PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE

TAILINGS RECLAMATION PLAN

OCTOBER 1993

VOLUME 1

SUA-442

DOCKET 40-6622

PATHFINDER
A Cogema Resources Company

September 23, 1999

Mr. Mohammad Haque
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety & Safeguards
Mail Stop T 7-J-8
U. S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852

Ref: Docket No. 40-6622
License No. SUA-442

Dear Mr. Haque:

Enclosed please find two current sets of the Shirley Basin Tailings Reclamation Plan as you requested. They represent the up-to-date version of the plan with all inserts. Note that any exhibits with a "9-99" revision date designation in the title block have been updated to reflect the five horizontal to 1 vertical reclaimed outslopes on the tailings embankments. Please call me if you have any questions.

Sincerely,

Tom Hardgrove

T. W. Hardgrove
Manager, Environmental and Regulatory Services

Enclosure

PATHFINDER
A Cogema Resources Company

November 24, 1997

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
United States Nuclear Regulatory Commission
Washington, D. C. 20555-0001

RE: Docket No. 40-6622, Source Material License SUA-442
Pathfinder Shirley Basin Tailings Reclamation

Dear Mr. Holonich:

Pursuant to your letter dated October 7, 1997, concerning hydrologic aspects of the tailings reclamation, Pathfinder Mines Corporation has developed the following information to address U.S. Nuclear Regulatory Commission staff concerns. Attachments include a report of the findings of an archaeological investigation, and a replacement Table 5-9, Figure 10-4 and page 5-37.

The following text addresses specific issues and comments directly. Reference is made to replacement pages where applicable.

Comment 1: Off-site Flooding, Manning's n and Cross Sections.

Response: The selected Manning's n of 0.02 was intended to reflect the extremely large flow depth and the nature of the floodplain. The intitial assumptions of PMP precipitation depth, PMP intensity and rangeland conditions were very conservative to remove all doubt concerning Spring Creek PMP flood stage. The resulting maximum discharge of 112650 cfs would expand the conveyance area of the channel far beyond any identifiable floodplain. The Manning's n of 0.02 is considered representative of the primary Spring Creek channel under flow depths in excess of 15 feet, and is also representative of the area above the primary channel where there is only sparse vegetation and limited sagebrush. Increased Manning's n values of 0.03 or 0.04 would be more applicable for a less severe storm where the relative roughness of elements on the floodplain is much greater. If the Manning's n is increased to 0.03 for the critical Spring Creek section, the maximum flood stage of 22 feet is still more than 150 feet from the covered tailings. At a Manning's of 0.04, the maximum flood

Pathfinder Mines Corporation • 935 Pendell Boulevard • P.O. Box 730 • Mills, Wyoming 82644
Tel: (307) 234-5019 Fax: (307) 473-7306

stage of 23.9 feet is at least 50 feet from the covered tailings. The increasing Manning's n values are considered a very conservative approach to estimating flood stage for an already conservative flood discharge. Increasing Manning's n reduces the flow velocities.

The two cross sections were taken from the most constricted area of Spring Creek in the vicinity of the tailings to give conservative flood stage estimates. The top width of flow for the PMF discharge is in excess of 1000 feet for a drainage with a primary channel width of just a few feet. The use of two cross sections to represent the channel and channel slope is consistent with the scale of the PMF stage and flow area in the region of concern. The flow depth is so large that the general floodplain slope is more applicable than the bed slope of the primary channel. Cross sections outside of the constricted area will not have critical flood stages that could approach the covered tailings and were not used for this reason. The slope of the floodplain at the area of the constriction is just slightly greater than the slope of 0.003 ft./ft. that was used in the computations. The slope of the floodplain on either side of the constriction ranges from 0.005 ft./ft. to 0.01 ft./ft. which is significantly greater than that used in the computations. If the slope in the computations is increased, the flood stage will decrease, and the flow velocity will increase, which negates much of the effect of increasing Manning's n.

Comment 2: Lateral and Vertical Stability of Receiving Streams

Response: An archaeological investigation of the Spring Creek channel has revealed that the location of the limits of the floodplain has not changed in over 4800 years. The report of this investigation (three copies) is included in this submittal. Aerial photos and on-site observation have revealed that both channels have reached a level of maturity where there is only lateral meandering within a distinct floodplain. There are no significant headcuts or other evidence of vertical instability.

The reduction in drainage area for the total Spring Creek drainage at the tailings area is roughly 8% with some additional reduction occurring downstream of the tailings area. This reduction occurs far downstream of the springs on Spring Creek and Fox Creek which are the sources of perennial flow. Thus the reduction in drainage area will have little or no impact on sustaining vegetation. The flow attenuation characteristics of the tailings drainage design will also slow release of runoff to Spring Creek, further enhancing stability.

The methods used to evaluate the scour were recommended by NRC personnel, and included two methods intended for continuous flow. The third method had provisions for using a flow duration. The design discharges for the computations were taken from a PMF and represent an extremely severe short duration and highly improbable event. The use of a continuous flow scour prediction methodology is obviously a misapplication, but it should be an extremely conservative approach. When the method incorporates a flow duration, the severity of the PMF discharges lends a tremendous degree of conservatism. In addition, the methods were originally intended for discharges from culverts, which is a more radical transition in channel configuration than release from a riprap channel.

