Naftz and Hoffman arrived on site at 8:00. Water level in S21 was measured at 8:15; Southwest corner, 11 inches. Southeast corner, 14.5 inches. Northeast corner, 12 inches. Northwest corner, 11.5 inches. Center, 10.5 inches.

**Stewart Lake, Utah Activities, August 26 – September 2, 2002**

It was noted that seepage all around S21 had increased. Water trickled through the sides of the levee in numerous locations. Pools 15 feet wide were observed alongside the levee, and some were even wider in some locations. Water in excavations as far as 25 feet from S21 was measured at 11 inches below ground level.

The flow from the main valve was not adjusted during the course of the day, the existing flow being enough to maintain levels in S21 and the Flood Plot.

Naftz and Hoffman measured flows in Brush Creek. Ashley Creek had no flow, only scattered, isolated, shallow pools of water.

Dave Pipher and his daughter Melissa visited the site. Melissa will collect daily water samples from an observation well in the Flood Plot during the next two weeks. She will mail them to Dave Naftz at the end of that period. Melissa will also observe conditions in S21 and will call Steve Hoffman when the ground there is dry enough for post-flood sediment sampling.

Water depth in S21 was measured at 19:20; Southwest corner, 10.5 inches. Southeast corner, 14 inches. Northeast corner, 12 inches. Northwest corner, 11.5 inches. Center, 10.5 inches.

Naftz and Hoffman left the site at 19:40, shutting off the flow at the main valve, ending all flow to S21 and the Flood Plot.

On **Monday, September 2,** Hoffman arrived on site at 8:45. Naftz was already on site. Water level in S21 was measured; Southwest corner, 9 inches. Southeast corner, 12 inches. Northeast corner, 10 inches. Northwest corner, 9.5 inches. Center, 8 inches.

The main valve was checked to ensure that it was shut tight. The gate in the manhole atop the North Overlook was closed as tightly as possible, but it remained partially open.

The 4 inch valve at the Flood Plot was closed, to prevent inflow. Only 12 slots, in the bottom-most section of gated pipe in S21, were left open. All others were closed.

Verlin Vincent was called, and was advised that the flood tests in Stewart Lake were finished, and that all water had been shut off.

Hoffman left the site at 9:45, to return to Denver with the pre-flood sediment samples. Dave Naftz was still on site, to complete sampling and monitoring for the day, before returning to Salt Lake City. Upon arrival in Denver, the selenium speciation samples were place in refrigerated storage. The total selenium samples were set out to air dry.

**Stewart Lake, Utah Activities, August 26 – September 2, 2002**

## Summary

Sediments in the Flood Plot and S21 were sampled prior to flooding. The ground water depth at the Flood Plot prior to flooding was 4 feet.

The Flood Plot was inundated for approximately half the day on Tuesday, August 27. A break in a pipe that night ended flows to the Flood Plot, and the plot was completely drained of water by the morning of Wednesday, August 28.

By mid day Wednesday the Flood Plot was inundated again, to a depth of around 1 foot. It remained inundated through Monday, September 2, though inflows to the plot were ended on the evening of Sunday, September 1, and it was anticipated that the plot would be empty within a day.

During the period of it inundation, USGS sampled and monitored ground water from various depths in the Flood Plot. Daily sampling of ground water beneath the plot will continue through the middle of September.

Water began flowing into site S21 by mid day on Tuesday, August 27. A break in the pipe during that night ended flows to S21, but repairs were completed and water began flowing into S21 again by 11:00 on Wednesday, August 28. By that evening most of S21 was wet, though the highest areas were still dry. By the morning of Thursday, August 29 S21 was filled to an average depth of 8.5 inches. Water depths were gradually increased through Sunday, September 1. The peak depth was on Sunday morning, with an average depth of 11.9 inches. Inflow to S21 ended Sunday evening. By the morning of Monday, September 2, the average depth of water in S21 had lowered to 9.7 inches.

A local resident will observe conditions in site S21 and will contact Steve Hoffman when conditions are right for post-flood sampling. At that time, Hoffman will return to Stewart Lake to sample S21 and the Flood Plot.

The levees around site S21 and the Flood Plot were constructed from lake bed sediments adjacent those sites. The levees were adequate for containing water within the sites for the six days the flood tests were performed, but probably would not have held up much longer. If the lake bed sediments were to be used for a permanent levee structure, more rigorous construction methods than were used on the test plots would be needed.

The levees first began seeping and leaking near their bases, where the levee material rested on original ground. Within a couple of days portions of the S21 levee were saturated, and water began trickling through. Although the levee around the Flood Plot was covered with heavy plastic, it also leaked, in much the same manner as around S21.

**Stewart Lake Activities, September 12-13, 2002**

On September 12, 2002, Steve Hoffman, USBR, arrived at Stewart Lake at 6:30 pm. The ground surface was saturated from recent rains, and vehicle access to the north overlook area was difficult. No activities were completed at Stewart Lake that evening.

