HOMESTAKE
ALBUQUERQUE OFFICE

Alan D. Cox
*Manager - Grants &
Southwest U.S.*

28 October 2003

U.S. Nuclear Regulatory Commission
Office of Nuclear Materials Safety and Safeguards
Division of Fuel Cycle Safety and Safeguards
Chief of Fuel Cycle Facilities Branch (Mailstop T8-A33)
C/o Document Control Desk
11545 Rockville Pike
Two White Flint North
Rockville, MD 20852-2738

Attn: Mr. Bill VonTill, Site Manager

Re: **Grants Reclamation Project**
Docket No. 40-8903
License No. SUA-1471
Request for Extension of Reclamation Milestones

Dear Mr Von Till:

Homestake Mining Company of California (HMC) is actively reclaiming the Grants Uranium Mill Site (Site) under a Reclamation Plan (Plan) approved by the U. S. Nuclear Regulatory Commission (NRC) and pursuant to a Source Material License #SUA-1471 (License). The milestones for completing the tailings pile reclamations are dependent on progress made in restoring the groundwater at the site. As the groundwater restoration progresses, we find it necessary to adjust these milestones to be consistent with projections of progress toward completing the groundwater corrective action plan (CAP).

Current License Requirements

The tailings pile reclamation work is being done to meet milestones for placement of interim cover, radon barrier, and erosion protection contained in the License, as amended, to conform with the Memorandum of Understanding (MOU) between the Environmental Protection Agency (EPA) and the NRC regarding the National Emission Standard for Hazardous Air Pollutants (NESHAPS) for radon (56 Fed. Reg. 55432, (Oct. 25, 1991)). See also 57 Fed. Reg. 20715 (May 14, 1992). These milestones are specified in License Conditions 36.A and 36.B as follows:

36.A. (1) Windblown tailings retrieval and placement on the pile:

For the Large Impoundment - December 31, 1996.

For the Small Impoundment - May 31, 1997.

NMSS01

36.A.(2) Placement of interim cover to decrease the potential for tailings dispersal and erosion:

For the Large Impoundment - December 31, 1996.

For the Small Impoundment - May 31, 1997.

36.A.(3) Placement of final radon barrier designed and constructed to limit radon emissions to an average of no more than 20 pCi/m^2s.

For the Large Impoundment which has no evaporation ponds - December 31, 2003

For the Small Impoundment, tailings pile surface areas are essentially covered by evaporation ponds constructed as part of the ground-water corrective action program. Prior to December 31, 2012, the area not covered by the evaporation ponds shall have final radon barrier in place. Final radon barrier placement over the entire pile shall be completed within 2 years of completion of the ground-water corrective actions.

36.B.(1) Placement of erosion protection as part of reclamation to comply with Criterion 6 of Appendix A of 10 CFR 40:

For the Large Impoundment – September 30, 2004.

For the Small Impoundment - September 30, 2013.

36.B.(2) Projected completion of ground-water corrective actions to meet performance objectives specified in the ground-water corrective action plan - May 1, 2010.

Discussion

As indicated in the HMC completion reports previously submitted to your office, HMC has successfully met the deadlines for the four milestone dates associated with windblown tailings retrieval and placement of the interim cover for both the Large Tailings Pile (LTP) and the Small Tailings Pile (STP) [License Conditions 36.A.(1) & (2)]. HMC has also expended considerable effort towards placement of final radon barrier and erosion protection on the LTP. This has been completed for all areas of the LTP except the top surface, which currently has an interim cover. Completion of the radon barrier and erosion protection layer for the top of the LTP is dependent upon attaining the necessary pile consolidation, as required by License Condition 37.F.

HMC began in 1992 to aggressively enhance the rate of settlement of the LTP by constructing a drainage system along the toe of the pile. After the pile contouring in 1994, HMC began installing wells within the tailings to evaluate and enhance the removal of tailings solutions by pumping the pore water. This has the additional benefit of reducing the contaminant source term that affects ground water quality.

An independent assessment of the settlement monitoring point data was conducted by MFG, Inc. (January 21, 2003 report, see Attachment 1). They conclude that there has been minimal settlement since 1999. However, they recommended that the radon barrier not be placed until the tailings pore water extraction program has been completed. They indicate that further tailings water extraction may induce stress changes in the tailings that would result in additional consolidation. They also point out the difficulty in constructing and maintaining the integrity of the radon barrier while servicing, abandoning, and placing new wells on the top of the pile.

In addition to the tailings collection well system utilized in the pore water extraction program for the LTP, HMC began evaluation of a fresh water injection / flushing program on the pile in 2000. Based upon favorable results, a full scale tailings injection / flushing program was initiated in 2002, which is currently scheduled to continue through 2005. Results of the program to date have shown that contaminant concentrations can be reduced substantially in the tailings pore water. This will result in reducing the long term tailings pile contributions to the alluvial aquifer. The continuation of this program is necessary to assure that project closure requirements and objectives will be met. A recent technical paper discussing the details and results of this program is enclosed as Attachment 2.

The following table summarizes the current project time schedule associated with the operation of the LTP collection and injection well systems situated on the top of the LTP.

Large Tailings Pile - Well Field Operational Plan

Well System	Year 2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
In-situ Tailings – Collection Wells	X	X	X	X	X					
In-situ Tailings – Injection Wells	X	X	X							
Alluvial aquifer beneath LTP - Collection Wells		X	X	X	X	X	X	X	X	
Alluvial aquifer beneath LTP - Injection Wells				X	X	X	X	X	X	

Our best estimate at this time is that the tailings water extraction program to continue through 2007. Alluvial aquifer water extraction beneath the LTP will continue for approximately four years beyond that time (2011). All wells will be abandoned and the placement of the radon barrier and erosion protection layers will be initiated and completed according to the proposed milestone completion dates.

For the conditions and reasons set forth above relating to the groundwater restoration program at the Site, HMC is requesting an extension of the existing LTP milestone dates for placement of the final radon barrier (December 31, 2003) and erosion protection cover (September 30, 2004). An extension of these LTP milestones to December 31, 2012 for the radon barrier placement and September 30, 2013 for erosion protective cover installation is believed to be appropriate based upon the current project plan and schedule.

HMC has refined its groundwater restoration schedule, which shows the active groundwater restoration program concluding in 2011. The decommissioning of the groundwater treatment facilities will begin in 2012 with evaporation pond material and other byproduct material placed in the STP. This effort along with the STP reclamation is scheduled to be completed within two years. HMC does not believe that the placement of the radon barrier on the STP prior to the decommissioning of the evaporation ponds is practical and is therefore requesting an extension of the December 31, 2012 milestone for placement of radon barrier on the STP to September 30, 2013. In addition, HMC proposes a corresponding change in the erosion protection placement milestone for the STP to December 31, 2013.

As indicated above, the milestones for completing the radon barrier and erosion protection for the LTP and STP are dependent on the groundwater corrective action plan (CAP). The current schedule projects the completion of ground-water corrective actions by December 31, 2011. As such, HMC is proposing a change in License Condition 36.B.(2) from May 1, 2010 to December 31, 2011 for completion of the ground-water corrective action program.

HMC's request to extend these milestones is authorized pursuant to the NESHAP Subpart T Settlement Agreement between Homestake Mining Company of California, the American Mining Congress (AMC), EPA, NRC licensees and others, with respect to EPA's final rule pertaining to the NESHAPs radon standard (See 58 Fed. Reg. 60341 (Nov. 15, 1993)), and the NRC's final rule regarding the same. (See 59 Fed. Reg. 28220 (June 1, 1994)).

As set forth in the agreement and these regulations, a licensee is permitted to request an extension of time to comply with the 20 pCi/m^2s flux standard based on either of two criteria:

1. A licensee may demonstrate, through appropriate monitoring, compliance with the flux standard and continue to demonstrate compliance annually during the extension period (58 Fed. Reg. at 60347, 60356; 40 C.F.R. § 192.32(a)(3)(ii); 59 Fed. Reg. at 28231; and 10 C.F.R. Part 40, Appendix A, Criterion 6A(2)), or alternatively,

2. A licensee who is not in compliance with the flux standard, may seek an extension based on cost and must show that (1) it is making good faith efforts to emplace the final radon barrier; (2) the extended time period is consistent with the definition of "available technology;" and (3) the radon releases during the extended period will not result in a significant incremental risk to the public health (58 Fed. Reg. at 60356; 40 C.F.R. § 192.32(a)(3)(ii); 59 Fed. Reg. at 28231; and 10 C.F.R. Part 40, Appendix A, Criterion 6A(2)).

HMC is requesting an extension of the final radon barrier milestones for both tailings piles based upon the first criterion because HMC is presently in compliance with the radon flux standard. However, HMC's License Condition No. 36.C. requires that HMC demonstrate that compliance with the final radon barrier completion date is not technologically feasible in order to extend that milestone.

As discussed earlier, final radon cover has already been placed on all areas of the LTP with the exception of the top. The radon flux was measured from the radon barrier on the North, West, and South Side Slopes in October 1994, just prior to the placement of the erosion protection layer. During August 1995, the radon flux was measured on the exposed interim cover on the top of the pile. Soon after the radon barrier for the Aprons and the East Side Slope was completed, radon flux measurements were completed (July 24, 1995) and erosion protection applied. A total of 99 measurements, each representing an equal area, were made. The average for all measurements was 17 pCi/m^2s, well within the 20 pCi/m^2s limit. A Radon Flux Report with this information and data was included as Attachment 2 in a prior request by HMC for extension of reclamation milestones (Roy R. Cellan, HMC to Joseph Holonich, NRC; December 18, 1996).

Radon flux measurements were made on the surface of the current configuration of the STP in August 1995. More than half of the pile surface is covered by Evaporation Pond No. 1. The synthetic liner and water essentially stops all radon from diffusing upward through the surface. Assuming this area to have zero radon flux, the area-weighted-average radon flux was 10.3 pCi/m^2s, well below the limit of 20 pCi/m^2s. The associated radon flux report including that data was included as Attachment 3 of the previously referenced letter for extension of reclamation milestones.

Radon flux measurements were made on the exposed interim cover of both tailings piles on October 20-21, 2003 with similar results. Using the October 1994 data obtained for the rock-covered portions of the LTP along with the recent flux measurements on the interim cover, the present average flux on the LTP is calculated to be 14 pCi/m^2s.

Radon flux measurements were also made on October 20-21, 2003 at the same locations of the STP as were made in August 1995. Using the same averaging technique, the present average radon flux for the STP is 6 pCi/m^2s.

These results show that the STP and LTP presently comply with the 20 pCi/m^2s standard set forth in 10 CFR Part 40, Appendix A.

HMC proposes to verify compliance with the flux standard on an annual basis during the extension period by comparing the ambient radon measured around the Site to the 1996 results. Since only the top portion of the LTP does not have an erosion protection layer (rock), it would be very impractical to make annual flux measurements over the pile to demonstrate compliance. HMC proposes to demonstrate compliance with the flux limits through air quality measurements. A discussion of the relative ambient radon and particulate levels around the site will be included in the annual environmental compliance monitoring report (License Condition No. 15).

HMC has taken all feasible, reasonable and practical efforts and resources to expeditiously proceed with ground-water remediation and cleanup activities at the Site. The maintenance and operation of more than 300 wells and their associated piping on the top of the LTP, as part of that continuing program, makes it infeasible to place the radon barrier by the current milestone date of December 31, 2003. The operation of these wells is an important aspect of the CAP. The CAP operations on the LTP should control when the final cover is appropriate for the LTP in conjunction with the pile consolidation requirement. Therefore placement of the final cover on the top of the LTP by the date in the license is technologically infeasible due to factors beyond HMC's control. Scheduled completion dates for the STP are dependent on completion of the CAP and thus require adjustment accordingly.

In order to extend the erosion protection and CAP completion milestones (License Condition No. 36B), HMC must address the added risk to the public health and safety and the environment (License Condition 36D). The schedule for the completion of the CAP is based on modeling and empirical data from HMC's aggressive groundwater restoration program. Accurate projections for completion of this program have been difficult due to the technical complexity of the problem. However, dewatering the pile and the subsequent alluvial water extraction beneath the pile is necessary to reduce the groundwater contaminants to acceptable levels. Continuing the program until completion of the CAP is justified in terms of reducing the long-term additional risk to the public. In order to assure that the short-term risk to the public is minimized, HMC is committed to continue an active maintenance program for the interim cover for the STP and LTP.

Summary / Proposed Milestones

Homestake Mining Company respectfully requests that the NRC approve an extension of the milestones for placement of the final radon barrier and the erosion protection layer on the LTP and STP and also the milestone for the completion of the CAP to the dates reflected in the following table:

Program Activity	License Condition Reference	Existing Milestone Date	Proposed Milestone Date
LTP – final radon barrier placement - top of pile	SUA-1471 – License Condition 36.A.(3)	December 31, 2003	December 31, 2012
LTP – erosion protection layer placement – top of pile	SUA-1471 – License Condition 36.B.(1)	September 30, 2004	September 30, 2013
STP – final radon barrier placement	SUA-1471 – License Condition 36.A.(3)	December 31, 2012	September 30, 2013
STP – erosion protection layer placement	SUA-1471 – License Condition 36.B.(1)	September 30,2013	December 31, 2013
Corrective Action Plan completion	SUA-1471 – License Condition 36.B.(2)	May 1, 2010	December 31, 2011

Thank you for your time and attention on this important matter. If you need additional information, or have questions regarding our request, please call me in our Albuquerque office at (505) 287-4456 or my cell phone (505) 400-2794.

Sincerely yours,

HOMESTAKE MINING COMPANY
Alan D. Cox

Enclosures (2)

1) Report on LTP settlement monitoring point data, MFG, Inc., January 21, 2003.
2) Paper entitled "Flushing of water from mill tailings at the Homestake Grants Reclamation Project" - Proceedings of the Tenth International Conference on Tailings and Mine Waste, 12-15 October 2003, Vail, Colorado, USA

Cc: B. Spitzberg, NRC
M. Purcell, EPA
B. Ingersoll, SLC
K. Baker, ERG, Inc., ABQ
G. Hoffman, Hydro Engineering, Casper
ABQ File
Grants File

ATTACHMENT 1

M
F
G
consulting
scientists and
engineers

MFG, Inc.
A TETRA TECH COMPANY
3801 Automation Way
Suite 100
Fort Collins, CO 80525-3434
970/223-9600
Fax: 970/223-7171

January 21, 2003 MFG No. 180899

RECEIVED
JAN 24 2003

Homestake Mining Company
Grants Reclamation Project
P.O. Box 98
Grants, New Mexico 87020-0011

Attention: Alan Cox
Manager – Grants & Southwest U.S.

Subject: Homestake Grants Large Tailings Impoundment
Review of 2002 Settlement Monitoring Data

Dear Alan:

This letter documents our review of 2002 settlement monitoring point data on the top surface of the large tailings impoundment. The settlement monitoring points were measured for Homestake on November 4, 2002 by Souder, Miller, and Associates.

The settlement monitoring point data and calculated settlement since 1996 are presented in the two tables attached with this letter. The monitoring point location map and plots of settlement with time for selected points in the center of the east and west cells are also attached.

The November 2002 data is consistent with: (1) the 2001 data, (2) the adjusted measurements from 1998 and 1999, and (3) the earlier data. There are a number of monitoring points that show settlement of 0.1 to 0.2 feet from October 2001 that may be within the accuracy of the elevation measuments. Total settlement has ranged from less than 0.1 foot on the perimeter of the impoundment (above tailings sands) to several feet in the center of the east and west cells (above tailings slimes). Total measured settlement in the center of the east cell is approximately 5.5 feet (at point C-7). Total measured settlement in the center of the west cell is approximately 11 feet (at point X-1). The larger amount of settlement in the west cell is most likely due to thicker zones of tailings slimes (based on 1993 auger hole logs).

Settlement values with time show a consistent rate from the start of monitoring in late 1993 through 1996. A short-term decrease in settlement rate in mid-1995 (possibly due to temporary cessation of pore water pumping) is seen at most of the monitoring points. There has been minimal additional settlement since 1999.

Although the settlement data shows that the radon barrier could be constructed on the top surface of the large tailings impoundment, completion of the radon barrier is not recommended until the tailings pore water extraction program is completed. This is because: (1) additional tailings pore water extraction may induce stress changes in the tailings that would result in additional consolidation, and (2) the well and piping system associated with pore water extraction should be removed to provide access for earthmoving and compaction equipment.