In addition to the scour predictions, a calculation of stable grade for the section of the channel downstream of the end protection should also be indicative of the maximum plausible scour depth. With the exception of a small and largely artificial discharge to the Mine Creek channel, the receiving drainage systems are highly ephemeral. The discharge to Mine Creek is supported by recharge systems which are operated as a portion of the ground-water restoration systems. The two channels of primary concern are those that drain to Spring Creek, and these are Basin 5-4 and Channel N. Under the design reclamation plan, Basin 5-4 drains to Mine Creek with a dramatically reduced drainage area. If the scour does reach the depth of the structure of 4.5 feet, the Mine Creek channel will have a relief of approximately 6 feet in over 1700 feet of length, or a slope of less than 0.4%. Channel N drains to a tributary of Spring Creek north of the tailings. The relief between the Channel N outlet and the confluence of the tributary and Spring Creek is roughly 28 feet over a distance of approximately 1300 feet. The design reclamation plan increases the measured drainage area to the tributary from 77 acres to approximately 133 acres, although the use of surge pond storage in the drainage design will likely reduce peak discharge substantially from the pre-mining condition. If the depth of the end protection structure is increased from 4.5 feet to 15 feet, (and the depth of scour reaches the base of the end protection structure) then the resulting channel slope is 1%. The tributary channel is currently stable at a slope of approximately 2.2%, and a reduction of slope to 1% should be more than adequate. Table 5-9 and Figure 10-4 have been revised to reflect these changes.

Please don't hesitate to contact me if you have questions or comments.

Sincerely,

Tom Hardgrove

T.W. Hardgrove
Coordinator of Mine Environmental Affairs

Enclosure: As stated

cc: E. L. Nugent
J.D. Wadsworth
R.W. Poyser
Hydro-Engineering, LLC
C. Cain, USNRC - Region 4

NOTE: Archaeological report is not included in copies.

11/24/97

REPLACEMENT AND ADDITIONAL PAGES AND EXHIBITS

The following table itemizes the enclosed revisions to the Shirley Basin Tailings Reclamation Plan and indicates the replacement pages for the document currently on file with the NRC.

Volume I Revisions

New Text/Exhibit	Replace(s)
Volume I Cover Page	Volume I Cover Page
Page 38	Page 38
Table 5-9, page 5-80	Table 5-9, page 5-80

Volume II Revisions

New Text/Exhibit	Replace(s)
Volume II Cover Page	Volume II Cover Page
Figure 10-4, page 10-25	Figure 10-4, page 10-25

The text is copied double-sided and, in many cases, the unmodified adjacent page is replaced along with the modified page to preserve the numbering sequence. The revision date for each page is located in the lower right hand corner of the page.

PATHFINDER
A Cogema Resources Company

September 10, 1997

Mr. Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety & Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Docket No. 40-6622
License No. SUA-442
Shirley Basin Mill

The attached comments and modified portions of the Tailings Reclamation Plan (five copies of each) are submitted in response to your letter dated May 12, 1997, concerning the Geotechnical Design and Radon Attenuation. The Soil Cleanup Verification and Sampling Plan was addressed in an earlier submittal. Comments 1 and 2 concerning the geotechnical design are addressed by the enclosed letter from Inberg-Miller Engineers. The cost estimate in reponse to Geotechnical Design Comment 3 is not yet complete, and it will be submitted to the NRC as soon as it is available. The balance of the comments are addressed by responses from Hydro-Engineering. Only the Hydro-Engineering responses include specific text or exhibit changes to the reclamation plan.

Please call me if there are any questions.

Sincerely,

Tom Hardgrove

T. W. Hardgrove
Coordinator of Mine Environmental Affairs

Enclosures

cc: E. L. Nugent
J. D. Wadsworth
R. W. Poyser
P. Mackin, CNWRA

Pathfinder Mines Corporation • 935 Pendell Boulevard • P.O. Box 730 • Mills, Wyoming 82644
Tel: (307) 234-5019 Fax: (307) 473-7306

INBERG-MILLER ENGINEERS

1120 EAST "C" STREET CASPER, WYOMING 82601-2195 307-577-0806

September 5, 1997

RECEIVED
SEP 08 1997
By TwH

7294-CX

Pathfinder Mines Corporation
P. O. Box 730
Mills, WY 82644

ATTENTION: THOMAS HARDGROVE

RE: RESPONSE TO N.R.C. STAFF REVIEW COMMENTS
PATHFINDER MINES CORPORATION RECLAMATION PLAN
SHIRLEY BASIN URANIUM MILL SITE
SHIRLEY BASIN, WYOMING

Gentlemen:

This letter summarizes our response to the NRC's staff review comments (items No. 1 and 2) regarding the slope stability and liquefaction potential analyses for Dams No. 4 and 5 at the above-referenced project. The NRC is requesting additional information regarding: 1) documentation of soil parameters used in the slope stability analyses, and 2) additional consideration of the methodologies used in the stability analyses. More specifically, an evaluation of the stability analyses is requested regarding: i) the effects of variations associated with the geometry of the slopes, soil and rock parameters, and pore pressures acting within the slopes, and ii) effects of the assumptions inherent in the Modified Bishop's Method. In addition, further discussion of the liquefaction potential and the selection of soil parameters related to: i) material strength loss, and ii) pore pressure development due to dynamic loads.

<u>DISCUSSION OF SOIL PARAMETERS</u>

The soil parameters used in the stability analyses were obtained from information contained in Pathfinder Mine Corporation's (PMC) reclamation plan prepared by Hydro-Engineering, Dames and Moore's reports on the design and redesign of No. 5 Tailings Dam, and estimated values. The soil parameters for the various soil types are discussed below.