On September 13, post-flood sediment samples were collected from the Lime Plot (S21) and from the Flood Plot. All samples were stored on ice in coolers during sampling efforts and when transported.

**In the Flood Plot**, sediment samples were collected for laboratory testing for total selenium levels and for selenium speciation. Samples were collected at 6 inch intervals from the surface, to a depth of 36 inches. The sample from zero to 6 inches was a composite of ten subsamples collected randomly across the plot. Samples below 6 inches were composites of 3 subsamples, collected at random locations across the plot.

**In site S21**, samples were collected for total selenium testing and for selenium speciation testing in each of the 4 quadrants (NE, NW, SE, and SW), at 6 inch intervals from the surface to a depth of 36 inches. Samples from zero to 6 inches were composites of ten subsamples collected randomly across each quadrant. Samples below 6 inches were composites of 3 subsamples, collected at random locations across each quadrant.

Dave Naftz, USGS , and Steve Noyes, USBR, arrived on site around 10:30 pm, to collect some USGS sampling and testing equipment. After gathering up the equipment, they assisted Hoffman in collecting sediment samples, until 2:00 pm, at which time they departed for Salt Lake City. Hoffman completed sediment sampling and left Stewart Lake at 4:30 pm, arriving at the Denver Federal Center at 10:30 pm.

Samples were stored on ice in coolers throughout the weekend, September 14 & 15. On September 16, the samples were delivered to the USBR Soils Laboratory in Denver. Samples for selenium speciation testing were refrigerated until they were sent to the Environmental Sciences Laboratory at the University of California, Riverside. Samples for total selenium testing were set out for air drying, until submitted to the USGS geochemistry laboratory.

**Stewart Lake Activities, September 30 – October 2, 2002**

From September 30 through October 2, 2002, USBR personnel collected sediment samples from 22 sites throughout Stewart Lake. Participants were Jack Jibson and Steven Hoffman. All of the sites have been sampled in previous years.

The lake was drained, but water was flowing in all of the drain ditches throughout the lake. Most of the length of the main central drain held water to a depth of approximately 9 inches, but the flow from the central drain through the lake outlet was very slight, just a trickle. Site S16, in the northeast quarter of the lake, was saturated to ground surface. Most of the rest of the lake bed surface was dry. Ground water depth was measured at 33 inches at site S15.

It was noted that tamarisk growth is very vigorous throughout the lake. It is particularly thick in the northeastern quarter of the lake bed, in areas that are not covered with bulrush or cattails. The tamarisk are commonly 6 feet tall, and spaced only a foot or two apart.

Two small surface flows along the northern perimeter of the lake, approximately two hundred yards west of the north overlook, were investigated. They flow out of a pool formed from seeps and discharge into the drain ditch along the north end of the lake. Both of the surface flows have formed miniature waterfalls, and there was some concern that there might be a heavy shale or stone barrier beneath them, which could present a problem if an interceptor drain is installed through the area.

A shovel was used to excavate into the flows, and it was determined that the material beneath them is silty clay and sandy clay, to a depth of at least 18 inches. The seeps originally flowed across the ground surface and cascaded down the side of the drain ditch. Over time, the flows have eroded into the soft clayey soil, cutting small gullies back away from the ditch face, forming the miniature waterfalls. There is no barrier beneath the two flows.

On September 30, sediments were sampled at sites S14, S15, S18, S20 and S21. The control area at S15 was sampled for total selenium at 6 inch intervals, down to a depth of 42 inches, and for selenium speciation from the zero to 6 inch depth. At site S21, all four quadrants were sampled for total selenium, from the zero to 6 inch depth only. Sites S14, S18, and S20 were sampled for total selenium, from the zero to 6 inch depth.

On October 1, sediments were sampled at 17 sites. At S1 and S10, samples were collected from the control areas at 6 inch intervals, to depths of 30 inches, to test for total selenium. Selenium speciation samples were collected from the control areas at S1 and S10, from zero to 6 inches. At the control area at site S7 and at site S22, sediments were sampled at 6 inch intervals, to depths of 36 inches, for total selenium.

Samples were collected for total selenium from zero to 6 inches at sites S2, S3, S4, S5, S6, S8, S9, S11, S12, S13, S16, S17, and S19.

**SEDIMENT SAMPLING, STEWART LAKE, UTAH**
**SEPTEMBER 30 to OCTOBER 2, 2002**

On October 2, Jibson and Hoffman transported the samples to Reclamation's soil and water quality laboratory at the Denver TSC. Throughout the sampling period and during transport, all samples were stored on ice in coolers. At the laboratory, the speciation samples were transferred from the coolers to a refrigerator.

On Friday, October 4, the speciation samples were placed on Blue Ice in an insulated container, and shipped to the University of California, Riverside, for selenium speciation testing.