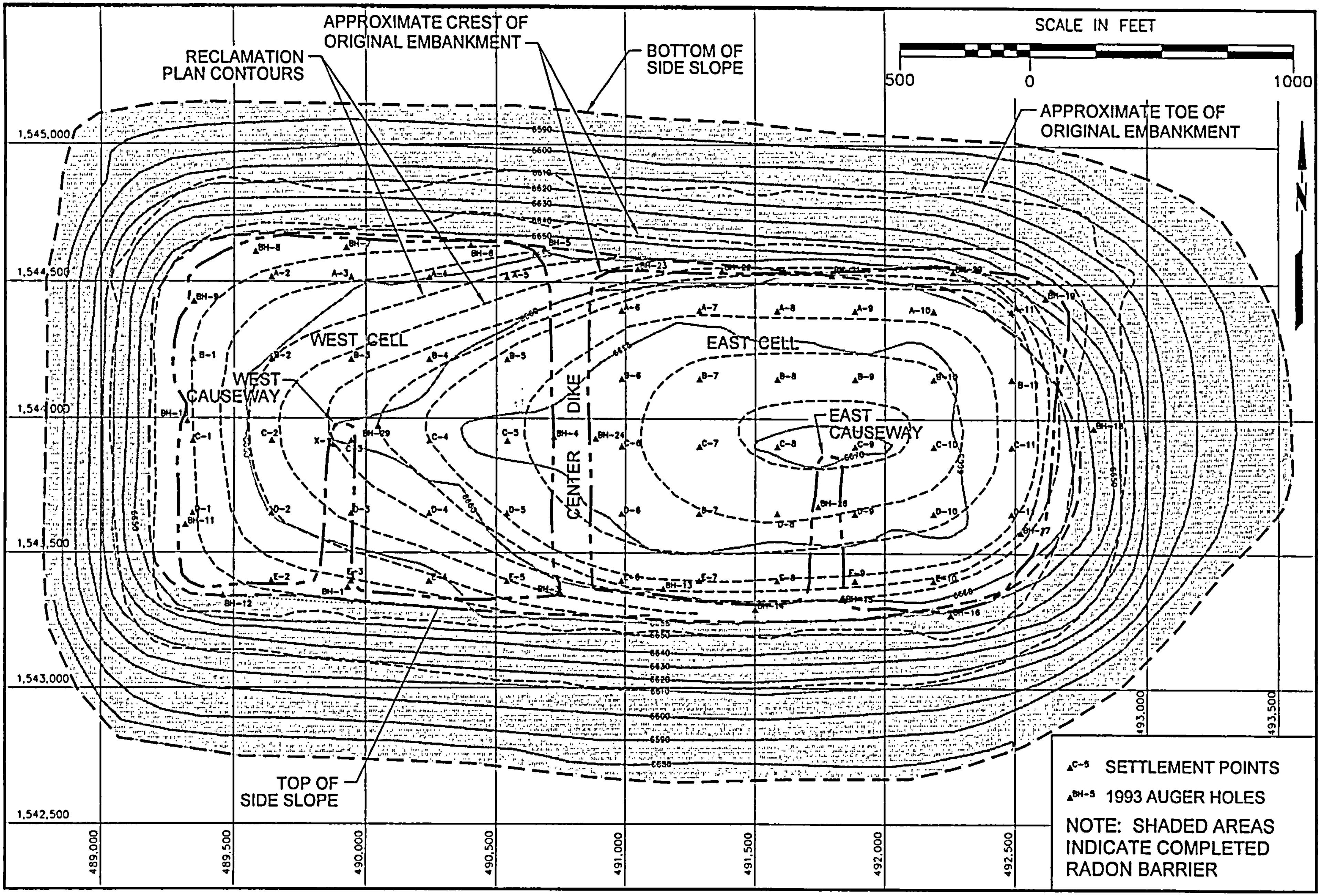
If you have questions concerning the information in this letter, please contact me.

Yours sincerely,
MFG, Inc.

Clint Strachan

Clint Strachan, P.E.
Project Manager

Attachments



consulting scientists and engineers

FIGURE 1
LARGE IMPOUNDMENT PLAN VIEW WITH
LOCATION OF SETTLEMENT MONITORING POINTS

Date:	JANUARY 2003
Project:	180899
File:	LAYOUT

Homestake Grants Large Tailings Impoundment -- Settlement Monitoring Point Data

Svyr* Date	AEC 10/23/93	AEC 03/25/96	AEC 06/18/96	AEC 07/31/96	AEC 08/30/96	AEC 09/30/96	AEC 11/01/96	AEC 12/02/96	AEC 12/31/96	AEC 04/30/97	AEC 06/02/97	AEC 06/30/97	AEC 08/01/97	AEC 01/09/98	AEC 04/08/98	CSA** 12/04/98	CSA 03/01/99	CSA 04/01/99	CSA 07/01/99	MEI 10/03/00	MEI 10/10/01	MEI 11/4/2002
A2	6657.15	6657.02	6656.94	6656.85	6656.89	6656.84	6656.92	6656.90	6656.90	6656.92	6656.87	6656.92	6656.88	6656.81	6656.79	6656.77	6656.89	6656.83	6656 86	6656.84	6656.79	6656.72
A3	6657.80	6657.38	6657.30	6657.26	6657.25	6657.22	6657.28	6657.20	6657.22	6657.23	6657.24	6657.27	6657.23	6657.22	6657.14	6657.12	6657.25	6657.18	6657.22	6657.20	6657.14	6657.01
A4	6658.06	6657.83	6657.76	6657.70	6657.71	6657.64	6657.66	6657.69	6657.64	6657.68	6657.70	6657.68	6657.67	6657.66	6657.63	6657.54	6657.69	6657.62	6657.65	6657.65	6657.61	6657.47
A5	6659.67	6659.33	6659 27	6659.23	6659.19	6659.17	6659.19	6659.18	6659.16	6659.22	6659.18	6659.28	6659.22	6659.15	6659.16	6659.08	6659.24	6659.19	6659.20	6659.22	6659.19	6659 03
A6	6665.79	6665.77	6665.57	6665.68	6665.64	6665.59	6665.62	6665.58	6665.57	6665.71	6665.65	6665.67	6665.61	6665.63	6665.57	6665.59	6665.69	6665.62	6665.68	6665 68	6665.67	6665.53
A7	6666.18	6666.21	6666.12	6666.09	6666.06	6666.06	6666.07	6666.05	6666.00	6666.06	6666.10	6666.05	6666.04	6666.03	6666.00	6665.98	6666.09	6666.05	6666.13	6666.10	6666.08	6666.01
A8	6666 68	6666.71	6666.61	6666.53	6666.61	6666.55	6666.54	6666.57	6666.56	6666.51	6666.56	6666.59	6666 60	6666.55	6666.53	6666.50	6666.50		6666.63	6666 61	6666 56	6666.49
A9	6666.41	6666.51	6666.38	6666.40	6666.34	6666.32	6666.31	6666.34	6666.35	6666.36	6666.33	6666.39	6666.28	6666.39	6666.26	6666.27	6666.27		6666.40	6666.36	6666.38	6666.25
A10	6666.16	6666.52	6666.39	6666.40	6666.38	6666.34	6666.33	6666.36	6666.32	6666.37	6666.32	6666.44	6666.32	6666.30	6666.30	6666.28	6666.27		6666.42	6666.30	6666.41	6666.30
A11	6663 97	6664.15	6664 03	6663 99	6663.98	6663.96	6663.99	6664.02	6663 87	6663.97	6664 06	6664.08	6663 96	6663.99	6663 93	6663 96	6663 94	6664.00	6664.09	6663 97	6664.07	6663.95
B1	6656.99	6656.84	6656.75	6656.75	6656.69	6656.66	6656.72	6656.75	6656.63	6656.68	6656.66	6656.75	6656.66	6656.60	6656.59	6656.60	6656.66	6656.66	6656.67	6656.65	6656.59	6656.50
B2	6660.66	6659.11	6658.98	6658.99	6658.94	6658.86	6658.94	6658.99	6658.84	6658.87	6658.82	6658.86	6658.76	6658.65	6658.66	6658.58	6658.68	6658.64	6658.66	6658.63	6658.53	6658.44
B3	6663.21	6659.77	6659.66	6659.60	6659.59	6659.64	6659.54	6659.57	6659.42	6659.51	6659.54	6659.44	6659.42	6659.38	6659.28	6659.24	6659.36	6659.33	6659.35	6659.29	6659.21	6659.09
B4	6664.78	6662.79	6662.67	6662.64	6662.65	6662.56	6662.64	6662.64	6662.51	6662.54	6662.63	6662.61	6662.57	6662.49	6662.45	6662.44	6662.56	6662.50	6662.53	6662.53	6662.49	6662.35
B5	6666.77	6665.47	6665.42	6665.32	6665.36	6665.28	6665.39	6665.30	6665.27	6665.32	6665.28	6665.42	6665.34	6665.30	6665.27	6665.20	6665.35	6665.32	6665.35	6665.38	6665.33	6665 22
B6	6669.34	6669.18	6669.13	6669.06	6669.03	6669.01	6668.97	6668.96	6668.98	6669.05	6668.95	6669.00	6668.90	6668.85	6668.81	6668.73	6668.88	6668.80	6668.84	6668.80	6668.75	6668.60
B7	6673.15	6672.65	6672.48	6672.42	6672.37	6672.32	6672.30	6672.30	6672.23	6672.21	6672.21	6672.23	6672.17	6672.10	6671.96	6671.88	6671.88	6671.91	6671.93	6671.87	6671.86	6671.77
B8	6671.24	6669.31	6669.13	6669.06	6669.02	6669.02	6668.98	6668.97	6668.94	6668.89	6668.91	6668.83	6668.84	6668.76	6668.67	6668.56	6668.58		6668.64	6668.60	6668.53	6668 49
B9	6671.79	6669.71	6669.55	6669.51	6669.46	6669.41	6669.39	6669.38	6669.33	6669.31	6669.32	6669.23				6668.99	6668.94	6669 02	6669.05	6670.09	6668.94	6668.81
B10	6671.75	6670.59	6670.48	6670.44	6670.41	6670.33	6670.37	6670.36	6670.33	6670.29	6670.34	6670.06	6670.27	6670.26	6670.12	6670.10	6670.12	6670.17	6670.22	6670.08	6670.11	6670.02
B11	6666.00	6666.17	6666.05	6666.03	6666 01	6666.03	6665.97	6665.98	6665.96	6666.02	6666 03	6666.11	6665.96	6665 96	6665.97	6665.96	6665 96	6666 04	6666.11	6666.01	6666.11	6666 00
C1	6657.40	6657.20	6657.12	6657.07	6657.05	6657.04	6657.06	6657.00	6657.00	6656.99	6657.03	6657.06	6657.04	6656.97	6656.95	6656.93	6656.85		6657.01	6657.00	6656.93	6656.83
C2	6663.53	6660.71	6660.69	6660.65	6660.66	6660.54	6660.61	6660.49	6660.50	6660.48	6660.48	6660.48	6660.48	6660.39	6660.35	6660.25	6660.21		6660.35	6660.34	6660.24	6660.17
C3	6671.82	6665.95	6665.73	6665.73	6665.65	6665.56	6665.59	6665.43	6665.42	6665.30	6665.31	6665.23	6665.23	6665.12	6665.00	6664.95	6664.87		6665.03	6665.00	6664.94	6664.84
C4	6671.49	6667.26	6667.22	6667.15	6667.15	6667.07	6667.05	6667.03	6667.00	6666.95	6666.93	6666.99	6666.90	6666.85	6666.83	6666.77	6666.73		6666.86	6667.46	6666.85	6666.68
C5	6674.67	6671.55	6671.53	6671.52	6671.52	6671.49	6671.46	6671.46	6671.42	6671.47	6671.45	6671.46	6671.46	6671.36	6671.34	6671.27	6671.28	6671.38	6671.40	6671.44	6671.34	6671.25
C6	6672.27	6671.33	6671.29	6671.28	6671.25	6671.17	6671.18	6671.17	6671.16	6671.20	6671.13	6671.40	6671.06	6671.01	6670.97	6670.95	6670.97	6671.00	6671.05	6671.02	6670.96	6670.82
C7	6676.13	6671.99	6671.76	6671.68	6671.52	6671.53	6671.46	6671.39	6671.41	6671.35	6671.25	6671.24	6671.13	6670.91	6670.87	6670.78	6670.71	6670.78	6670.80	6670.72	6670.67	6670.58
C8	6675.39	6672.56	6672.47	6672.42	6672.38	6672.27	6672.26	6672.22	6672.21	6672.20	6672.16	6672.16	6672.17	6671.99	6671.96	6671.87	6671.89	6671.93	6671.97	6671.96	6671.92	6671.89
C9	6674.67	6671.93	6671.90	6671.86	6671.82	6671.72	6671.69	6671.64	6671.70	6671.62	6671.68	6671.58	6671.56	6671.51	6671.49	6671.40	6671.41	6671.49	6671.54	6671.47	6671.48	6671.43
C10	6675.00	6673.11	6673.01	6673.09	6673.05	6672.88	6672.92	6672.91	6672.89	6672.81	6672.86	6672.85	6672.83	6672.72	6672.69	6672.62	6672.61	6672.66	6672.71	6672.58	6672.58	6672.49
C11	6666 81	6666.80	6666.84	6666.67	6666.69	6666.58	6666.63	6666.59	6666.55	6666.65	6666 63	6666.50	6666 60	6666.56	6666 57	6666.56	6666 56		6666 70	6666 61	6666.70	6666.60
D1	6658.78	6658.57	6658.56	6658.51	6658.54	6658.47	6658.47	6658.59	6658.46	6658.47	6658.46	6658.47	6658.51	6658.42	6658.44	6658.36	6658.31		6658.44	6658.44	6658.34	6658.29
D2	6659.19	6657.80	6657.80	6657.77	6657.81	6657.69	6657.73	6657.72	6657.65	6657.64	6657.64	6657.68	6657.60	6657.59	6657.55	6657.52	6657.48		6657.62	6657.59	6657.52	6657.44
D3	6661.70	6659 53	6659.53	6659 41	6659 49	6659.40	6659.45	6659.39	6659.32	6659.39	6659.36	6659.48	6659.38	6659.36	6659.29	6659.27	6659 22		6659.33	6659.30	6659.24	6659.11
D4	6662.82	6661.38	6661.38	6661.33	6661.36	6661.25	6661.32	6661.29	6661.31	6661.26	6661.31	6661.33	6661.28	6661.22	6661.21	6661.17	6661.11		6661.24	6661.26	6661.22	6661.07
D5	6666.53	6665.12	6665.08	6665 03	6665.12	6664.98	6664.99	6665.09	6665.00	6665.03	6665.04	6665.12	6665.01	6665.00	6665.00	6664.95	6664.95		6665.07	6665.11	6665 02	6664.94
D6	6669.14	6669 08	6669 05	6669.02	6669.07	6668.97	6668.99	6669.03	6669.01	6669 04	6669.03	6669.07	6669.02	6668.97	6668.97	6668.96	6668 96		6669.05	6669.05	6669.02	6668.88
D7	6670.18	6668.64	6668.55	6668.51	6668.54	6668.45	6668.50	6668.47	6668.40	6668.50	6668.36	6668.36	6668.38	6668.26	6668.24	6668.14	6668.14		6668.25	6668.16	6668.12	6668.06
D8	6670.97	6669.78	6669.71	6669.68	6669.76	6669.60	6669.69	6669.65	6669.63	6669.60	6669.65	6669.66										
D9	6670.62	6669.61	6669.56	6669.51	6669.57	6669.42	6669.53	6669.50	6669.37	6669.48	6669.47	6669.39	6669.42	6669.29	6669.24	6669.24	6669.17		6669.29	6669.20	6669.20	6671.43
D10	6670.78	6669 57	6669.50	6669.51	6669.52	6669.38	6669.47	6669.45	6669.31	6669.37	6669.44	6669.38	6669.32	6669.21	6669.15	6669.09	6669.08		6669.19	6669.03	6669.02	6668.95
D11	6665.66	6665.79	6665 62	6665 60	6665 66	6665.58	6665 62	6665.70	6665.56	6665 59	6665 61	6665.69	6665 64	6665.60	6665.58	6665 61	6665.59		6665.72	6665 63	6665.72	6665.69
E2	6657.57	6657.15	6657.07	6657.10	6657.11	6657.04	6657.07	6657.05	6657.14	6657.04	6657.04	6657.06	6657.05	6657.03	6657.04	6657.00	6656.94		6657.07	6657.06	6656.99	6656.92
E3	6657.82	6657.96	6657.92	6657.90	6657.97	6657.83	6657.92	6657.83	6657.83	6657.92	6657.87	6657.97	6657.89	6657.91	6657.90	6657.90	6657.86		6658.00	6658.00	6657.99	6657.88
E4	6656.50	6656.19	6656.13	6656.14	6656.14	6656.09	6656.13	6656.11	6656.17	6656.15	6656.12	6656.03	6656.10	6656.12	6656.18	6656.09	6656.02		6656.16	6656.18	6656.14	6655.96
E5	6661.16	6660.93	6660.87	6660.87	6660.83	6660.78	6660.85	6660.84	6660.84	6660.87	6660.85	6660.93	6660.81	6660.88	6660.86	6660.82	6660.80		6660.92	6660.96	6660.89	6660.80
E6	6665.05	6664.96	6664.92	6664.86	6664.92	6664.83	6664.87	6664.84	6664.87	6664.93	6664.90	6664.94	6664.94	6664 84	6664.86	6664.86	6664.85		6664.95	6664.98	6664.95	6664.85
E7	6666.84	6666.76	6666.88	6666 67	6666.72	6666.63	6666.73	6666.61	6666.64	6666.65	6666.67	6666.70	6666.71	6666.61	6666.64	6666.65	6666.60		6666.75	6666.72	6666.70	6666.62
E8	6666.20	6666.14	6666.08	6666.03	6666.10	6666.01	6666.05	6665.98	6665.99	6666.06	6666.08	6666.11	6666.08	6666.02	6666.03	6666.02	6666 03		6666.18	6666.14	6666.12	6666.05
E9	6665.53	6665.45	6665.37	6665.33	6665.39	6665.33	6665.36	6665.28	6665.30	6665.37	6665.34	6665.36	6665.37	6665.35	6665.39	6665.32	6665.34		6665.47	6665.43	6665.45	6665.14
E10	6665 93	6665.96	6665.86	6665.81	6665.90	6665 83	6665.84	6665.86	6665.80	6665 92	6665.93	6665 87	6665.89	6665 81	6665.83	6665.81	6665 81		6665.95	6665.79	6665 90	6665 80
X-1	6673.16	6664.04	6663.71	6663.59	6663.50	6663.39	6663.38	6663.19	6663.19	6662.94	6663.00	6662.94	6662.88	6662.66	6662.51	6662.43	6662.30		6662.45	6662.37	6662.27	6662.16