<u>Sand Cover</u>

The unit weight of the sand cover material was determined from Table 3-2 of the reclamation plan. Section 4.2 of the reclamation plan identifies Sample STH-7 as a typical material for use as the sandy cover materials. Table 3-2 lists the value of 95 percent of the maximum dry density to be 104.5 pcf. The moist unit weight was determined by using a moisture content of 6 percent as identified within Section 4.2. The cohesion value was conservatively assumed to be zero, even though Sample STH-7 is classified as a sandy, fat clay. Based on our experience at the Petrotomics Mine

DISCUSSION OF SOIL PARAMETERS, Continued

Sand Cover, Continued

located adjacent to the Pathfinder Mine, surficial sandy soils that would likely be suitable for use as the sand cover materials contain less clay and exhibit significant angularity. Likewise, the phi value is based on these same observations and is assumed to be 35 degrees, a typical value of dense sand. It is recognized that if the clay content was increased, phi values would decrease. However, cohesion values would also increase with a greater clay content. Thus, the change within the shear strength of the soil would be minimized.

Clay Cover

The moist unit weight of clay cover materials is, in our opinion, conservatively assumed to be 100 pcf. This value is based on the average of the 95 percent of maximum dry density for samples STH-2, STH-4, STH-5, STH-6, and STH-11, identified as typical clay cover materials in the reclamation plan, at a moisture content of 12 percent. The moisture content is conservatively lower than the estimated long term moisture content of 16.6 percent. The phi angle is conservatively assumed to be zero, even though these clay soils appear to contain some sand. An assumed value of 500 psf was used for the cohesion value. We believe this to be a conservative value for cohesion based on typical values for compacted lean (CL) and fat (CH) clays listed within NAVFAC Design Manual 7.2, May 1982, of 1800 psf and 2150 psf, respectively.

Sand Tailings

The moist unit weight of 105 pcf is based on the value used in the radon computer model in the reclamation plan of 1.59 gm/cm^3 (99.3 pcf) dry density at 6 percent moisture. The average dry unit weight and natural moisture content of samples TW4-1B, TW4-4B, TW4-5B, TW4-1C, and TW5-2B, noted as characteristic samples of sand tailings, was 90 pcf and 23 percent, respectively, resulting in a moist unit weight of 111 pcf. Because long term moisture is likely to be considerably less than that observed in the samples the value for unit weight used within the radon model was considered most appropriate. Because little data is available on the strength characteristics of sand tailings, the cohesion and phi values were estimated from typical values of saturated clayey and silty sands.

Slime Tailings

The moist unit weight of 100 pcf is based on the average dry unit weight of samples TW4-2C and TW4-3C at an average moisture content of 71 percent. Based on conversations with Tom Michel of Hydro-Engineering and review of lab results, the slime tailings contains a significant amount of sand tailings. Therefore, phi and cohesion values were estimated from values typical of sandy clays. Due to the hydraulically

DISCUSSION OF SOIL PARAMETERS, Continued

Slime Tailings, Continued
placed nature of the slime tailings, the cohesion value was significantly reduced below typical values for saturated sandy clays. The values are consistent with typical values of slime tailings contained in Steven G. Vick's "Planning, Design and Analysis of Tailings Dams" and a report entitled "Characterization of Inactive Uranium Tailings Sites: Shiprock, New Mexico" prepared for the Department of Energy, Albuquerque, New Mexico, written by the Geotechnical Engineering Program, Colorado State University, 1984.

Dam No. 4 Embankment
The moist unit weight of 115 pcf is based on the average values of samples obtained in borings performed by Inberg-Miller Engineers. The phi value is conservatively assumed to be zero and the cohesion value is based on the unconfined compressive strength test performed on Sample B-2-3.

Dam No. 4 Foundation Soils
The density and strength parameters for the upper and lower foundation soils are based on the results from laboratory testing of samples collected from borings performed by Inberg-Miller Engineers. The unit weight of 125 pcf for the lower foundation is based on testing on Sample B-2-14 and the cohesion of 2000 psf is based on the unconfined compressive strength of the same sample. Based on standard penetration testing and pocket penetrometer tests, the upper foundation soils exhibit a lower relative density and likely have a lower cohesion value. The phi value was conservatively assumed to be zero, and the cohesion estimated to be half of that of the lower foundation, or 1000 psf.

Dam No. 5 Embankment, Drain and Foundation Soils
The moist unit weight for the embankment and the drain are based on 95 percent of the maximum dry density as determined from AASHTO T-180 (modified proctor). The unit weight for the foundation is based on the average value of samples collected within a boring performed by Dames and Moore. The phi and cohesion values are based on the results of direct shear tests performed on recompacted clayey and silty sand samples for the embankment, recompacted sand tailing for the drain, and undisturbed clayey and silty sands for the foundation.

It is recognized that the foundation materials are variable as observed within the test boring performed by Dames and Moore for the design of Dam No. 5. Therefore, it is important to determine the foundation soils with the lowest shear strength. Based on Dames and Moore's test results, the maximum shear strength of the sandy foundation soils is less than the minimum

DISCUSSION OF SOIL PARAMETERS, Continued

shear strength of the clayey foundation soils. In light of this, Dam No. 4 was reanalyzed for the purpose of this response using the foundation soils from Dam No. 5. The results of the analysis are tabulated below, and plots of the analyses are enclosed.