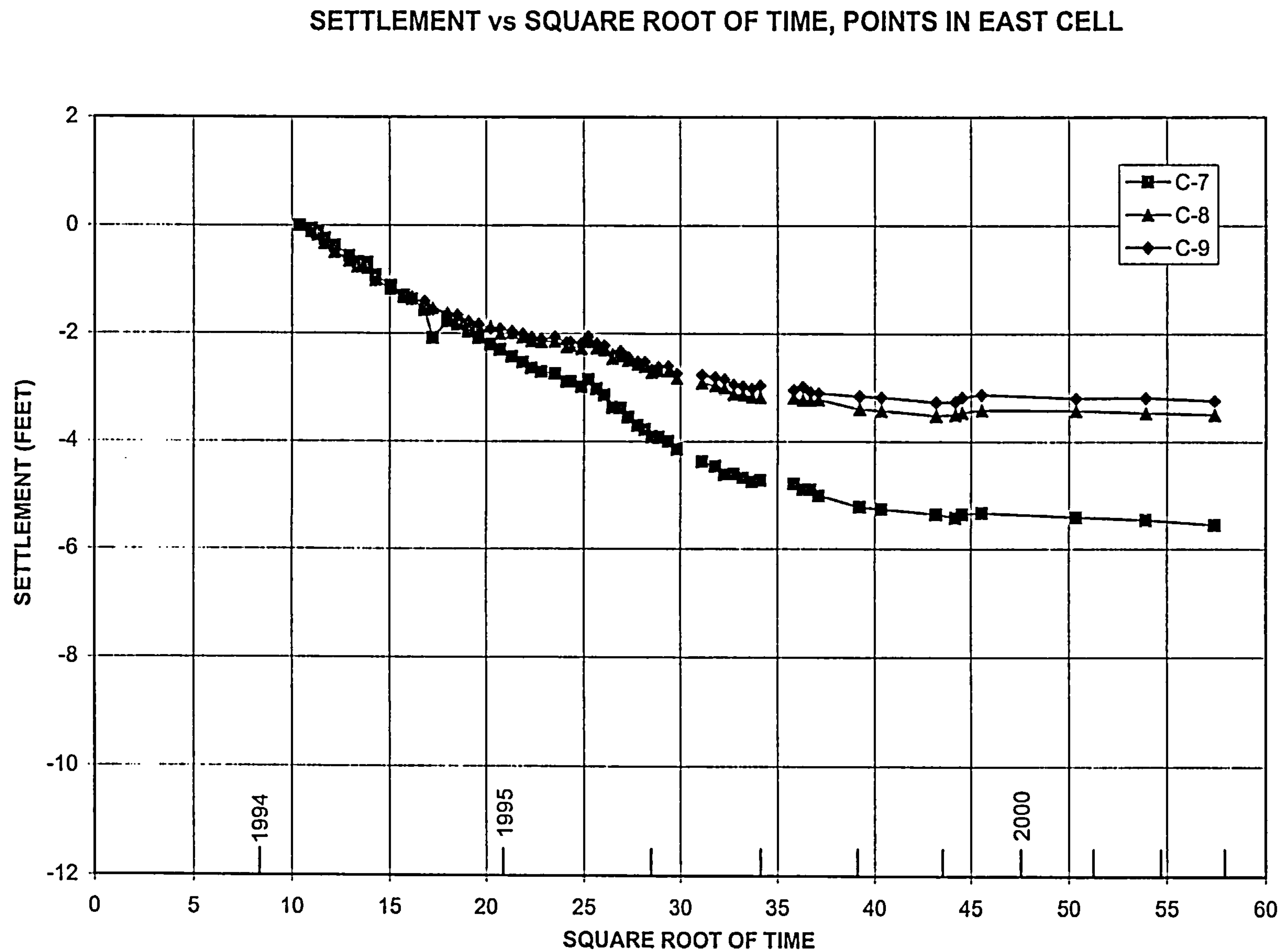
*Surveying contractors: AEC - Anderson Engineering Company, CSA - Clint Sherrill & Associates, MEI - Miller Engineers Inc. or Souder, Miller & Assoc.

**CSA values in table are 3.20 feet lower than actual values reported by CSA to reflect use of different survey control points.

Homestake Grants Large Tailings Impoundment -- Settlement Data

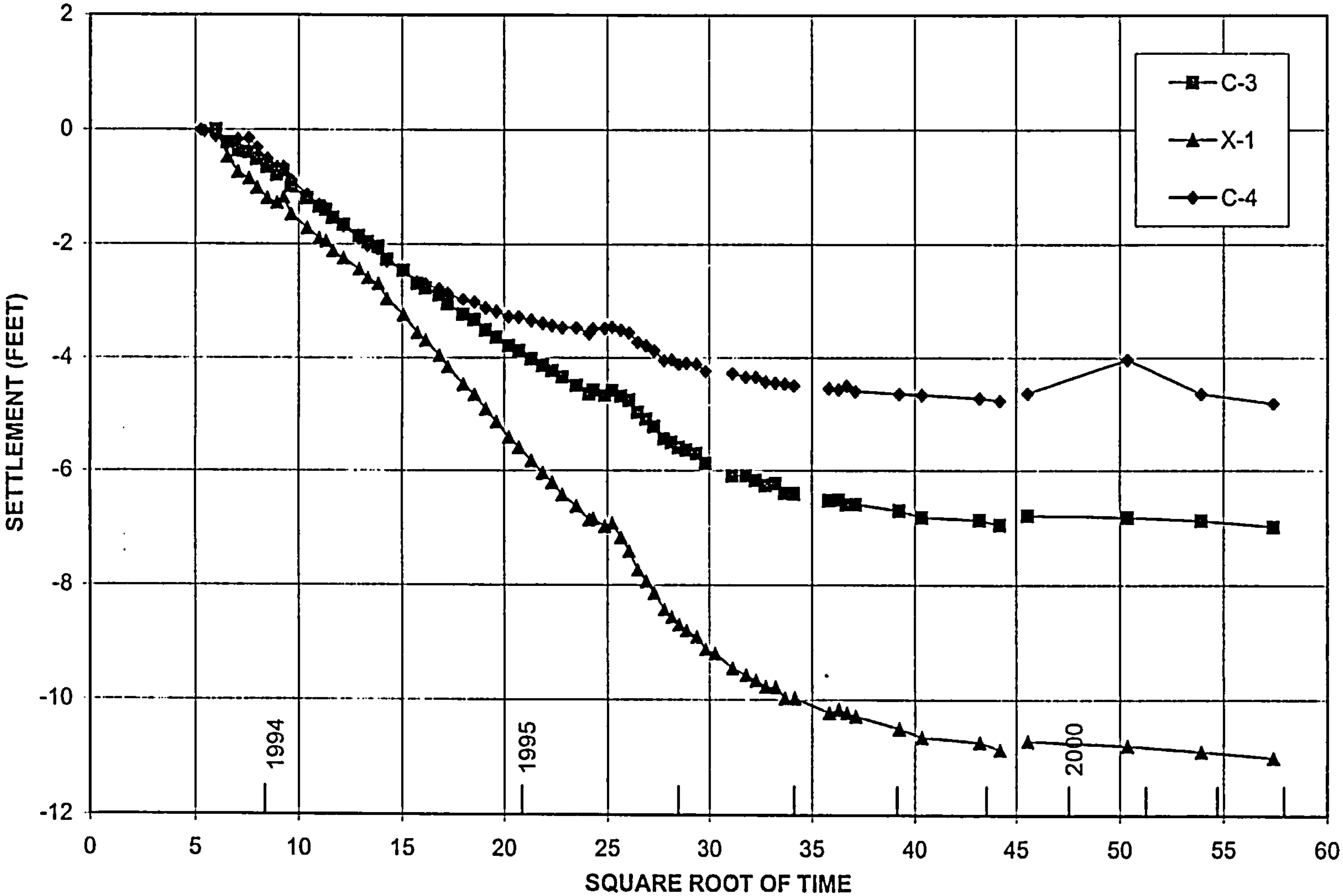
Svyr* Date	AEC 10/23/93	AEC 03/25/96	AEC 06/18/96	AEC 07/31/96	AEC 08/30/96	AEC 09/30/96	AEC 11/01/96	AEC 12/02/96	AEC 12/31/96	AEC 04/30/97	AEC 06/02/97	AEC 06/30/97	AEC 08/01/97	AEC 01/09/98	AEC 04/08/98	CSA 12/04/98	CSA 03/01/99	CSA 04/01/99	CSA 07/01/99	MEI 10/03/00	MEI 10/10/01	MEI 11/4/2002
A2	0.00	0.13	0.21	0.30	0.26	0.31	0.23	0.25	0.25	0.23	0.28	0.23	0.27	0.34	0.36	0.38	0.26	0.32	0.29	0.31	0.36	0.43
A3	0.00	0.42	0.50	0.54	0.55	0.58	0.52	0.60	0.58	0.57	0.56	0.53	0.57	0.58	0.66	0.68	0.55	0.62	0.58	0.60	0 66	0.79
A4	0.00	0.23	0.30	0.36	0.35	0.42	0.40	0.37	0.42	0.38	0.36	0.38	0.39	0.40	0.43	0.52	0.37	0.44	0.41	0.41	0.45	0.59
A5	0.00	0.34	0.40	0.44	0.48	0.50	0.48	0.49	0.51	0.45	0.49	0.39	0.45	0.52	0.51	0.59	0.43	0.48	0.47	0.45	0.48	0.64
A6	0.00	0.02	0.22	0.11	0.15	0.20	0.17	0.21	0.22	0.08	0.14	0.12	0.18	0.16	0.22	0.20	0.10	0.17	0.11	0.11	0.12	0.26
A7	0.00	-0.03	0.06	0.09	0.12	0.12	0.11	0.13	0.18	0.12	0.08	0.13	0.14	0.15	0.18	0.20	0.09	0.13	0.05	0.08	0.10	0.17
A8	0 00	-0.03	0.07	0.15	0.07	0.13	0.14	0.11	0.12	0.17	0.12	0.09	0.08	0.13	0.15	0.18	0.18		0 05	0.07	0.12	0.19
A9	0 00	-0.10	0.03	0.01	0.07	0 09	0.10	0.07	0.06	0.05	0.08	0.02	0.13	0.02	0.15	0.14	0.14		0.01	0.05	0.03	0.16
A10	0.00	-0.36	-0.23	-0.24	-0.22	-0.18	-0.17	-0.20	-0.16	-0.21	-0.16	-0.28	-0.16	-0.14	-0.14	-0.12	-0.11		-0.26	-0.14	-0.25	-0.14
A11	0 00	-0.18	-0.06	-0 02	-0.01	0.01	-0.02	-0.05	0.10	0 00	-0 09	-0.11	0.01	-0.02	0.04	0 01	0 03	-0.03	-0.12	0 00	-0.10	0.02
B1	0.00	0.15	0.24	0.24	0.30	0.33	0.27	0.24	0.36	0.31	0.33	0.24	0.33	0.39	0.40	0.39	0.33	0.33	0.32	0.34	0.40	0.49
B2	0.00	1.55	1.68	1.67	1.72	1.80	1.72	1.67	1.82	1.79	1.84	1.80	1.90	2.01	2.00	2.08	1.98	2.02	2.00	2.03	2.13	2.22
B3	0.00	3.44	3.55	3.61	3.62	3.57	3.67	3.64	3.79	3.70	3.67	3.77	3.79	3.83	3.93	3.97	3.85	3.88	3.86	3.92	4.00	4.12
B4	0.00	1.99	2.11	2.14	2.13	2.22	2.14	2.14	2.27	2.24	2.15	2.17	2.21	2.29	2.33	2.34	2.22	2.28	2.25	2.25	2.29	2.43
B5	0.00	1.30	1.35	1.45	1.41	1.49	1.38	1.47	1.50	1.45	1.49	1.35	1.43	1.47	1.50	1.57	1.42	1.45	1.42	1.39	1.44	1.55
B6	0.00	0.16	0.21	0.28	0.31	0.33	0.37	0.38	0.36	0.29	0.39	0.34	0.44	0.49	0.53	0.61	0.46	0.54	0.50	0.54	0.59	0.74
B7	0.00	0.50	0.67	0.73	0.78	0.83	0.85	0.85	0.92	0.94	0.94	0.92	0.98	1.05	1.19	1.27	1.27	1.24	1.22	1.28	1.29	1.38
B8	0.00	1.93	2.11	2.18	2.22	2.22	2.26	2.27	2.30	2.35	2.33	2.41	2.40	2.48	2.57	2.68	2.66		2.60	2.64	2.71	2.75
B9	0.00	2.08	2.24	2.28	2.33	2.38	2.40	2.41	2.46	2.48	2.47	2.56				2.80	2.85	2.77	2.74	1.70	2.85	2.98
B10	0.00	1.16	1.27	1.31	1.34	1.42	1.38	1.39	1.42	1.46	1.41	1.69	1.48	1.49	1.63	1.65	1.63	1.58	1.53	1.67	1.64	1.73
B11	0 00	-0.17	-0.05	-0.03	-0.01	-0 03	0.03	0 02	0.04	-0.02	-0.03	-0.11	0.04	0 04	0 03	0.04	0 04	-0 04	-0.11	-0.01	-0.11	0.00
C1	0.00	0.20	0.28	0.33	0.35	0.36	0.34	0.40	0.40	0.41	0.37	0.34	0.36	0.43	0.45	0.47	0.55		0.39	0.40	0.47	0.57
C2	0.00	2.82	2.84	2.88	2.87	2.99	2.92	3.04	3.03	3.05	3.05	3.05	3.05	3.14	3.18	3.28	3.32		3.18	3.19	3.29	3.36
C3	0.00	5.87	6.09	6.09	6.17	6 26	6.23	6.39	6.40	6.52	6.51	6.59	6.59	6.70	6 82	6.87	6.95		6.79	6.82	6.88	6.98
C4	0.00	4.23	4.27	4.34	4.34	4.42	4.44	4.46	4.49	4.54	4.56	4.50	4.59	4.64	4.66	4.72	4.76		4.63	4.03	4.64	4.81
C5	0.00	3.12	3.14	3.15	3.15	3.18	3 21	3.21	3.25	3.20	3.22	3.21	3.21	3.31	3.33	3.40	3.39	3.29	3.27	3.23	3.33	3.42
C6	0.00	0.94	0.98	0.99	1.02	1.10	1.09	1.10	1.11	1.07	1.14	0.87	1.21	1.26	1.30	1.32	1.30	1.27	1.22	1.25	1.31	1.45
C7	0.00	4.14	4.37	4.45	4.61	4 60	4 67	4.74	4.72	4.78	4.88	4.89	5.00	5.22	5 26	5.35	5.42	5.35	5.33	5.41	5.46	5.55
C8	0.00	2.83	2.92	2.97	3.01	3.12	3.13	3.17	3.18	3.19	3.23	3.23	3.22	3.40	3.43	3.52	3.50	3.46	3.42	3.43	3.47	3.50
C9	0.00	2.74	2.77	2.81	2.85	2.95	2.98	3.03	2.97	3.05	2.99	3.09	3.11	3.16	3.18	3.27	3.26	3.18	3.13	3.20	3.19	3.24
C10	0.00	1.89	1.99	1.91	1.95	2.12	2.08	2.09	2.11	2.19	2.14	2.15	2.17	2.28	2.31	2.38	2.39	2.34	2.29	2.42	2.42	2.51
C11	0 00	0 01	-0 03	0.14	0.12	0.23	0.18	0.22	0.26	0.16	0.18	0.31	0.21	0.25	0.24	0.25	0.25		0.11	0.20	0.11	0 21
D1	0.00	0.21	0.22	0.27	0.24	0.31	0.31	0.19	0.32	0.31	0.32	0.31	0.27	0.36	0.34	0.42	0.47		0.34	0.34	0.44	0.49
D2	0.00	1.39	1.39	1.42	1.38	1.50	1.46	1.47	1.54	1.55	1.55	1.51	1.59	1.60	1.64	1.67	1.71		1.57	1.60	1.67	1.75
D3	0.00	2.17	2.17	2.29	2.21	2.30	2.25	2.31	2.38	2.31	2.34	2.22	2.32	2.34	2.41	2.43	2.48		2.37	2.40	2.46	2.59
D4	0.00	1.44	1.44	1.49	1.46	1.57	1.50	1.53	1.51	1.56	1.51	1.49	1.54	1.60	1.61	1.65	1.71		1.58	1.56	1.60	1.75
D5	0.00	1.41	1.45	1.50	1.41	1.55	1.54	1.44	1.53	1.50	1.49	1.41	1.52	1.53	1.53	1.58	1.58		1.46	1.42	1.51	1.59
D6	0.00	0.06	0.09	0.12	0.07	0.17	0.15	0.11	0.13	0.10	0.11	0.07	0.12	0.17	0.17	0.18	0.18		0.09	0.09	0.12	0.26
D7	0.00	1.54	1.63	1.67	1.64	1.73	1.68	1.71	1.78	1.68	1.82	1.82	1.80	1.92	1.94	2.04	2.04		1.93	2.02	2.06	2.12
D8	0.00	1.19	1.26	1.29	1.21	1.37	1.28	1.32	1.34	1.37	1.32	1.31										
D9	0.00	1.01	1.06	1.11	1.05	1.20	1.09	1.12	1.25	1.14	1.15	1.23	1.20	1.33	1.38	1.38	1.45		1.33	1.42	1.42	-0.81
D10	0.00	1.21	1.28	1.27	1.26	1.40	1.31	1.33	1.47	1.41	1.34	1.40	1.46	1.57	1.63	1.69	1.70		1.59	1.75	1.76	1.83
D11	0.00	-0.13	0.04	0 06	0.00	0.08	0.04	-0 04	0.10	0.07	0.05	-0.03	0.02	0.06	0 08	0 05	0 07		-0 06	0 03	-0 06	-0.03
E2	0.00	0.42	0.50	0.47	0.46	0.53	0.50	0.52	0.43	0.53	0.53	0.51	0.52	0.54	0.53	0.57	0.63		0.50	0.51	0.58	0.65
E3	0.00	-0.14	-0.10	-0.08	-0.15	-0.01	-0.10	-0.01	-0.01	-0.10	-0.05	-0.15	-0.07	-0.09	-0.08	-0.08	-0.04		-0.18	-0.18	-0.17	-0.06
E4	0 00	0.31	0.37	0.36	0.36	0.41	0.37	0.39	0.33	0.35	0.38	0.47	0.40	0.38	0.32	0.41	0.48		0.34	0.32	0.36	0.54
E5	0.00	0.23	0 29	0.29	0.33	0.38	0.31	0.32	0.32	0.29	0.31	0.23	0.35	0.28	0.30	0.34	0.36		0.24	0 20	0.27	0.36
E6	0.00	0.09	0.13	0.19	0.13	0.22	0.18	0.21	0.18	0.12	0.15	0.11	0.11	0.21	0.19	0.19	0.20		0.10	0.07	0.10	0.20
E7	0.00	0.08	-0.04	0.17	0.12	0.21	0.11	0.23	0.20	0.19	0.17	0.14	0.13	0.23	0.20	0.19	0.24		0.09	0.12	0.14	0.22
E8	0.00	0.06	0.12	0.17	0.10	0.19	0.15	0.22	0.21	0.14	0.12	0.09	0.12	0.18	0.17	0.18	0.17		0.02	0.06	0.08	0.15
E9	0.00	0.08	0.16	0.20	0.14	0.20	0.17	0.25	0.23	0.16	0.19	0.17	0.16	0.18	0.14	0.21	0.19		0.06	0.10	0.08	0.39
E10	0 00	-0.03	0.07	0.12	0 03	0.10	0 09	0 07	0.13	0.01	0.00	0.06	0 04	0.12	0.10	0.12	0.12		-0 02	0.14	0 03	0.13
X-1	0.00	9.12	9.45	9.57	9.66	9.77	9.78	9.97	9.97	10.22	10.16	10.22	10.28	10.50	10.65	10.73	10.86		10.71	10.79	10.89	11.00

*Surveying contractors: AEC - Anderson Engineering Company, CSA - Clint Sherrill & Associates, MEI - Miller Engineers Inc. or Souder, Miller & Assoc.