Modified Dam No. 4 Factors of Safety		
Ground-Water Conditions	Static Factor of Safety	Seismic Factor of Safety
High	4.25	1.76
Low	4.04	2.13

It can be observed that the soil parameters used within the original analysis of Dam No. 4 yield more conservative results than that based on more rigorous laboratory defined samples used for the analysis of Dam No. 5. Therefore, in our opinion, the results from the soil parameters used in the previous report are conservative for the various stability analyses.

DISCUSSION OF SLOPE STABILITY ANALYSES

Effects of Variations in Embankment Parameters

In order to evaluate the conservative nature of variations in soil parameters, it is important to consider the results of the modified Dam No. 4 analysis discussed previously. Since the shear strength of sandy soils is less than the clayey soils, using the sandy foundation soils would result in the most conservative results. The Dames and Moore reports state that in the original design for Dam No. 5 the maximum shear strength of the sandy foundation soils is 4900 psf. However, from the original analysis of Dam No. 4, it can be observed that the bottom of failure surface for the high water seismic analysis is tangent to an elevation at approximately 7050. Shear strength at this depth is approximately 1300 psf. Any variations of soil parameters resulting in a shear strength greater than 1300 psf would exhibit conservative results.

Variations in geometry for Dam No. 4 would not effect stability analyses significantly because the critical failure surfaces are controlled by the shear strength of the foundation soils. However, variations in the geometry for Dam No. 5 would affect stability results. The stability analysis for Dam No. 5 was performed on the maximum cross-section. The most critical failure condition occurs at high water conditions under seismic loading. Additional stability analysis event at a downstream slope of 3:1 instead of the previously analyzed 4:1 slope, results in minimum factor of safety of 1.10. Additionally, we understand that the final reclamation plan, as currently being revised, flattens the down stream slope to 5:1 which would result in more conservative results than the 3:1 and 4:1 analyzed slopes.

DISCUSSION OF SLOPE STABILITY ANALYSES, Continued

Discussion of Stability Method Used

In our opinion, the modified Bishop's Method yields conservative results for both static and pseudo-static analyses. Due to both embankments being constructed of generally cohesive materials, it is reasonable to assume that a circular failure surface would occur within the embankments. The modified Bishop's Method is based on moment equilibrium. However, it is also useful to evaluate force equilibrium methods to compare the conservatism of the analyses. The most common force equilibrium method is the Janbu Method of analysis. The following tables summarize the minimum factors of safety based on the Janbu Method.

Dam No. 4 - Minimum Factors of Safety$_{(Janbu)}$		
Ground-Water Conditions	Static Factor of Safety	Seismic Factor of Safety
High	3.51	1.26
Low	3.71	1.40

Dam No. 5 - Minimum Factors of Safety$_{(Janbu)}$		
Ground-Water Conditions	Static Factor of Safety	Seismic Factor of Safety
High	2.22	1.11
Low	2.49	1.26

Evaluation of Liquefaction Potential

While no specific laboratory tests were performed on samples of the embankment or foundation soils to determine liquefaction potential, it is our opinion that there exists a low potential for volume or strength changes to occur under seismic loading. As discussed in our November 15, 1996 Report, this conclusion is based on the type of materials that make up the dams, foundations and tailings, and the relatively low seismic potential of the area. As discussed earlier, we believe that by assuming relatively low values of soil strength to the static and psuedo-static analyses, we have provided a reasonable basis of evaluating a possible reduction in soil shear strength.

DISCUSSION OF SLOPE STABILITY ANALYSES, Continued

Evaluation of Pore Pressure Development

In order to evaluate variations in pore pressure within the embankments, it is important to consider conditions which would result in the greatest pore pressures. The greatest pore pressures typically occur upon rapid drawdown conditions, in which high water conditions occur within the dam and low water conditions exist outside of the embankment. Results of rapid drawdown analyses for each dam are tabulated below:

Rapid Drawdown Conditions- Minimum Factors of Safety		
Seismic Conditions	Dam No. 4	Dam No. 5
0.2 g	1.53	1.27
none	4.10	2.56

The rapid drawdown conditions for Dam No. 5 were analyzed for a 4:1 downstream slope. The proposed 5:1 downstream slope would in our opinion yield even more conservative results. We also performed rapid drawdown analyses using Janbu, presented below.

Rapid Drawdown - Minimum Factors of Safety$_{(Janbu)}$		
Seismic Condition	Dam No. 4	Dam No. 5
0.2 g	1.40	1.14
none	3.71	2.25

As the dewatering of the tailings basins continue over time, the potential for pore pressure development to occur is reduced, as saturated soil conditions are replaced with unsaturated conditions. We have analyzed this unsaturated condition for both dams under the long-term conditions assumption of a low steady-state ground-water level.

DISCUSSION OF SLOPE STABILITY ANALYSES, Continued

Selection of Seismic Coefficient

The stability analyses performed for our November 15, 1996 utilized a seismic coefficient of 0.2g, based on a review of the information available at the time. Since the date of the report, we have received a report from James C. Case, Head of the Geologic Hazards Section of the Wyoming Geological Survey. In that report, Mr. Case analyzes the seismic potential for the site, and concludes that the maximum credible "floating" earthquake for the site would have a magnitude of 6.25, with a peak horizontal acceleration of 0.15g. Because we believe that our existing analysis provides a reasonable assessment of the site, we do not recommend that the stability analysis be re-run with the lower acceleration. However, it should be recognized that by using the higher acceleration of 0.2g in our stability analyses, we believe that our overall approach to the seismic stability of the site is relatively conservative. A copy of Mr. Case's report is enclosed for your information.

We appreciate the opportunity to provide this additional information regarding slope stability analysis of the embankments. If you have any questions with the contents of this letter or enclosures, please call.

Sincerely,

INBERG-MILLER ENGINEERS

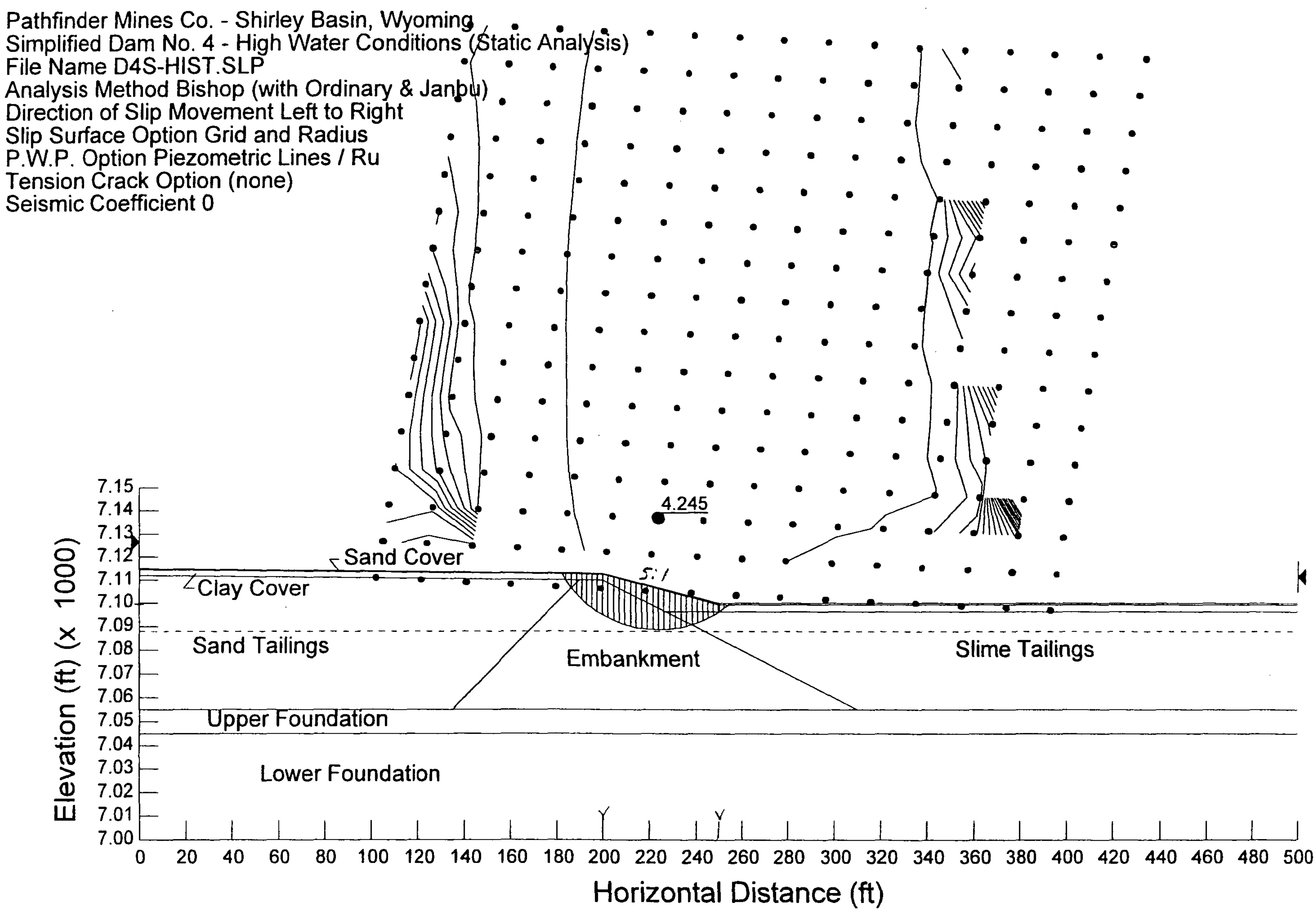
Shawn D. Steiner, P.E.
Geotechnical Engineer

REVIEWED BY:

Steven F. Moldt, P.E.
Vice President

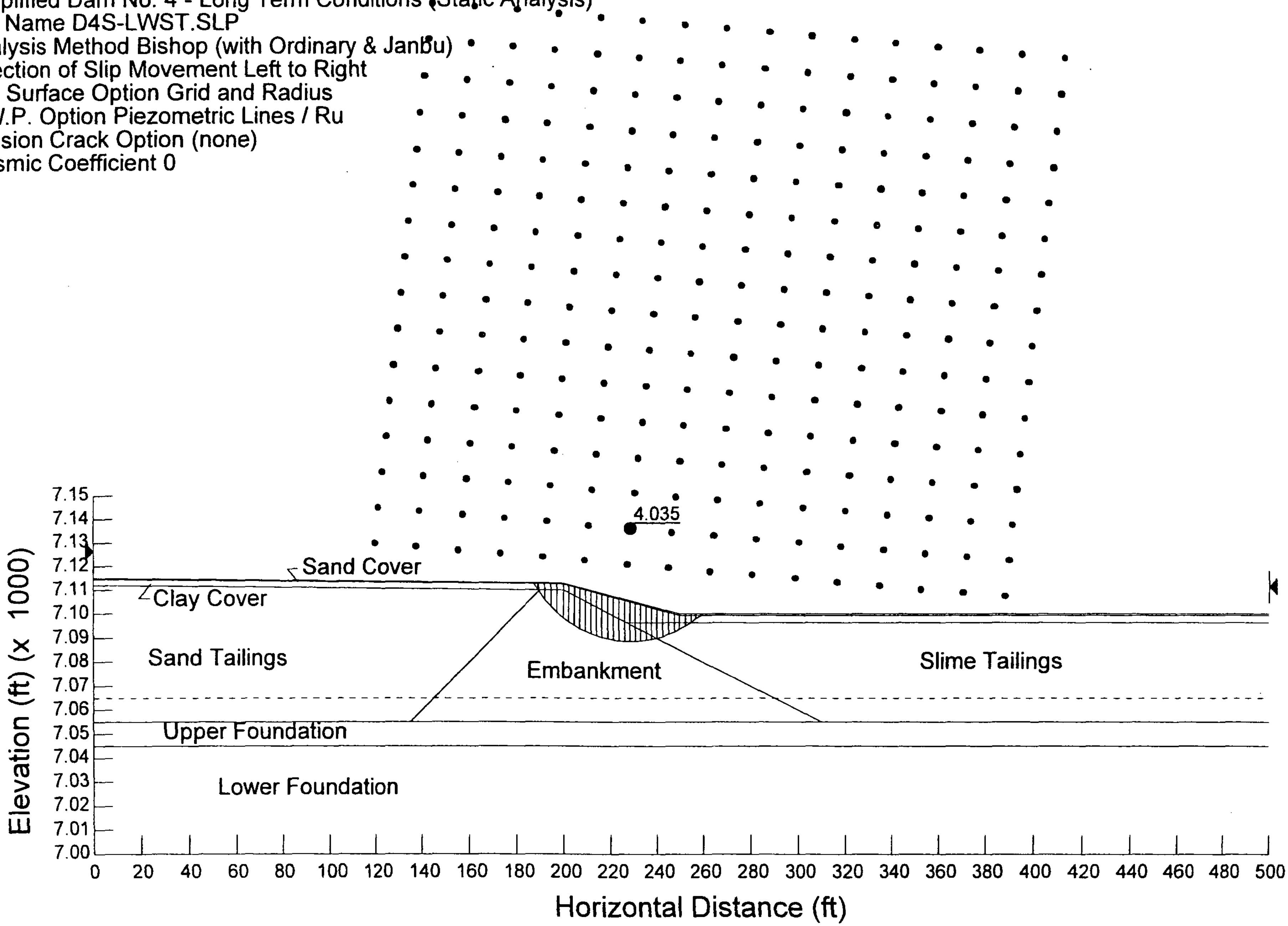
SDS:cag:ltr\7294-cx.nrc

Enclosures: Slope Stability Analyses
Copy of James C. Case August, 1997 Report
References



Pathfinder Mines Co. - Shirley Basin, Wyoming
Simplified Dam No. 4 - High Water Conditions (Static Analysis)
File Name D4S-HIST.SLP
Analysis Method Bishop (with Ordinary & Janbu)
Direction of Slip Movement Left to Right
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
4.245
Sand Cover
Clay Cover
Sand Tailings
Embankment
Slime Tailings
Upper Foundation
Lower Foundation
Elevation (ft) (x 1000)
7.15
7.14
7.13
7.12
7.11
7.10
7.09
7.08
7.07
7.06
7.05
7.04
7.03
7.02
7.01
7.00
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500
Horizontal Distance (ft)

Pathfinder Mines Co. - Shirley Basin, Wyoming
Simplified Dam No. 4 - Long Term Conditions (Static Analysis)
File Name D4S-LWST.SLP
Analysis Method Bishop (with Ordinary & Janbu)
Direction of Slip Movement Left to Right
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0