1/7/2003 settlement

SETTLEMENT vs SQUARE ROOT OF TIME, POINTS IN WEST CELL



1/7/2003 settlement

ATTACHMENT 2

Flushing of water from mill tailings at the Homestake Grants Reclamation Project

G.L. Hoffman
Hydro-Engineering, L.L.C., Casper, Wyo., USA

A.D. Cox
Homestake Mining Company of California, Grants, N. Mex., USA

ABSTRACT: Dewatering of uranium tailings at Homestake Mining Company's Grants uranium mill site has proven to be more difficult than initially predicted. The removal of *in-situ* water in the tailings pile is important in controlling the potential for long-term impacts to the local ground-water system. The use of fresh water injection to drive the water to adjacent collection/recovery wells was initially evaluated in 2000. A complete flushing program for the tailings pile was initiated in 2002 with an average total injection rate of 302 gpm into 152 wells. Production from the tailings dewatering wells has increased to above 100 gpm after declining to below 35 gpm prior to the initiation of the injection/flushing program. Testing to date has indicated that the injection/flushing program is successful in reducing uranium, molybdenum and selenium concentrations in the tailings pile to levels that minimize potential for impact to the local alluvial ground-water system.

1 INTRODUCTION

A large-scale ground-water restoration program has existed at Homestake's Grants Project since 1977. The removal of the source (tailings seepage) is important to enable restoration of ground water at this site. A dewatering program of these tailings was initiated in 1995 and proved difficult to maintain the desired rates from approximately 130 dewatering wells. Fresh water injection has been added to the dewatering program to increase the dewatering rates and drive the high concentration water to the dewatering wells since the year 2000.

2 TAILINGS HISTORY

The large tailings pile contains 22 million tons of uranium tailings from operations of a mill between 1958 and 1990. The large tailings pile was constructed by cycloning the tailings with deposition of the sand material forming the outer dikes and slimes flowing inside of the dikes to ponds. Pools of water were maintained in the west and east cells during the operation of the Grants mill. Re-contouring of the large tailings began in 1993 and was completed in 1995. Figure 1 shows the present topography of the tailings site which shows elevations that are approximately 90 feet high above the flat alluvial plain. Hydraulic tailings deposition at the site has resulted in segregation of the silt and clay particles (slime) in the center of the pile's two cells. The segregation of the slimes in the inner portion of the pile has resulted in smaller permeabilities which makes the dewatering program difficult.

2.1 *Tailings condition*

Tailings wells were drilled in 1994 and 1995 to define the hydrologic conditions in the tailings. Figure 2 shows the approximate locations of the two slime areas and the sand dikes that surround the slimes. The perimeter of the tailings and a center dike are composed of primarily tailings sand, while the inner portion of the tailings consist of mainly slimes. Sand and slime lenses are also present in areas dominated by the other type of milled tailings material. The cross section shown on Figure 2 shows the approximate locations of the sand and slime tailings. This cross section shows the base of the tailings with a perched alluvial sand beneath the base of the tailings. The tailings and the perched sand are in direct contact in some areas of the large tailings pile. The tailings and perched alluvium contact areas are more prevalent on the east, southeast and south central sides of the tailings but local areas of contact exist throughout the tailings.

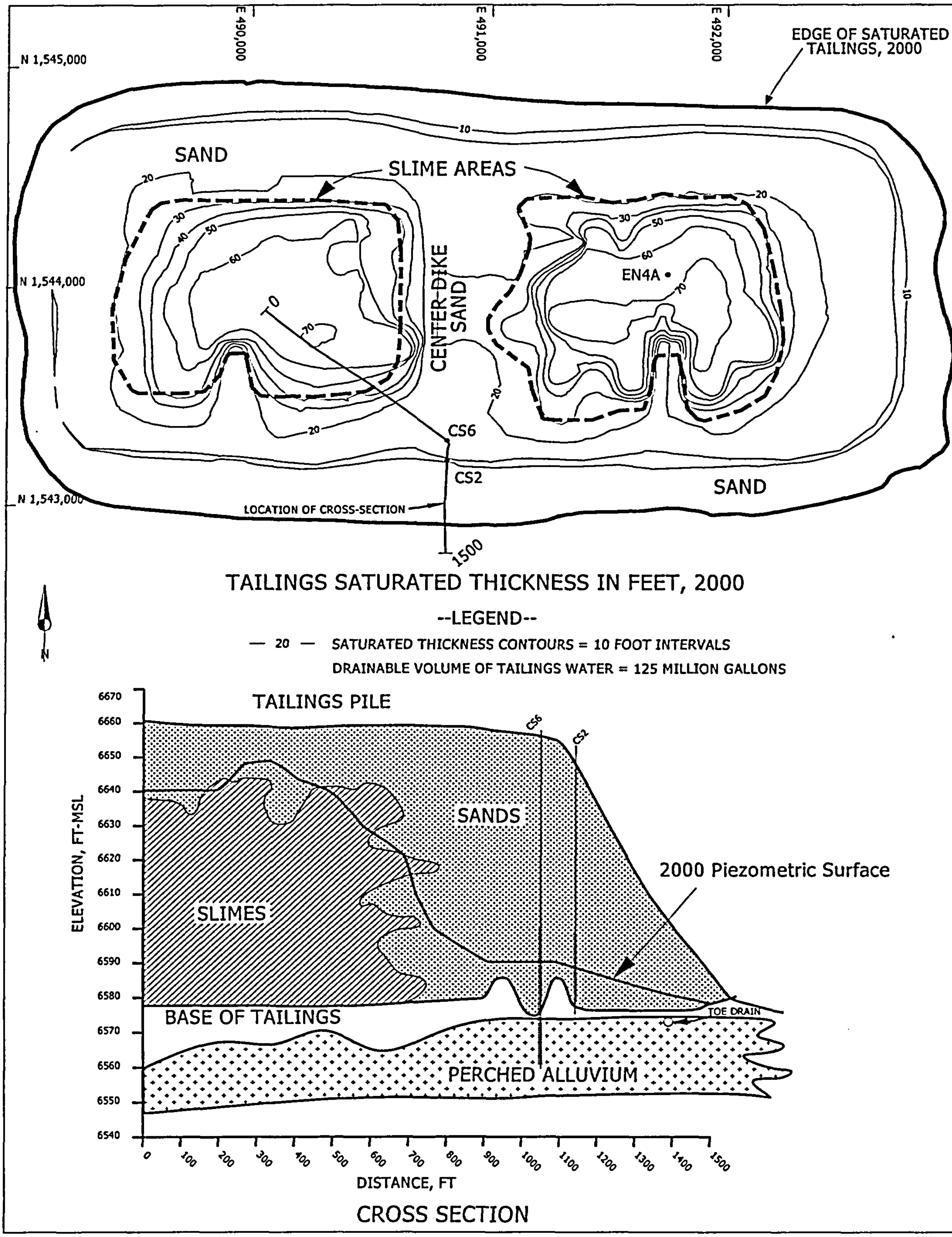


FIGURE 2. TAILINGS SATURATED THICKNESS WITH SAND AND SLIME AREAS AND CROSS SECTION

produced by the drains with the fresh water injection program.

3.2 *Projected dewatering rates*

The combination of dewatering with the fresh water injection program will enable larger extraction rates to be obtained. Table 2 presents the projected dewatering rates from 2003 through 2007. Evaporation pond capacity is limited so the projected rates for 2003 and 2004 are lower than potential production rates. An additional 152 and 47 million gallons of water are projected to be produced from the tailings dewatering wells and the toe drains respectively from 2003 through 2007.

Table 2. Projected Tailings Dewatering Rates in gpm.

	Year				
	'03	'04	'05	'06	'07
Tails Wells	30	60	80	60	60
Toe Drain	50	30	10	0	0
Total	80	90	90	60	60

Note; Projected Volume: Tails Wells = 152 and Toe Drain = 47 million gallons.

The toe drains are expected to produce an average of 50 gpm for 2003. A larger rate of production from the toe drains would likely be possible for 2004 but the pumping rate is expected to be reduced to 30 gpm in 2004. A portion of the toe drain water, which has concentrations less than a conductivity of 15 mmhos/cm, will be allowed to migrate through the partially saturated alluvium to the alluvial aquifer. The toe drain water that contains lower concentrations will help flush higher concentrations in the partially saturated alluvium down to the alluvial aquifer for eventual collection. Therefore, allowing some of the toe drain water to migrate to the alluvial aquifer is considered beneficial and this process will start in 2004. The rate of drainage to the toe drains is expected to start to decline in 2005 but the concentrations of the water in the toe drains are also expected to be significantly less and therefore only 10 gpm is projected to be pumped from the toe drains in 2005.

The dewatering wells are projected to be operated through 2007. The concentrations in the tailings are expected to be small in 2007 and therefore continued operation of the dewatering is not expected to be beneficial.

4 FRESH WATER INJECTION

Fresh water injection into the uranium tailings at the Grants Project was initially tested in 2000. This testing showed that the dewatering well production was increased substantially with the injection. It also showed that the concentrations were reduced substantially in the tailings. The test demonstrated that the fresh water injection into the tailings was worthwhile even with the increased volume of water to be pumped. A total of 106 new 2-inch wells were completed only in the tailings for the fresh water injection program. These new wells were used along with 46 existing wells to inject the fresh water into tailings.

4.1 *Tailings injection history*

Fresh water injection was initiated in 2000 to test the feasibility of the fresh water injection program. Table 3 presents the average yearly rate that was injected into the tailings from 1995 through 2002 with projected injection through 2007. The full program in 2002 averaged 302 gpm of water injected into the tailings. A total of 277 million gallons of fresh water have been injected into the tailings through 2002. Figure 1 shows the locations of the fresh water injection wells.

Table 3. Actual and Projected Tailings Injection Rates in gpm.

	Actual Injection Rates							
	Year							
	'95	'96	'97	'98	'99	'00	'01	'02
Tails Wells	0	0	0	0	2	61	162	302

	Projected Injection Rates				
	Year				
	'03	'04	'05	'06	'07
Tails Wells	300	300	0	0	0

Note; Actual Volume: Tails Wells = 277 million gallons and Projected Volume: Tails Wells = 315 million gallons.

4.2 *Projected tailings injection*

The tailings injection program is planned to be continued through 2004. The fresh water injection program is expected to average 300 gpm for 2003 and 2004, as tabulated in the lower portion of Table 3. This will be an additional 315 million gallons of fresh water injection. The total fresh water injection volume from 2000 through 2004 should be slightly less than 600 million gallons of injection at the end of the program.

The total volume of injection water from 2000 through 2007 is significantly greater than the total dewatering volume for this same period. Table 4 lists the volumes since the start of injection in mil-

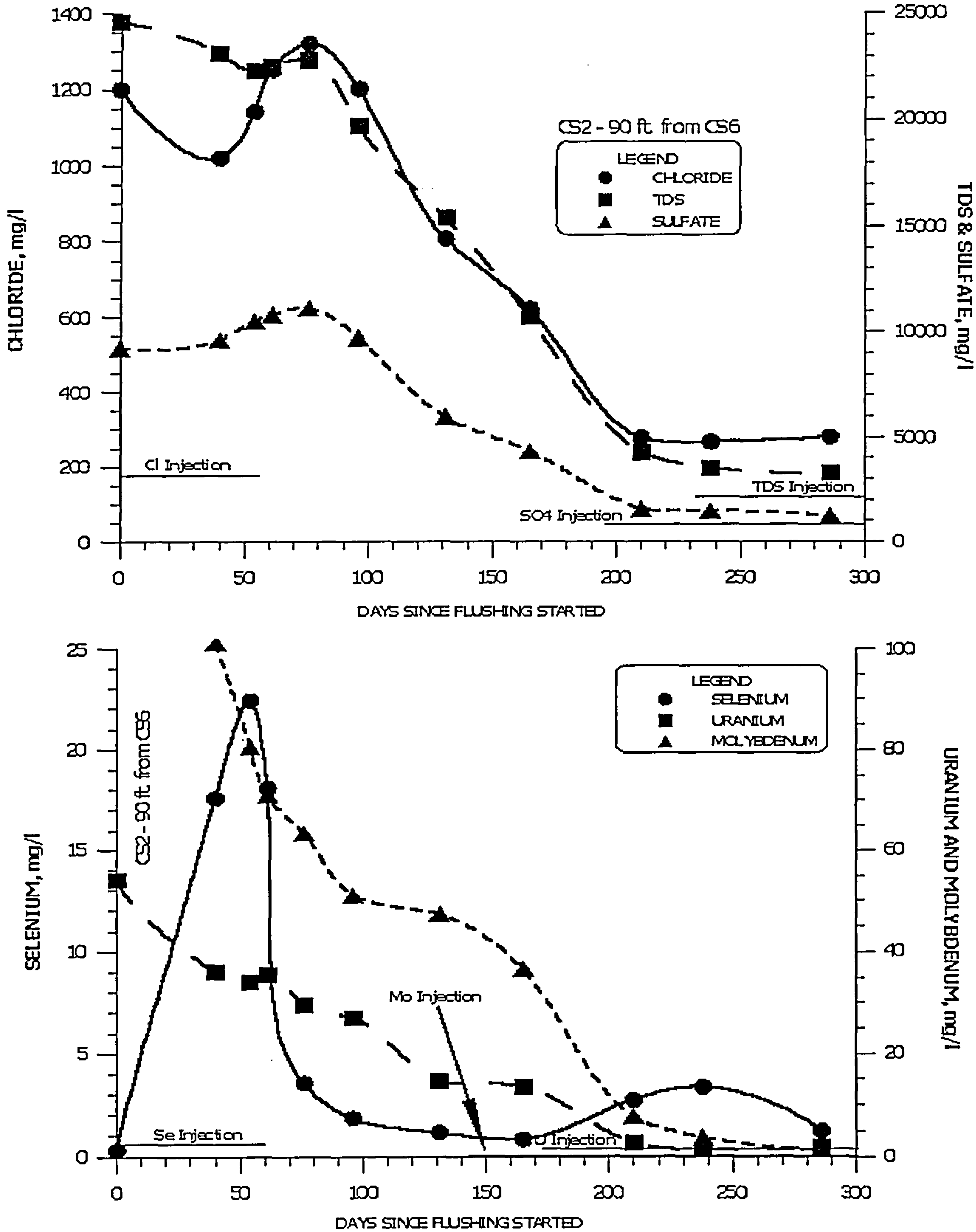


Figure 3. Chloride, TDS, Sulfate, Selenium, Uranium and Molybdenum Concentrations for Well CS2 versus Time Since Well CS6 Injection Started.

as expected. This test indicated it may take 5 years for the injection water to travel 50 feet through the slime material. The changes in the key parameters of uranium and molybdenum indicate that the flushing of concentrations through the slimes, even though very slow, will be very successful.

Figure 5 presents the conductivities in mmhos/cm for the tailings water in April 2003. This figure shows patterns where concentrations are less than 10, between 10 and 20, between 20 and 30, and greater than 30 mmhos/cm. Conductivity in the entire tailings area except for the outer edges of the sand dike was greater than 30 mmhos/cm prior to the fresh water injection. This figure shows that conductivity in large areas has been decreased substantially by the fresh water injection program. The majority of the tailings conductivities are expected to be significantly below 10 mmhos/cm at the end of the fresh water injection and dewatering program. Concentrations are expected to increase slightly after the injection ceases as some lower permeability lenses gradually drain.

4.4 *Constituent removal*

The fresh water injection, while increasing the residual volume of water in the tailings, will ultimately allow extraction of a greater volume of mobile constituents from the tailings. In the absence of fresh water injection, the collection rates from the tailings would continue to decline and the rate of extraction of mobile constituents would parallel the dewatering rate.

Fresh water injection functions as a drive for higher concentration water within the tailings. The collection wells initially extract the higher concentration tailings water at increased rates due to the greater saturated thickness and gradients used by the injection. The concentrations in the collections wells will decline as the fresh water injection front reaches the well. Ideally, the injection front would be fairly steep and would result in an abrupt decrease in concentration as the front reached a collection well. This would allow sequential termination of collection in local areas with very limited extraction of fresh water. The heterogeneities in the tailings material, non uniform flow paths, and natural dispersion processes will smear the injection front and result in collection of mixed water at intermediate concentrations. However, the mass of volume of constituents extracted is dramatically greater with the injection/collection combination. Figure 6 presents the amount of removal of pounds of uranium with injection for each year in the upper graph. The lower graph presents the cumulative mass of removal of uranium with the injection system. The projected cumulative removal with only a dewatering system is less than one-half the volume with injection. This illustrates the effectiveness of the injection in facilitating constituent removal in a timely manner.

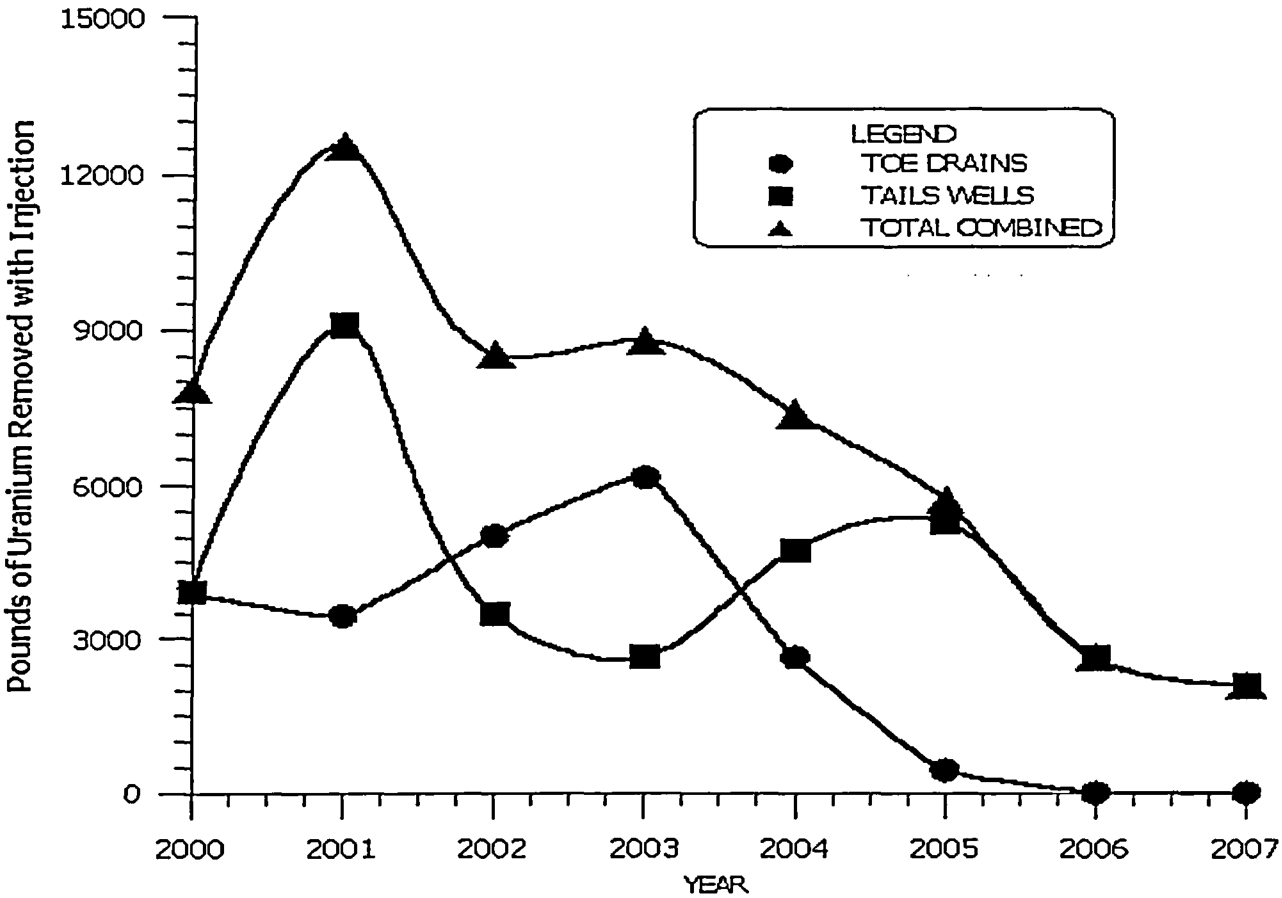
5 CONCLUSIONS

The use of fresh water injection along with the dewatering program at the Grants Project site is beneficial. The volume of total well dewatering from the Grants site without the fresh water injection would have been significantly less than 100 million gallons. With the fresh water injection program, approximately 250 million gallons of dewatering with wells is expected from the tailings by the end of the dewatering program. This volume will be approximately twice the volume of drainable water in the tailings prior to the fresh water injection program but the pumping of the additional volume is deemed necessary to obtain the removal of a large percentage of the high concentration water.

The volume of water in storage in the tailings at the end of dewatering in 2007 is likely to be similar to the volume in storage in 2000 prior to the fresh water injection. Concentrations in the tailings water are expected to be low enough that the impacts to the alluvial aquifer will be minimized.

REFERENCES:

Hoffman, G.L. & Cellan, R.R. 1998. Slime dewatering at the Homestake's Grants Project. *Proceedings of the Fifth International Conference on Tailings and Mine Waste; 98:* 299-308. Rotterdam:Balkema.



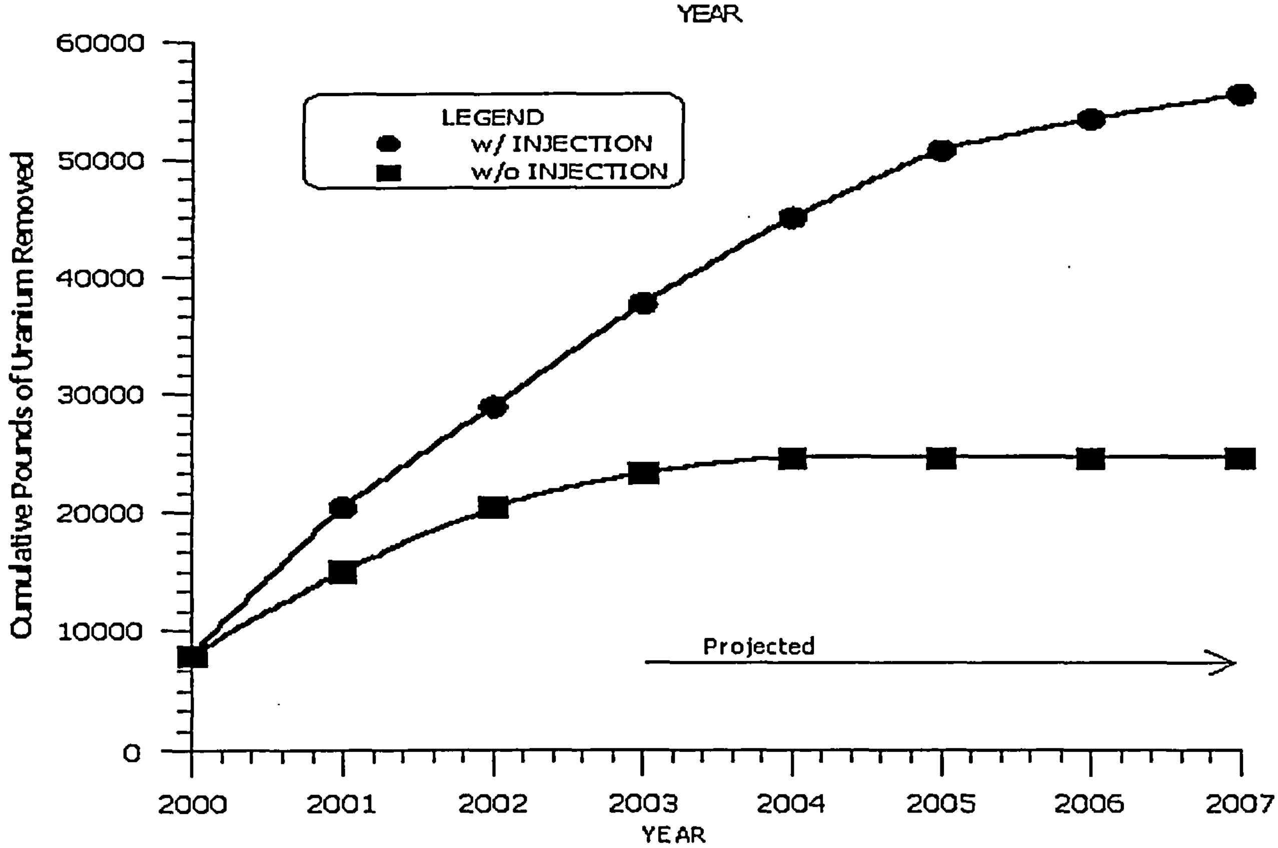


Figure 6. Pounds of Uranum Removed from the Tailings With and Without Injection.

ATTACHMENT 1

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consulting
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January 21, 2003

MFG No. 180899

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JAN 24 2003

Homestake Mining Company
Grants Reclamation Project
P.O. Box 98
Grants, New Mexico 87020-0011

Attention: Alan Cox
Manager – Grants & Southwest U.S.

Subject: Homestake Grants Large Tailings Impoundment
Review of 2002 Settlement Monitoring Data

Dear Alan:

This letter documents our review of 2002 settlement monitoring point data on the top surface of the large tailings impoundment. The settlement monitoring points were measured for Homestake on November 4, 2002 by Souder, Miller, and Associates.

The settlement monitoring point data and calculated settlement since 1996 are presented in the two tables attached with this letter. The monitoring point location map and plots of settlement with time for selected points in the center of the east and west cells are also attached.

The November 2002 data is consistent with: (1) the 2001 data, (2) the adjusted measurements from 1998 and 1999, and (3) the earlier data. There are a number of monitoring points that show settlement of 0.1 to 0.2 feet from October 2001 that may be within the accuracy of the elevation measuments. Total settlement has ranged from less than 0.1 foot on the perimeter of the impoundment (above tailings sands) to several feet in the center of the east and west cells (above tailings slimes). Total measured settlement in the center of the east cell is approximately 5.5 feet (at point C-7). Total measured settlement in the center of the west cell is approximately 11 feet (at point X-1). The larger amount of settlement in the west cell is most likely due to thicker zones of tailings slimes (based on 1993 auger hole logs).

Settlement values with time show a consistent rate from the start of monitoring in late 1993 through 1996. A short-term decrease in settlement rate in mid-1995 (possibly due to temporary cessation of pore water pumping) is seen at most of the monitoring points. There has been minimal additional settlement since 1999.

Although the settlement data shows that the radon barrier could be constructed on the top surface of the large tailings impoundment, completion of the radon barrier is not recommended until the tailings pore water extraction program is completed. This is because: (1) additional tailings pore water extraction may induce stress changes in the tailings that would result in additional consolidation, and (2) the well and piping system associated with pore water extraction should be removed to provide access for earthmoving and compaction equipment.

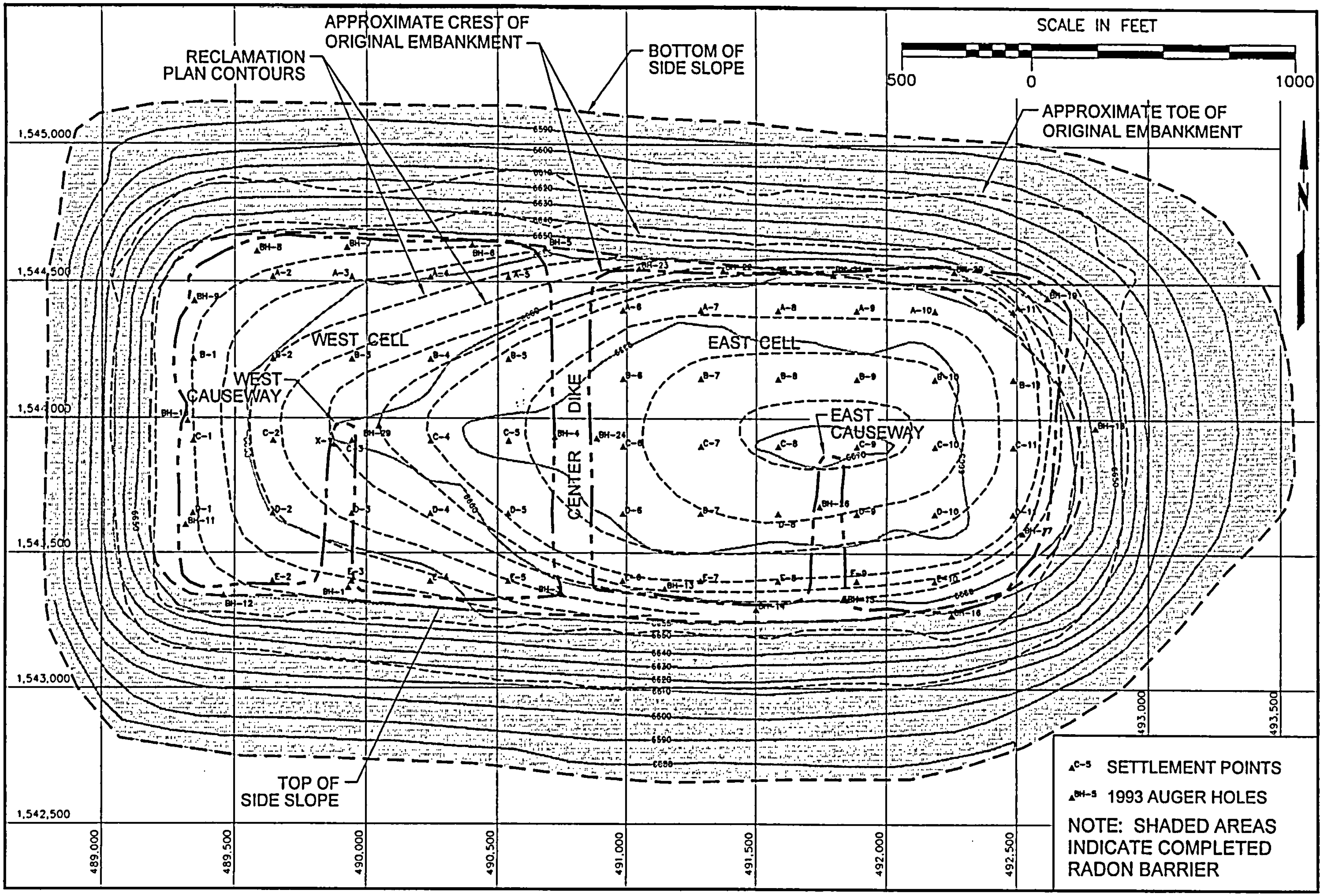
If you have questions concerning the information in this letter, please contact me.

Yours sincerely,
MFG, Inc.