Pathfinder Mines Co. - Shirley Basin, Wyoming
Simplified Dam No. 4 - High Water Conditions
File Name D4S-HIEQ.SLP
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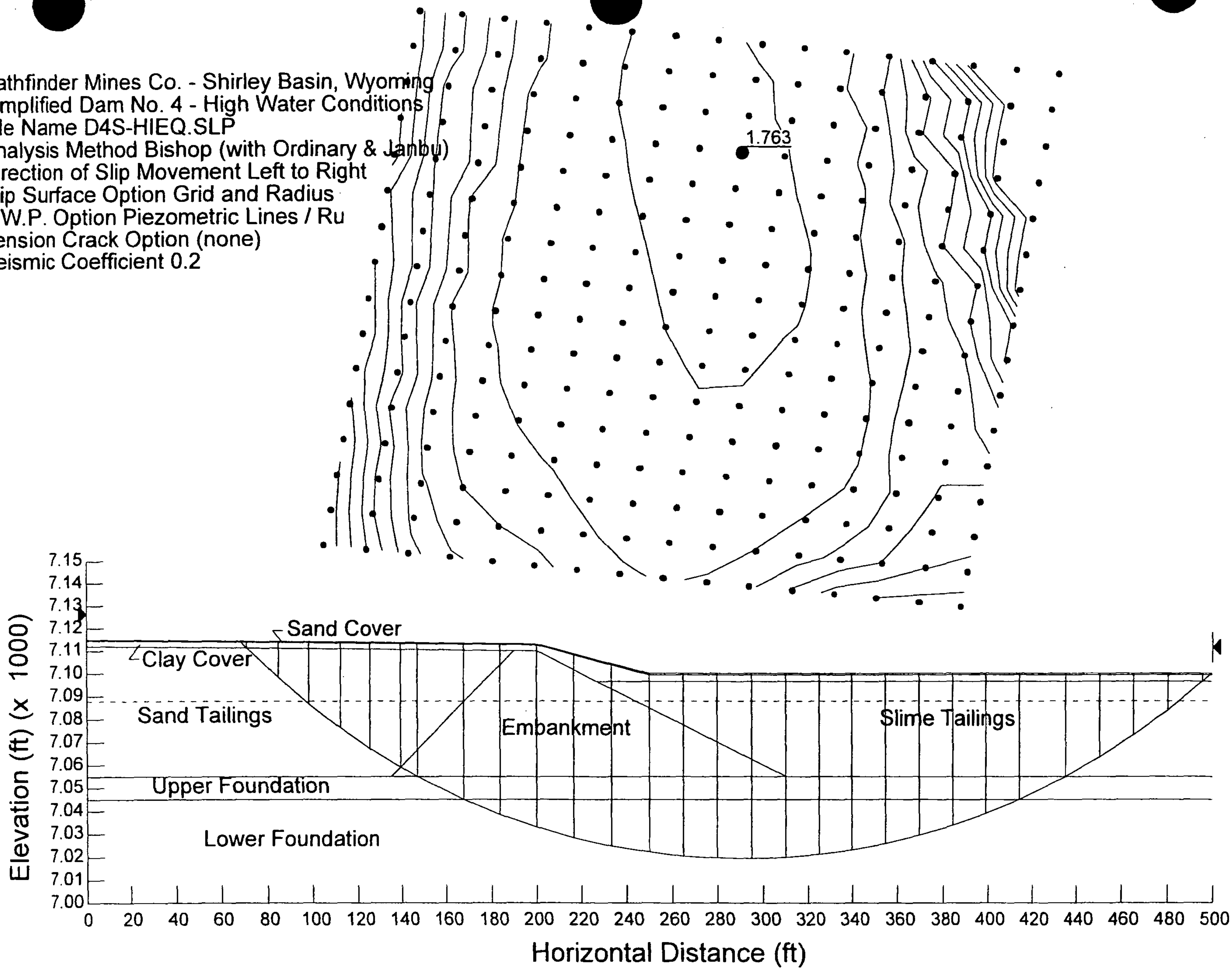
Direction of Slip Movement Left to Right
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0.2