Clint Strachan

Clint Strachan, P.E.
Project Manager

Attachments



consulting scientists and engineers

FIGURE 1
LARGE IMPOUNDMENT PLAN VIEW WITH
LOCATION OF SETTLEMENT MONITORING POINTS

Date:	JANUARY 2003
Project:	180899
File:	LAYOUT

Homestake Grants Large Tailings Impoundment -- Settlement Monitoring Point Data

Svyr*	AEC	AEC	AEC	AEC	AEC	AEC	AEC	AEC	AEC	AEC	AEC	AEC	AEC	AEC	AEC	CSA**	CSA	CSA	CSA	MEI	MEI	MEI
Date	10/23/93	03/25/96	06/18/96	07/31/96	08/30/96	09/30/96	11/01/96	12/02/96	12/31/96	04/30/97	06/02/97	06/30/97	08/01/97	01/09/98	04/08/98	12/04/98	03/01/99	04/01/99	07/01/99	10/03/00	10/10/01	11/4/2002
A2	6657.15	6657.02	6656.94	6656.85	6656.89	6656.84	6656.92	6656.90	6656.90	6656.92	6656.87	6656.92	6656.88	6656 81	6656.79	6656.77	6656.89	6656.83	6656.86	6656.84	6656.79	6656.72
A3	6657.80	6657.38	6657.30	6657.26	6657.25	6657.22	6657.28	6657.20	6657.22	6657.23	6657.24	6657.27	6657.23	6657.22	6657.14	6657.12	6657.25	6657.18	6657.22	6657.20	6657.14	6657.01
A4	6658.06	6657.83	6657.76	6657.70	6657.71	6657.64	6657.66	6657.69	6657.64	6657.68	6657.70	6657.68	6657.67	6657.66	6657.63	6657.54	6657.69	6657.62	6657.65	6657.65	6657.61	6657.47
A5	6659.67	6659.33	6659.27	6659.23	6659.19	6659.17	6659.19	6659.18	6659.16	6659.22	6659.18	6659.28	6659.22	6659.15	6659.16	6659.08	6659.24	6659.19	6659.20	6659.22	6659.19	6659.03
A6	6665.79	6665.77	6665.57	6665.68	6665.64	6665.59	6665 62	6665.58	6665.57	6665.71	6665.65	6665.67	6665.61	6665.63	6665.57	6665.59	6665.69	6665 62	6665.68	6665.68	6665.67	6665.53
A7	6666.18	6666.21	6666.12	6666.09	6666.06	6666.06	6666.07	6666.05	6666.00	6666.06	6666.10	6666.05	6666.04	6666.03	6666.00	6665.98	6666.09	6666.05	6666.13	6666.10	6666.08	6666.01
A8	6666.68	6666.71	6666.61	6666.53	6666.61	6666.55	6666.54	6666.57	6666.56	6666.51	6666.56	6666.59	6666.60	6666.55	6666.53	6666.50	6666.50		6666.63	6666.61	6666 56	6666.49
A9	6666.41	6666.51	6666.38	6666.40	6666.34	6666.32	6666.31	6666.34	6666.35	6666.36	6666.33	6666.39	6666.28	6666.39	6666.26	6666.27	6666.27		6666.40	6666.36	6666.38	6666.25
A10	6666.16	6666.52	6666.39	6666.40	6666.38	6666.34	6666.33	6666.36	6666.32	6666.37	6666.32	6666.44	6666.32	6666.30	6666.30	6666.28	6666.27		6666.42	6666.30	6666.41	6666.30
A11	6663 97	6664.15	6664 03	6663 99	6663.98	6663 96	6663.99	6664.02	6663.87	6663.97	6664 06	6664.08	6663 96	6663.99	6663 93	6663 96	6663 94	6664.00	6664.09	6663.97	6664.07	6663 95
B1	6656.99	6656.84	6656.75	6656.75	6656.69	6656.66	6656.72	6656.75	6656.63	6656.68	6656.66	6656.75	6656.66	6656.60	6656.59	6656.60	6656.66	6656.66	6656.67	6656.65	6656.59	6656.50
B2	6660.66	6659.11	6658.98	6658.99	6658.94	6658.86	6658.94	6658.99	6658.84	6658.87	6658 82	6658.86	6658.76	6658.65	6658.66	6658.58	6658.68	6658.64	6658.66	6658.63	6658.53	6658.44
B3	6663.21	6659.77	6659 66	6659.60	6659.59	6659.64	6659.54	6659.57	6659.42	6659.51	6659.54	6659.44	6659.42	6659.38	6659.28	6659.24	6659.36	6659.33	6659.35	6659.29	6659.21	6659.09
B4	6664.78	6662.79	6662.67	6662.64	6662.65	6662.56	6662.64	6662.64	6662.51	6662.54	6662.63	6662.61	6662.57	6662.49	6662.45	6662.44	6662.56	6662.50	6662.53	6662.53	6662.49	6662.35
B5	6666.77	6665.47	6665.42	6665.32	6665.36	6665.28	6665.39	6665.30	6665.27	6665.32	6665.28	6665.42	6665.34	6665.30	6665.27	6665.20	6665.35	6665.32	6665.35	6665.38	6665.33	6665.22
B6	6669.34	6669.18	6669.13	6669.06	6669.03	6669.01	6668.97	6668.96	6668.98	6669.05	6668.95	6669.00	6668.90	6668.85	6668.81	6668.73	6668.88	6668.80	6668.84	6668.80	6668.75	6668.60
B7	6673.15	6672.65	6672.48	6672.42	6672.37	6672.32	6672.30	6672.30	6672.23	6672.21	6672.21	6672.23	6672.17	6672.10	6671.96	6671.88	6671.88	6671.91	6671.93	6671.87	6671.86	6671.77
B8	6671.24	6669.31	6669.13	6669.06	6669 02	6669.02	6668.98	6668.97	6668.94	6668.89	6668.91	6668.83	6668.84	6668.76	6668.67	6668.56	6668 58		6668.64	6668 60	6668.53	6668 49
B9	6671.79	6669.71	6669.55	6669.51	6669.46	6669.41	6669.39	6669.38	6669.33	6669.31	6669.32	6669.23				6668.99	6668.94	6669.02	6669.05	6670.09	6668.94	6668.81
B10	6671.75	6670.59	6670.48	6670.44	6670.41	6670.33	6670.37	6670.36	6670.33	6670.29	6670.34	6670.06	6670.27	6670.26	6670.12	6670.10	6670.12	6670.17	6670.22	6670.08	6670.11	6670.02
B11	6666 00	6666.17	6666 05	6666.03	6666 01	6666 03	6665.97	6665.98	6665.96	6666.02	6666.03	6666.11	6665.96	6665.96	6665.97	6665 96	6665.96	6666.04	6666.11	6666.01	6666.11	6666.00
C1	6657.40	6657.20	6657.12	6657.07	6657.05	6657.04	6657.06	6657.00	6657.00	6656.99	6657.03	6657.06	6657.04	6656.97	6656.95	6656.93	6656.85		6657.01	6657.00	6656.93	6656.83
C2	6663.53	6660.71	6660.69	6660.65	6660.66	6660.54	6660.61	6660.49	6660.50	6660.48	6660.48	6660.48	6660.48	6660.39	6660.35	6660.25	6660.21		6660.35	6660.34	6660.24	6660.17
C3	6671.82	6665.95	6665.73	6665.73	6665.65	6665.56	6665.59	6665.43	6665.42	6665.30	6665.31	6665.23	6665.23	6665.12	6665.00	6664.95	6664.87		6665.03	6665.00	6664.94	6664.84
C4	6671.49	6667.26	6667.22	6667.15	6667.15	6667.07	6667.05	6667.03	6667.00	6666.95	6666.93	6666.99	6666.90	6666.85	6666.83	6666.77	6666.73		6666.86	6667.46	6666.85	6666.68
C5	6674.67	6671.55	6671.53	6671.52	6671.52	6671.49	6671.46	6671.46	6671.42	6671.47	6671.45	6671.46	6671.46	6671.36	6671.34	6671.27	6671.28	6671.38	6671.40	6671.44	6671.34	6671.25
C6	6672.27	6671.33	6671.29	6671.28	6671.25	6671.17	6671.18	6671.17	6671.16	6671.20	6671.13	6671.40	6671.06	6671.01	6670.97	6670.95	6670.97	6671.00	6671.05	6671.02	6670.96	6670.82
C7	6676.13	6671.99	6671.76	6671.68	6671.52	6671.53	6671.46	6671.39	6671.41	6671.35	6671.25	6671.24	6671.13	6670.91	6670.87	6670.78	6670.71	6670.78	6670.80	6670.72	6670.67	6670.58
C8	6675.39	6672.56	6672.47	6672.42	6672.38	6672.27	6672.26	6672.22	6672.21	6672.20	6672.16	6672.16	6672.17	6671.99	6671.96	6671.87	6671.89	6671.93	6671.97	6671.96	6671.92	6671.89
C9	6674.67	6671.93	6671.90	6671.86	6671.82	6671.72	6671.69	6671.64	6671.70	6671.62	6671.68	6671.58	6671.56	6671.51	6671.49	6671.40	6671.41	6671.49	6671.54	6671.47	6671.48	6671.43
C10	6675.00	6673.11	6673.01	6673 09	6673 05	6672.88	6672.92	6672.91	6672.89	6672.81	6672.86	6672.85	6672.83	6672.72	6672.69	6672.62	6672.61	6672.66	6672.71	6672.58	6672.58	6672.49
C11	6666 81	6666 80	6666 84	6666 67	6666 69	6666 58	6666 63	6666 59	6666.55	6666.65	6666 63	6666 50	6666.60	6666.56	6666 57	6666.56	6666.56		6666 70	6666 61	6666.70	6666 60
D1	6658.78	6658.57	6658.56	6658.51	6658.54	6658.47	6658.47	6658.59	6658.46	6658.47	6658.46	6658.47	6658.51	6658.42	6658.44	6658.36	6658.31		6658.44	6658.44	6658.34	6658.29
D2	6659.19	6657.80	6657.80	6657.77	6657.81	6657.69	6657.73	6657.72	6657.65	6657.64	6657.64	6657.68	6657.60	6657.59	6657.55	6657.52	6657.48		6657.62	6657.59	6657.52	6657.44
D3	6661.70	6659.53	6659.53	6659.41	6659.49	6659.40	6659.45	6659.39	6659.32	6659.39	6659.36	6659.48	6659.38	6659.36	6659.29	6659.27	6659.22		6659 33	6659.30	6659.24	6659.11
D4	6662.82	6661.38	6661.38	6661.33	6661.36	6661.25	6661.32	6661.29	6661.31	6661.26	6661.31	6661.33	6661.28	6661.22	6661.21	6661.17	6661.11		6661.24	6661.26	6661.22	6661.07
D5	6666.53	6665.12	6665.08	6665.03	6665.12	6664.98	6664.99	6665.09	6665.00	6665.03	6665.04	6665.12	6665 01	6665.00	6665.00	6664.95	6664.95		6665.07	6665.11	6665.02	6664 94
D6	6669.14	6669.08	6669.05	6669.02	6669.07	6668.97	6668.99	6669.03	6669.01	6669.04	6669.03	6669.07	6669.02	6668.97	6668.97	6668.96	6668.96		6669.05	6669.05	6669 02	6668.88
D7	6670.18	6668.64	6668.55	6668.51	6668.54	6668.45	6668.50	6668.47	6668.40	6668.50	6668.36	6668.36	6668.38	6668.26	6668.24	6668.14	6668.14		6668.25	6668.16	6668.12	6668.06
D8	6670.97	6669.78	6669.71	6669.68	6669.76	6669.60	6669.69	6669.65	6669.63	6669.60	6669 65	6669.66										
D9	6670 62	6669 61	6669 56	6669 51	6669.57	6669.42	6669.53	6669.50	6669.37	6669.48	6669.47	6669.39	6669.42	6669.29	6669.24	6669.24	6669.17		6669.29	6669 20	6669.20	6671.43
D10	6670.78	6669.57	6669.50	6669.51	6669.52	6669.38	6669.47	6669.45	6669.31	6669.37	6669.44	6669.38	6669.32	6669.21	6669.15	6669.09	6669.08		6669.19	6669 03	6669.02	6668.95
D11	6665.66	6665.79	6665.62	6665 60	6665.66	6665 58	6665 62	6665.70	6665.56	6665.59	6665 61	6665.69	6665 64	6665 60	6665.58	6665.61	6665.59		6665.72	6665.63	6665.72	6665 69
E2	6657.57	6657.15	6657.07	6657.10	6657.11	6657.04	6657.07	6657.05	6657.14	6657.04	6657.04	6657.06	6657.05	6657.03	6657.04	6657.00	6656.94		6657.07	6657.06	6656.99	6656.92
E3	6657.82	6657.96	6657.92	6657.90	6657.97	6657.83	6657.92	6657.83	6657.83	6657.92	6657.87	6657.97	6657.89	6657.91	6657.90	6657.90	6657.86		6658.00	6658.00	6657.99	6657.88
E4	6656.50	6656.19	6656.13	6656.14	6656.14	6656.09	6656.13	6656.11	6656.17	6656.15	6656.12	6656.03	6656.10	6656.12	6656.18	6656.09	6656.02		6656.16	6656.18	6656.14	6655.96
E5	6661.16	6660.93	6660 87	6660 87	6660.83	6660.78	6660.85	6660.84	6660.84	6660.87	6660.85	6660.93	6660.81	6660.88	6660.86	6660.82	6660.80		6660.92	6660.96	6660.89	6660.80
E6	6665.05	6664.96	6664.92	6664.86	6664.92	6664.83	6664.87	6664.84	6664.87	6664.93	6664.90	6664.94	6664.94	6664.84	6664.86	6664.86	6664 85		6664.95	6664.98	6664.95	6664.85
E7	6666.84	6666.76	6666.88	6666.67	6666.72	6666.63	6666.73	6666.61	6666.64	6666.65	6666.67	6666.70	6666.71	6666.61	6666.64	6666.65	6666.60		6666.75	6666.72	6666.70	6666.62
E8	6666.20	6666.14	6666.08	6666.03	6666.10	6666.01	6666 05	6665 98	6665.99	6666.06	6666.08	6666.11	6666.08	6666.02	6666.03	6666 02	6666.03		6666.18	6666.14	6666.12	6666.05
E9	6665.53	6665.45	6665.37	6665.33	6665.39	6665.33	6665.36	6665.28	6665.30	6665.37	6665.34	6665.36	6665.37	6665.35	6665.39	6665.32	6665.34		6665.47	6665.43	6665.45	6665.14
E10	6665.93	6665 96	6665.86	6665 81	6665.90	6665.83	6665.84	6665 86	6665.80	6665.92	6665.93	6665.87	6665.89	6665 81	6665.83	6665.81	6665 81		6665 95	6665.79	6665.90	6665 80
X-1	6673.16	6664.04	6663.71	6663.59	6663.50	6663.39	6663.38	6663.19	6663.19	6662.94	6663.00	6662.94	6662.88	6662.66	6662.51	6662.43	6662.30		6662.45	6662.37	6662.27	6662.16

*Surveying contractors: AEC - Anderson Engineering Company, CSA - Clint Sherrill & Associates, MEI - Miller Engineers Inc. or Souder, Miller & Assoc.

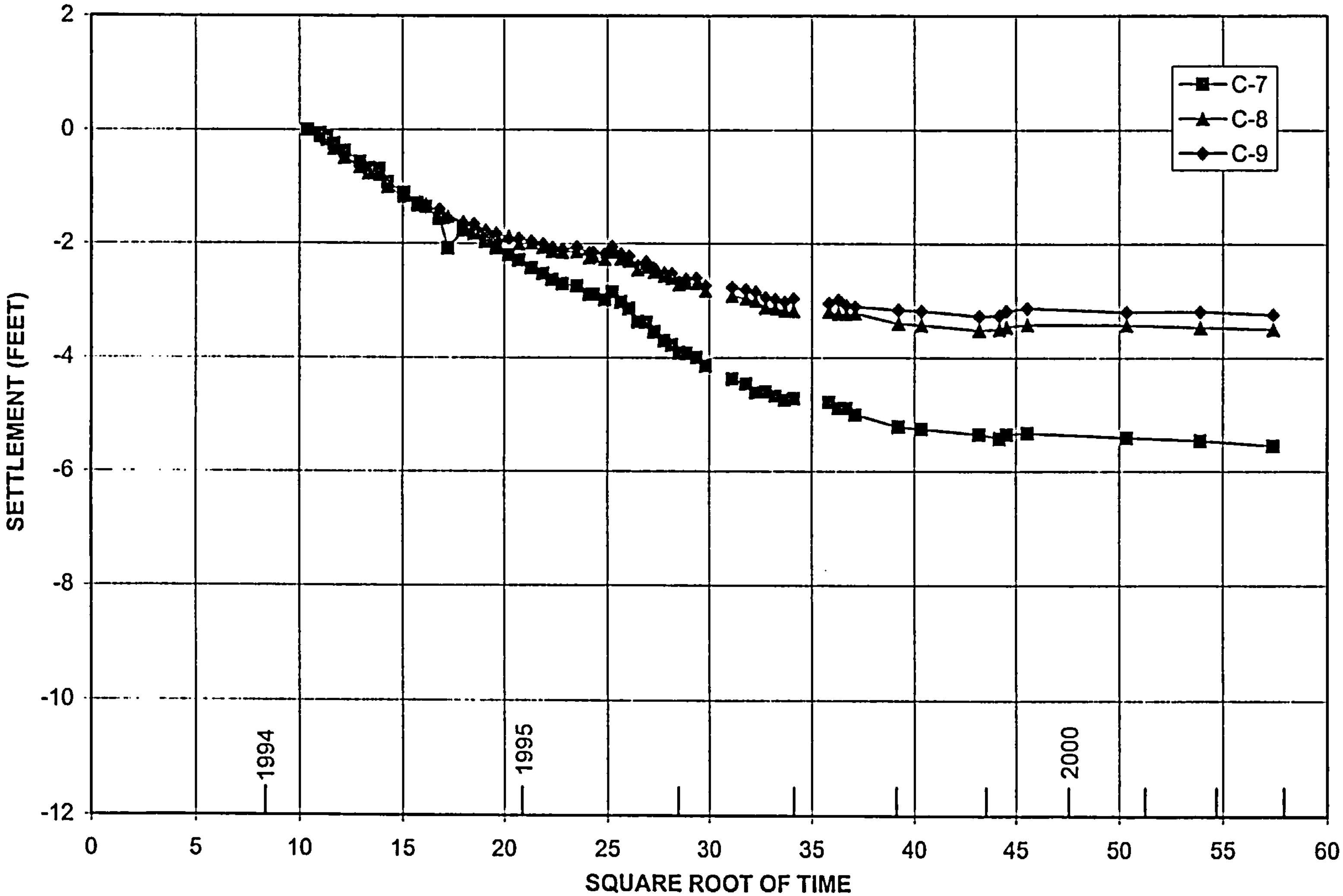
**CSA values in table are 3.20 feet lower than actual values reported by CSA to reflect use of different survey control points.

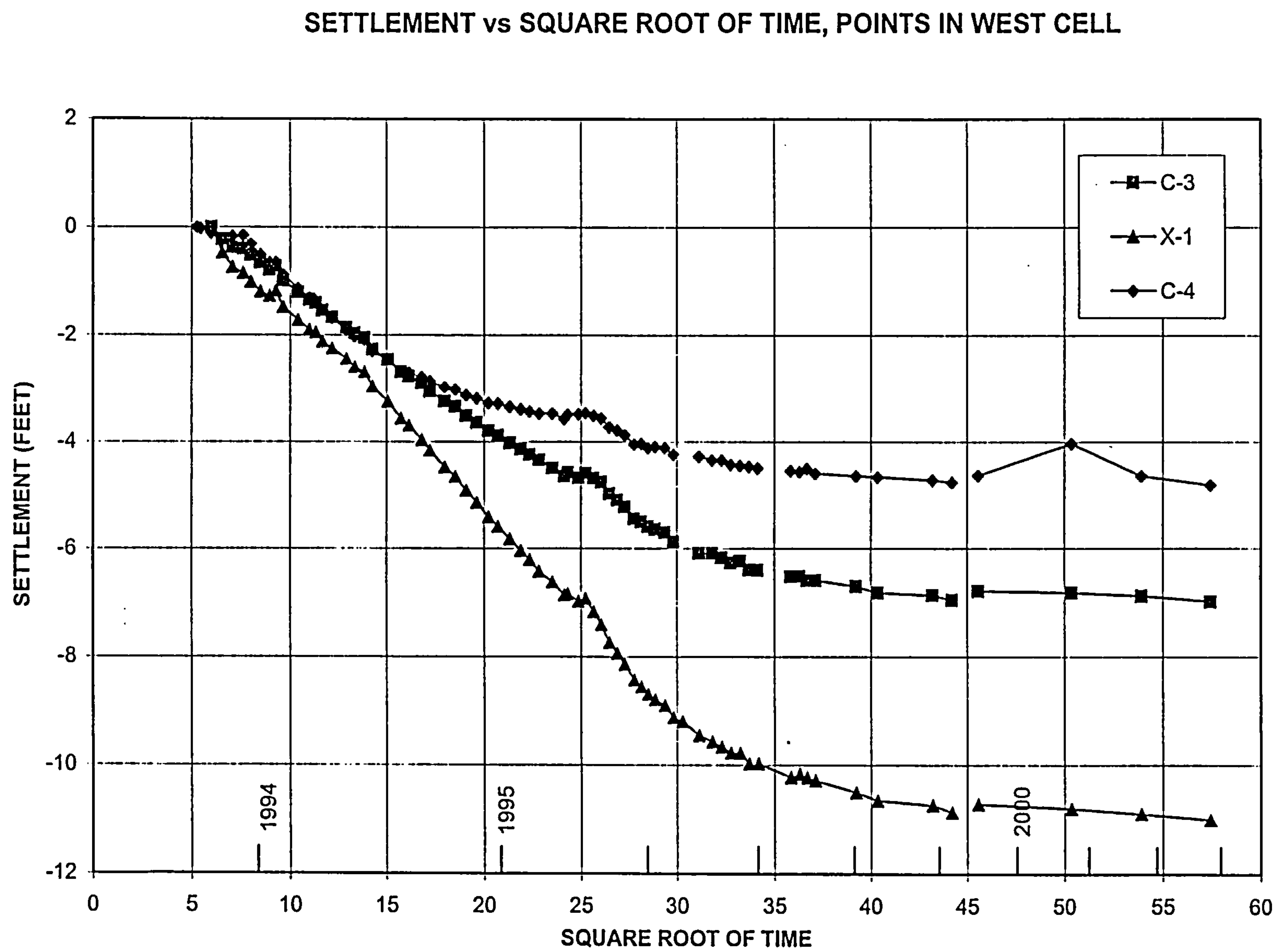
Homestake Grants Large Tailings Impoundment -- Settlement Data

Svyr* Date	AEC 10/23/93	AEC 03/25/96	AEC 06/18/96	AEC 07/31/96	AEC 08/30/96	AEC 09/30/96	AEC 11/01/96	AEC 12/02/96	AEC 12/31/96	AEC 04/30/97	AEC 06/02/97	AEC 06/30/97	AEC 08/01/97	AEC 01/09/98	AEC 04/08/98	CSA 12/04/98	CSA 03/01/99	CSA 04/01/99	CSA 07/01/99	MEI 10/03/00	MEI 10/10/01	MEI 11/4/2002
A2	0.00	0.13	0.21	0.30	0.26	0.31	0.23	0.25	0.25	0.23	0.28	0.23	0.27	0.34	0.36	0.38	0.26	0.32	0.29	0.31	0.36	0.43
A3	0.00	0.42	0.50	0.54	0.55	0.58	0.52	0.60	0.58	0.57	0.56	0.53	0.57	0.58	0.66	0.68	0.55	0.62	0.58	0.60	0.66	0.79
A4	0.00	0.23	0.30	0.36	0.35	0.42	0.40	0.37	0.42	0.38	0.36	0.38	0.39	0.40	0.43	0.52	0.37	0.44	0.41	0.41	0.45	0.59
A5	0.00	0.34	0.40	0.44	0.48	0.50	0.48	0.49	0.51	0.45	0.49	0.39	0.45	0.52	0.51	0.59	0.43	0.48	0.47	0.45	0.48	0.64
A6	0.00	0.02	0.22	0.11	0.15	0.20	0.17	0.21	0.22	0.08	0.14	0.12	0.18	0.16	0.22	0.20	0.10	0.17	0.11	0.11	0.12	0.26
A7	0.00	-0.03	0.06	0.09	0.12	0.12	0.11	0.13	0.18	0.12	0.08	0.13	0.14	0.15	0.18	0.20	0.09	0.13	0.05	0.08	0.10	0.17
A8	0.00	-0.03	0.07	0.15	0.07	0.13	0.14	0.11	0.12	0.17	0.12	0 09	0.08	0.13	0.15	0.18	0.18		0.05	0.07	0.12	0.19
A9	0 00	-0.10	0.03	0 01	0.07	0.09	0.10	0.07	0.06	0.05	0.08	0.02	0.13	0.02	0.15	0.14	0.14		0.01	0.05	0.03	0.16
A10	0.00	-0.36	-0.23	-0.24	-0.22	-0.18	-0.17	-0.20	-0.16	-0.21	-0.16	-0.28	-0.16	-0.14	-0.14	-0.12	-0.11		-0.26	-0.14	-0.25	-0.14
A11	0 00	-0.18	-0.06	-0.02	-0.01	0 01	-0.02	-0.05	0.10	0.00	-0.09	-0.11	0.01	-0.02	0.04	0 01	0 03	-0.03	-0.12	0 00	-0.10	0 02
B1	0 00	0.15	0.24	0.24	0.30	0.33	0.27	0.24	0.36	0.31	0.33	0.24	0.33	0.39	0.40	0.39	0.33	0.33	0.32	0.34	0.40	0.49
B2	0.00	1.55	1.68	1.67	1.72	1.80	1.72	1.67	1.82	1.79	1.84	1.80	1.90	2.01	2.00	2.08	1.98	2.02	2.00	2.03	2.13	2.22
B3	0.00	3.44	3.55	3.61	3.62	3.57	3.67	3.64	3.79	3.70	3.67	3.77	3.79	3.83	3.93	3.97	3.85	3.88	3.86	3.92	4.00	4.12
B4	0.00	1.99	2.11	2.14	2.13	2.22	2.14	2.14	2.27	2.24	2.15	2.17	2.21	2.29	2.33	2.34	2.22	2.28	2.25	2.25	2.29	2.43
B5	0.00	1.30	1.35	1.45	1.41	1.49	1.38	1.47	1.50	1.45	1.49	1.35	1.43	1.47	1.50	1.57	1.42	1.45	1.42	1.39	1.44	1.55
B6	0 00	0.16	0.21	0.28	0.31	0.33	0.37	0.38	0.36	0.29	0.39	0.34	0.44	0.49	0.53	0.61	0.46	0.54	0.50	0.54	0.59	0.74
B7	0.00	0.50	0.67	0.73	0.78	0.83	0.85	0.85	0.92	0.94	0.94	0.92	0.98	1.05	1.19	1.27	1.27	1.24	1.22	1.28	1.29	1.38
B8	0.00	1.93	2.11	2.18	2.22	2.22	2.26	2.27	2.30	2.35	2.33	2.41	2.40	2.48	2.57	2.68	2.66		2.60	2.64	2.71	2.75
B9	0.00	2.08	2.24	2.28	2.33	2.38	2.40	2.41	2.46	2.48	2.47	2.56				2.80	2.85	2.77	2.74	1.70	2.85	2.98
B10	0.00	1.16	1.27	1.31	1.34	1.42	1.38	1.39	1.42	1.46	1.41	1.69	1.48	1.49	1.63	1.65	1.63	1.58	1.53	1.67	1.64	1.73
B11	0.00	-0.17	-0.05	-0.03	-0.01	-0.03	0.03	0.02	0.04	-0.02	-0.03	-0.11	0 04	0 04	0 03	0.04	0.04	-0 04	-0.11	-0 01	-0.11	0.00
C1	0.00	0.20	0.28	0.33	0.35	0.36	0.34	0.40	0.40	0.41	0.37	0.34	0.36	0.43	0.45	0.47	0.55		0.39	0.40	0.47	0.57
C2	0.00	2.82	2.84	2.88	2.87	2.99	2.92	3.04	3.03	3.05	3.05	3.05	3.05	3.14	3.18	3 28	3.32		3.18	3.19	3.29	3.36
C3	0.00	5.87	6.09	6.09	6.17	6.26	6.23	6.39	6.40	6.52	6.51	6.59	6.59	6.70	6.82	6.87	6.95		6.79	6.82	6.88	6.98
C4	0.00	4.23	4.27	4.34	4.34	4.42	4.44	4.46	4.49	4.54	4.56	4.50	4.59	4.64	4.66	4.72	4.76		4.63	4.03	4.64	4.81
C5	0.00	3.12	3.14	3.15	3.15	3.18	3 21	3.21	3.25	3.20	3.22	3.21	3.21	3.31	3.33	3.40	3.39	3.29	3.27	3.23	3.33	3.42
C6	0.00	0.94	0.98	0.99	1.02	1.10	1.09	1.10	1.11	1.07	1.14	0.87	1.21	1.26	1.30	1.32	1.30	1.27	1.22	1.25	1.31	1.45
C7	0.00	4.14	4.37	4.45	4.61	4.60	4.67	4.74	4.72	4.78	4.88	4.89	5.00	5.22	5.26	5.35	5.42	5.35	5.33	5.41	5.46	5.55
C8	0.00	2.83	2.92	2.97	3.01	3.12	3.13	3.17	3.18	3.19	3.23	3.23	3.22	3.40	3.43	3.52	3.50	3.46	3.42	3.43	3.47	3.50
C9	0.00	2.74	2.77	2.81	2.85	2.95	2.98	3.03	2.97	3.05	2.99	3.09	3.11	3.16	3.18	3.27	3.26	3.18	3.13	3.20	3.19	3.24
C10	0.00	1.89	1.99	1.91	1.95	2.12	2.08	2.09	2.11	2.19	2.14	2.15	2.17	2.28	2.31	2.38	2.39	2.34	2.29	2.42	2.42	2.51
C11	0.00	0.01	-0.03	0.14	0.12	0.23	0.18	0.22	0.26	0.16	0.18	0.31	0.21	0.25	0.24	0.25	0.25		0.11	0.20	0.11	0.21
D1	0.00	0.21	0.22	0.27	0.24	0.31	0.31	0.19	0.32	0.31	0.32	0.31	0.27	0.36	0.34	0.42	0.47		0.34	0.34	0.44	0.49
D2	0.00	1.39	1.39	1.42	1.38	1.50	1.46	1.47	1.54	1.55	1.55	1.51	1.59	1.60	1.64	1.67	1.71		1.57	1.60	1.67	1.75
D3	0.00	2.17	2.17	2.29	2.21	2.30	2.25	2.31	2.38	2.31	2.34	2.22	2.32	2.34	2.41	2.43	2.48		2.37	2.40	2.46	2.59
D4	0.00	1.44	1.44	1.49	1.46	1.57	1.50	1.53	1.51	1.56	1.51	1.49	1.54	1.60	1.61	1.65	1.71		1.58	1.56	1.60	1.75
D5	0.00	1.41	1.45	1.50	1.41	1.55	1.54	1.44	1.53	1.50	1.49	1.41	1.52	1.53	1.53	1.58	1.58		1.46	1.42	1.51	1.59
D6	0.00	0 06	0.09	0.12	0.07	0.17	0.15	0.11	0.13	0.10	0.11	0.07	0.12	0.17	0.17	0.18	0.18		0.09	0.09	0.12	0.26
D7	0.00	1.54	1.63	1.67	1.64	1.73	1.68	1.71	1.78	1.68	1.82	1.82	1.80	1.92	1.94	2.04	2.04		1.93	2.02	2.06	2.12
D8	0.00	1.19	1.26	1.29	1.21	1.37	1.28	1.32	1.34	1.37	1.32	1.31										
D9	0.00	1.01	1.06	1.11	1.05	1.20	1.09	1.12	1.25	1.14	1.15	1.23	1.20	1.33	1.38	1.38	1.45		1.33	1.42	1.42	-0.81
D10	0.00	1.21	1.28	1.27	1.26	1.40	1.31	1.33	1.47	1.41	1.34	1.40	1.46	1.57	1.63	1.69	1.70		1.59	1.75	1.76	1.83
D11	0.00	-0.13	0.04	0.06	0.00	0 08	0.04	-0.04	0.10	0.07	0 05	-0.03	0.02	0 06	0 08	0 05	0 07		-0 06	0 03	-0 06	-0 03
E2	0.00	0.42	0.50	0.47	0.46	0.53	0.50	0.52	0.43	0.53	0.53	0.51	0.52	0.54	0.53	0.57	0.63		0.50	0.51	0.58	0.65
E3	0.00	-0.14	-0.10	-0.08	-0.15	-0.01	-0.10	-0.01	-0.01	-0.10	-0.05	-0.15	-0.07	-0.09	-0.08	-0.08	-0.04		-0.18	-0.18	-0.17	-0.06
E4	0.00	0.31	0.37	0.36	0.36	0.41	0.37	0.39	0.33	0.35	0.38	0.47	0.40	0.38	0.32	0.41	0.48		0.34	0.32	0.36	0.54
E5	0.00	0.23	0.29	0.29	0.33	0.38	0.31	0.32	0.32	0.29	0.31	0.23	0.35	0.28	0.30	0.34	0.36		0.24	0 20	0.27	0.36
E6	0.00	0.09	0.13	0.19	0.13	0.22	0.18	0.21	0.18	0.12	0.15	0.11	0.11	0.21	0.19	0.19	0.20		0.10	0.07	0.10	0.20
E7	0.00	0.08	-0.04	0.17	0.12	0.21	0.11	0.23	0.20	0.19	0.17	0.14	0.13	0.23	0.20	0.19	0.24		0.09	0.12	0.14	0.22
E8	0.00	0.06	0.12	0.17	0.10	0.19	0.15	0.22	0.21	0.14	0.12	0.09	0.12	0.18	0.17	0.18	0.17		0.02	0.06	0.08	0.15
E9	0.00	0.08	0.16	0.20	0.14	0.20	0.17	0.25	0.23	0.16	0.19	0.17	0.16	0.18	0.14	0.21	0.19		0.06	0.10	0.08	0.39
E10	0.00	-0 03	0 07	0.12	0.03	0.10	0.09	0 07	0.13	0 01	0.00	0.06	0.04	0.12	0.10	0.12	0.12		-0 02	0.14	0 03	0.13
X-1	0.00	9.12	9.45	9.57	9.66	9.77	9.78	9.97	9.97	10.22	10.16	10.22	10.28	10.50	10.65	10.73	10.86		10.71	10.79	10.89	11.00

*Surveying contractors: AEC - Anderson Engineering Company, CSA - Clint Sherril & Associates, MEI - Miller Engineers Inc. or Souder, Miller & Assoc.

SETTLEMENT vs SQUARE ROOT OF TIME, POINTS IN EAST CELL





SETTLEMENT vs SQUARE ROOT OF TIME, POINTS IN WEST CELL
SETTLEMENT (FEET)
2
0
-2
-4
-6
-8
-10
-12
0
5
10
15
20
25
30
35
40
45
50
55
60
SQUARE ROOT OF TIME
C-3
X-1
C-4
1994
1995
2000

ATTACHMENT 2

Flushing of water from mill tailings at the Homestake Grants Reclamation Project

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ABSTRACT: Dewatering of uranium tailings at Homestake Mining Company's Grants uranium mill site has proven to be more difficult than initially predicted. The removal of *in-situ* water in the tailings pile is important in controlling the potential for long-term impacts to the local ground-water system. The use of fresh water injection to drive the water to adjacent collection/recovery wells was initially evaluated in 2000. A complete flushing program for the tailings pile was initiated in 2002 with an average total injection rate of 302 gpm into 152 wells. Production from the tailings dewatering wells has increased to above 100 gpm after declining to below 35 gpm prior to the initiation of the injection/flushing program. Testing to date has indicated that the injection/flushing program is successful in reducing uranium, molybdenum and selenium concentrations in the tailings pile to levels that minimize potential for impact to the local alluvial ground-water system.

1 INTRODUCTION

A large-scale ground-water restoration program has existed at Homestake's Grants Project since 1977. The removal of the source (tailings seepage) is important to enable restoration of ground water at this site. A dewatering program of these tailings was initiated in 1995 and proved difficult to maintain the desired rates from approximately 130 dewatering wells. Fresh water injection has been added to the dewatering program to increase the dewatering rates and drive the high concentration water to the dewatering wells since the year 2000.

2 TAILINGS HISTORY

The large tailings pile contains 22 million tons of uranium tailings from operations of a mill between 1958 and 1990. The large tailings pile was constructed by cycloning the tailings with deposition of the sand material forming the outer dikes and slimes flowing inside of the dikes to ponds. Pools of water were maintained in the west and east cells during the operation of the Grants mill. Re-contouring of the large tailings began in 1993 and was completed in 1995. Figure 1 shows the present topography of the tailings site which shows elevations that are approximately 90 feet high above the flat alluvial plain. Hydraulic tailings deposition at the site has resulted in segregation of the silt and clay particles (slime) in the center of the pile's two cells. The segregation of the slimes in the inner portion of the pile has resulted in smaller permeabilities which makes the dewatering program difficult.

2.1 *Tailings condition*

Tailings wells were drilled in 1994 and 1995 to define the hydrologic conditions in the tailings. Figure 2 shows the approximate locations of the two slime areas and the sand dikes that surround the slimes. The perimeter of the tailings and a center dike are composed of primarily tailings sand, while the inner portion of the tailings consist of mainly slimes. Sand and slime lenses are also present in areas dominated by the other type of milled tailings material. The cross section shown on Figure 2 shows the approximate locations of the sand and slime tailings. This cross section shows the base of the tailings with a perched alluvial sand beneath the base of the tailings. The tailings and the perched sand are in direct contact in some areas of the large tailings pile. The tailings and perched alluvium contact areas are more prevalent on the east, southeast and south central sides of the tailings but local areas of contact exist throughout the tailings.

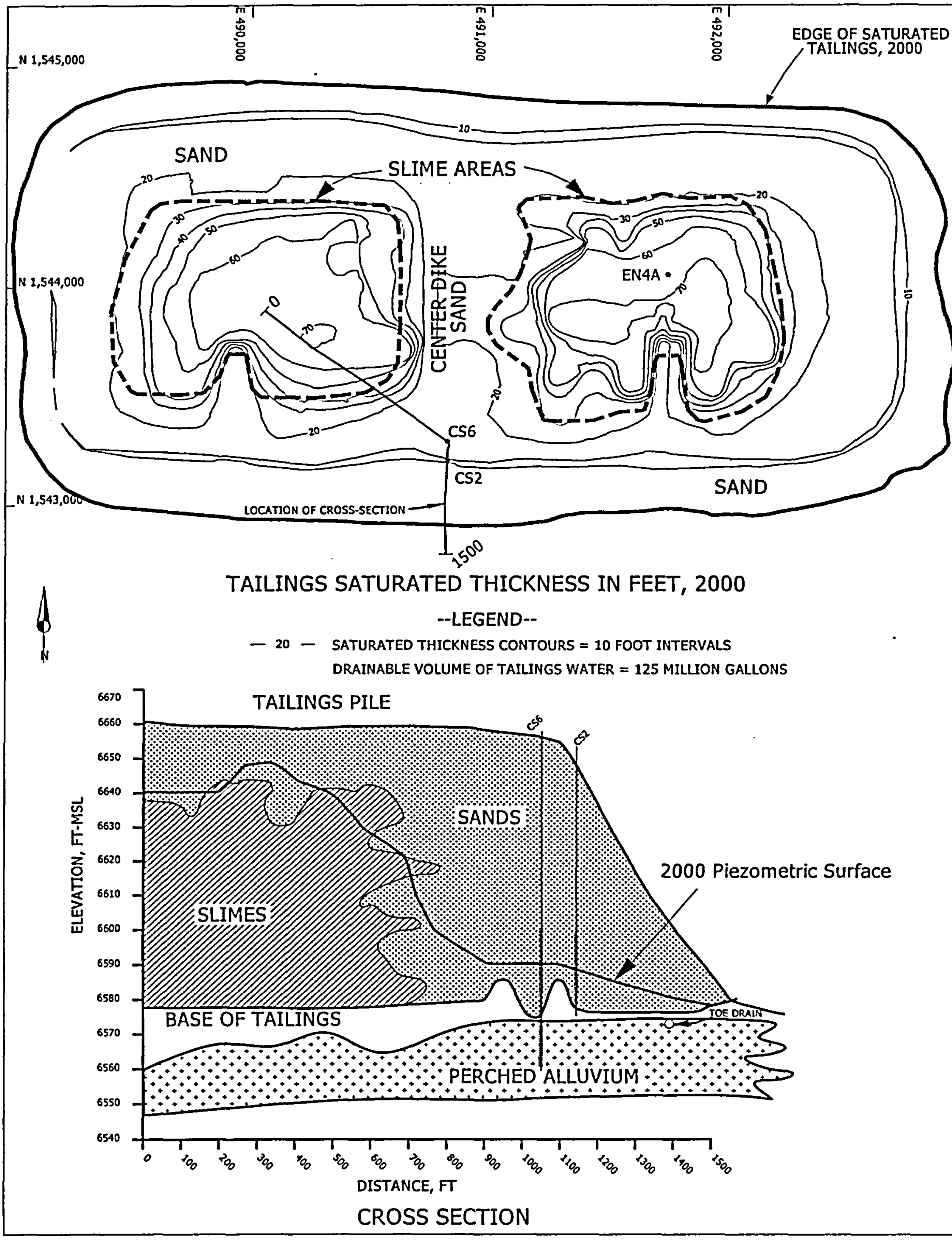

FIGURE 2. TAILINGS SATURATED THICKNESS WITH SAND AND SLIME AREAS AND CROSS SECTION

produced by the drains with the fresh water injection program.

3.2 *Projected dewatering rates*

The combination of dewatering with the fresh water injection program will enable larger extraction rates to be obtained. Table 2 presents the projected dewatering rates from 2003 through 2007. Evaporation pond capacity is limited so the projected rates for 2003 and 2004 are lower than potential production rates. An additional 152 and 47 million gallons of water are projected to be produced from the tailings dewatering wells and the toe drains respectively from 2003 through 2007.

Table 2. Projected Tailings Dewatering Rates in gpm.

	Year				
	'03	'04	'05	'06	'07
Tails Wells	30	60	80	60	60
Toe Drain	50	30	10	0	0
Total	80	90	90	60	60

Note; Projected Volume: Tails Wells = 152 and Toe Drain = 47 million gallons.

The toe drains are expected to produce an average of 50 gpm for 2003. A larger rate of production from the toe drains would likely be possible for 2004 but the pumping rate is expected to be reduced to 30 gpm in 2004. A portion of the toe drain water, which has concentrations less than a conductivity of 15 mmhos/cm, will be allowed to migrate through the partially saturated alluvium to the alluvial aquifer. The toe drain water that contains lower concentrations will help flush higher concentrations in the partially saturated alluvium down to the alluvial aquifer for eventual collection. Therefore, allowing some of the toe drain water to migrate to the alluvial aquifer is considered beneficial and this process will start in 2004. The rate of drainage to the toe drains is expected to start to decline in 2005 but the concentrations of the water in the toe drains are also expected to be significantly less and therefore only 10 gpm is projected to be pumped from the toe drains in 2005.

The dewatering wells are projected to be operated through 2007. The concentrations in the tailings are expected to be small in 2007 and therefore continued operation of the dewatering is not expected to be beneficial.

4 FRESH WATER INJECTION

Fresh water injection into the uranium tailings at the Grants Project was initially tested in 2000. This testing showed that the dewatering well production was increased substantially with the injection. It also showed that the concentrations were reduced substantially in the tailings. The test demonstrated that the fresh water injection into the tailings was worthwhile even with the increased volume of water to be pumped. A total of 106 new 2-inch wells were completed only in the tailings for the fresh water injection program. These new wells were used along with 46 existing wells to inject the fresh water into tailings.

4.1 *Tailings injection history*

Fresh water injection was initiated in 2000 to test the feasibility of the fresh water injection program. Table 3 presents the average yearly rate that was injected into the tailings from 1995 through 2002 with projected injection through 2007. The full program in 2002 averaged 302 gpm of water injected into the tailings. A total of 277 million gallons of fresh water have been injected into the tailings through 2002. Figure 1 shows the locations of the fresh water injection wells.

Table 3. Actual and Projected Tailings Injection Rates in gpm.

	Actual Injection Rates							
	Year							
	'95	'96	'97	'98	'99	'00	'01	'02
Tails Wells	0	0	0	0	2	61	162	302

	Projected Injection Rates				
	Year				
	'03	'04	'05	'06	'07
Tails Wells	300	300	0	0	0

Note; Actual Volume: Tails Wells = 277 million gallons and Projected Volume: Tails Wells = 315 million gallons.

4.2 *Projected tailings injection*

The tailings injection program is planned to be continued through 2004. The fresh water injection program is expected to average 300 gpm for 2003 and 2004, as tabulated in the lower portion of Table 3. This will be an additional 315 million gallons of fresh water injection. The total fresh water injection volume from 2000 through 2004 should be slightly less than 600 million gallons of injection at the end of the program.

The total volume of injection water from 2000 through 2007 is significantly greater than the total dewatering volume for this same period. Table 4 lists the volumes since the start of injection in mil-

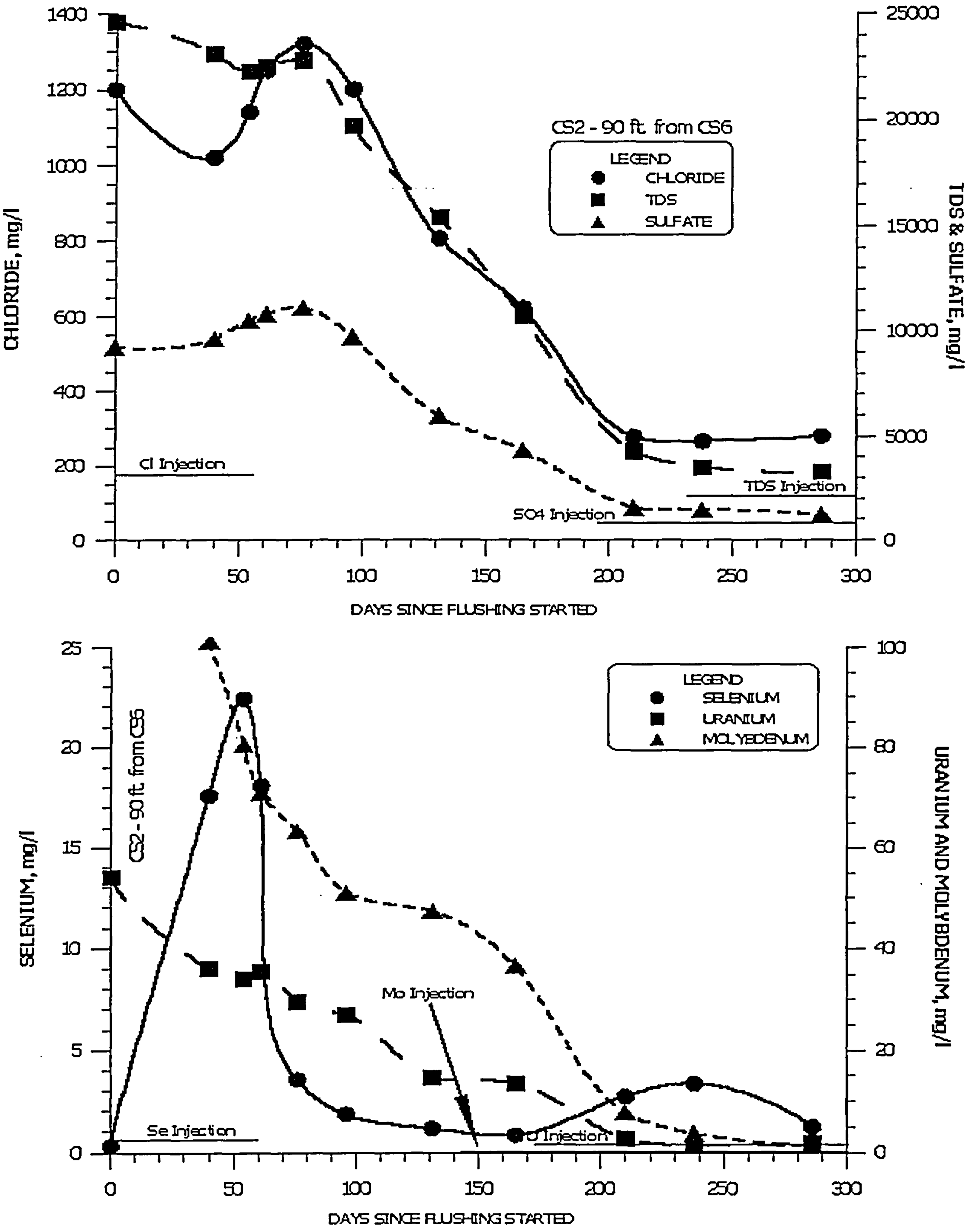

Figure 3. Chloride, TDS, Sulfate, Selenium, Uranium and Molybdenum Concentrations for Well CS2 versus Time Since Well CS6 Injection Started.

as expected. This test indicated it may take 5 years for the injection water to travel 50 feet through the slime material. The changes in the key parameters of uranium and molybdenum indicate that the flushing of concentrations through the slimes, even though very slow, will be very successful.

Figure 5 presents the conductivities in mmhos/cm for the tailings water in April 2003. This figure shows patterns where concentrations are less than 10, between 10 and 20, between 20 and 30, and greater than 30 mmhos/cm. Conductivity in the entire tailings area except for the outer edges of the sand dike was greater than 30 mmhos/cm prior to the fresh water injection. This figure shows that conductivity in large areas has been decreased substantially by the fresh water injection program. The majority of the tailings conductivities are expected to be significantly below 10 mmhos/cm at the end of the fresh water injection and dewatering program. Concentrations are expected to increase slightly after the injection ceases as some lower permeability lenses gradually drain.

4.4 *Constituent removal*

The fresh water injection, while increasing the residual volume of water in the tailings, will ultimately allow extraction of a greater volume of mobile constituents from the tailings. In the absence of fresh water injection, the collection rates from the tailings would continue to decline and the rate of extraction of mobile constituents would parallel the dewatering rate.

Fresh water injection functions as a drive for higher concentration water within the tailings. The collection wells initially extract the higher concentration tailings water at increased rates due to the greater saturated thickness and gradients used by the injection. The concentrations in the collections wells will decline as the fresh water injection front reaches the well. Ideally, the injection front would be fairly steep and would result in an abrupt decrease in concentration as the front reached a collection well. This would allow sequential termination of collection in local areas with very limited extraction of fresh water. The heterogeneities in the tailings material, non uniform flow paths, and natural dispersion processes will smear the injection front and result in collection of mixed water at intermediate concentrations. However, the mass of volume of constituents extracted is dramatically greater with the injection/collection combination. Figure 6 presents the amount of removal of pounds of uranium with injection for each year in the upper graph. The lower graph presents the cumulative mass of removal of uranium with the injection system. The projected cumulative removal with only a dewatering system is less than one-half the volume with injection. This illustrates the effectiveness of the injection in facilitating constituent removal in a timely manner.

5 CONCLUSIONS

The use of fresh water injection along with the dewatering program at the Grants Project site is beneficial. The volume of total well dewatering from the Grants site without the fresh water injection would have been significantly less than 100 million gallons. With the fresh water injection program, approximately 250 million gallons of dewatering with wells is expected from the tailings by the end of the dewatering program. This volume will be approximately twice the volume of drainable water in the tailings prior to the fresh water injection program but the pumping of the additional volume is deemed necessary to obtain the removal of a large percentage of the high concentration water.

The volume of water in storage in the tailings at the end of dewatering in 2007 is likely to be similar to the volume in storage in 2000 prior to the fresh water injection. Concentrations in the tailings water are expected to be low enough that the impacts to the alluvial aquifer will be minimized.

REFERENCES:

Hoffman, G.L. & Cellan, R.R. 1998. Slime dewatering at the Homestake's Grants Project. *Proceedings of the Fifth International Conference on Tailings and Mine Waste; 98:* 299-308. Rotterdam:Balkema.

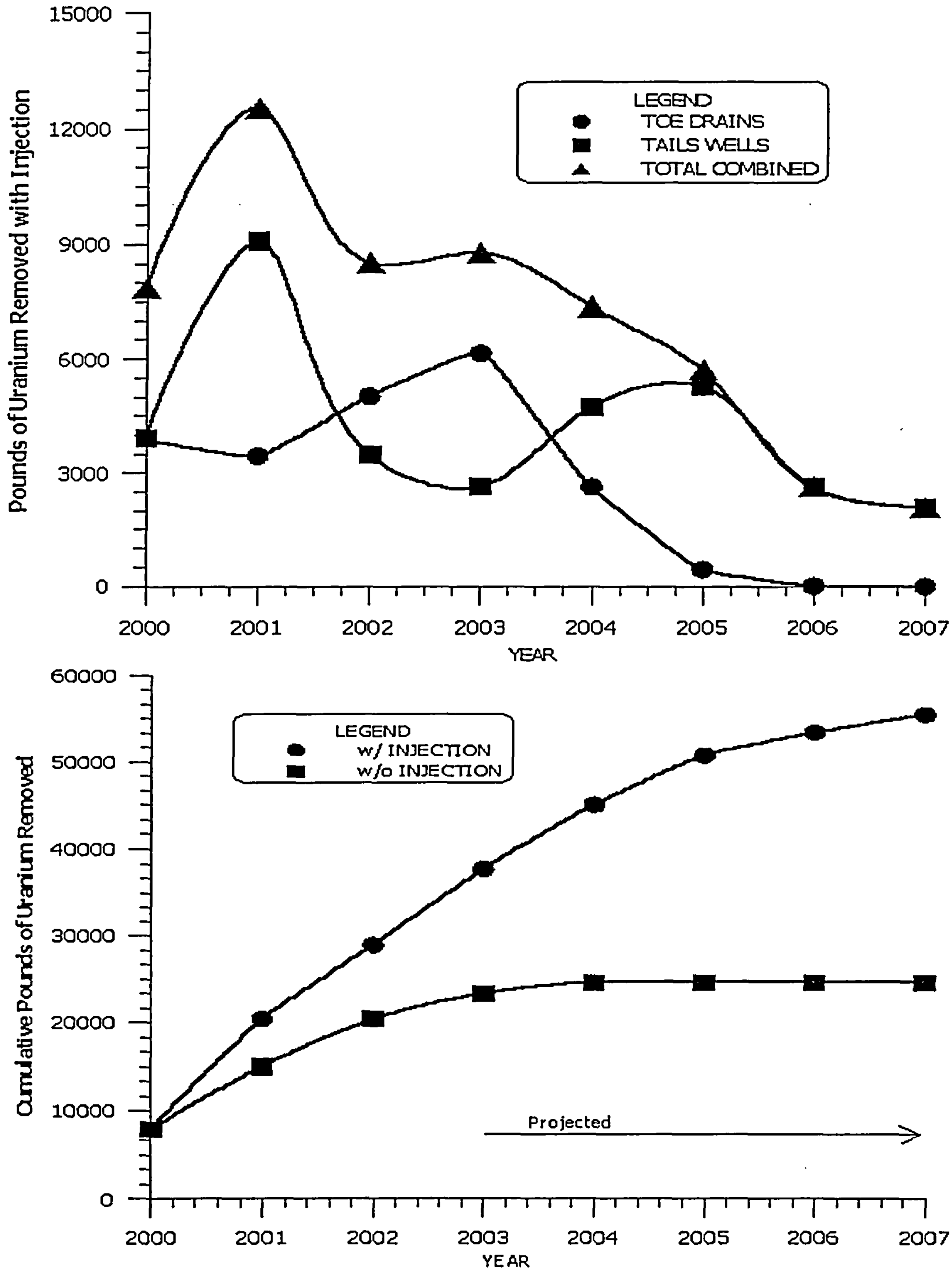

Figure 6. Pounds of Uranum Removed from the Tailings With and Without Injection.