Pathfinder Mines Co. - Shirley Basin, Wyoming
Simplified Dam No. 4 - Long Term Conditions (Static Analysis)
File Name D4S-LWEQ.SLP
Analysis Method Bishop (with Ordinary & Janbu)
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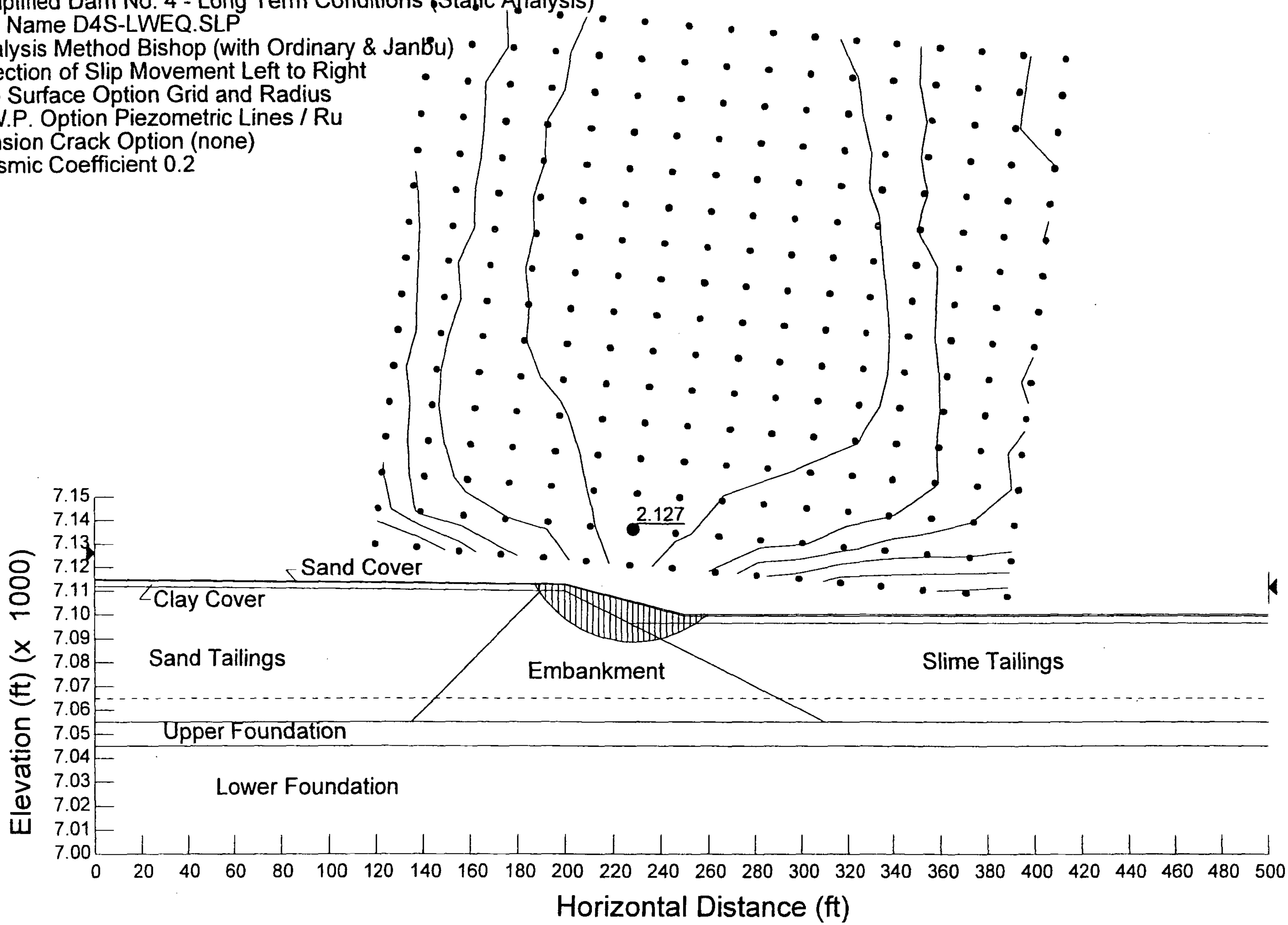
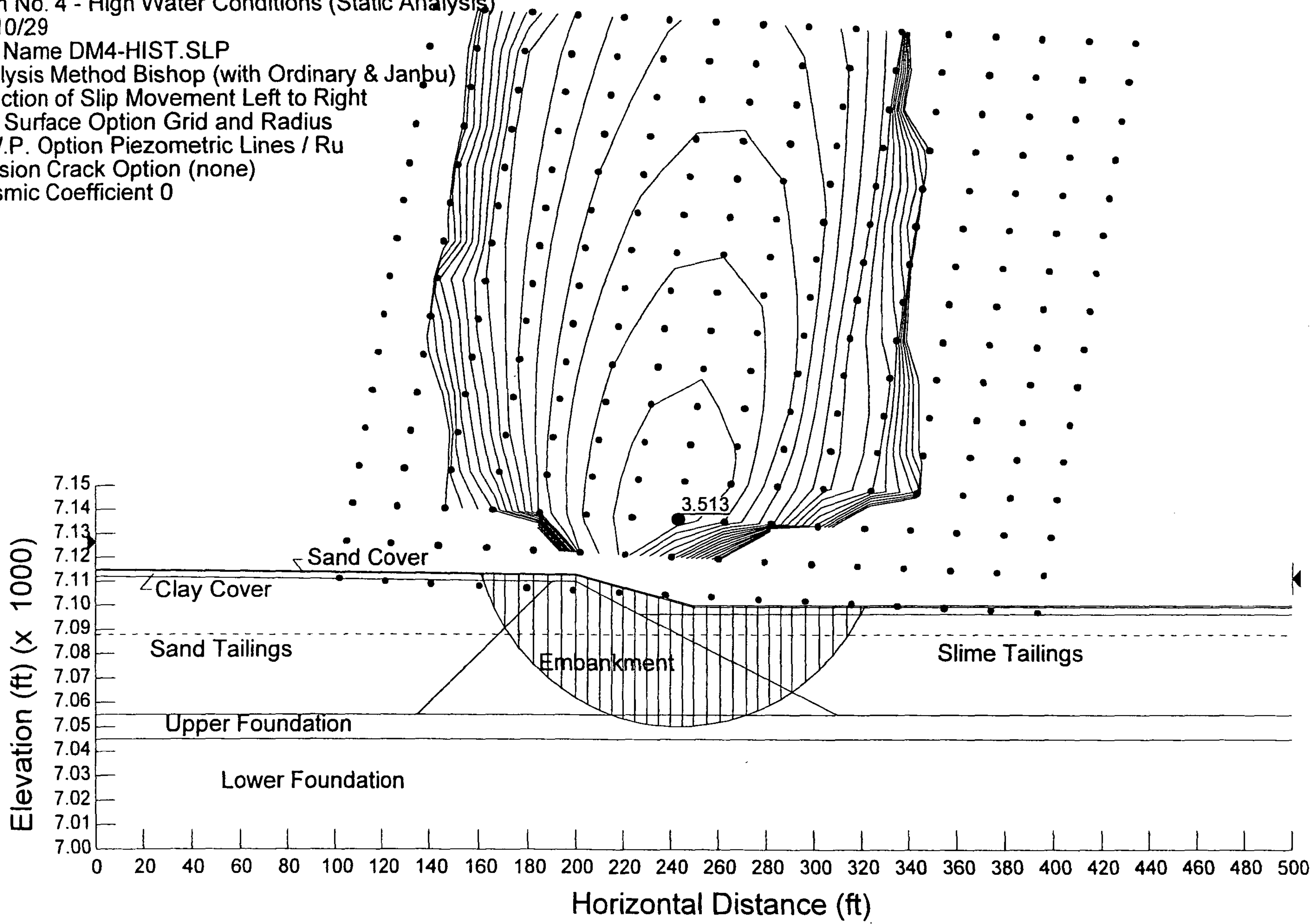
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0.2



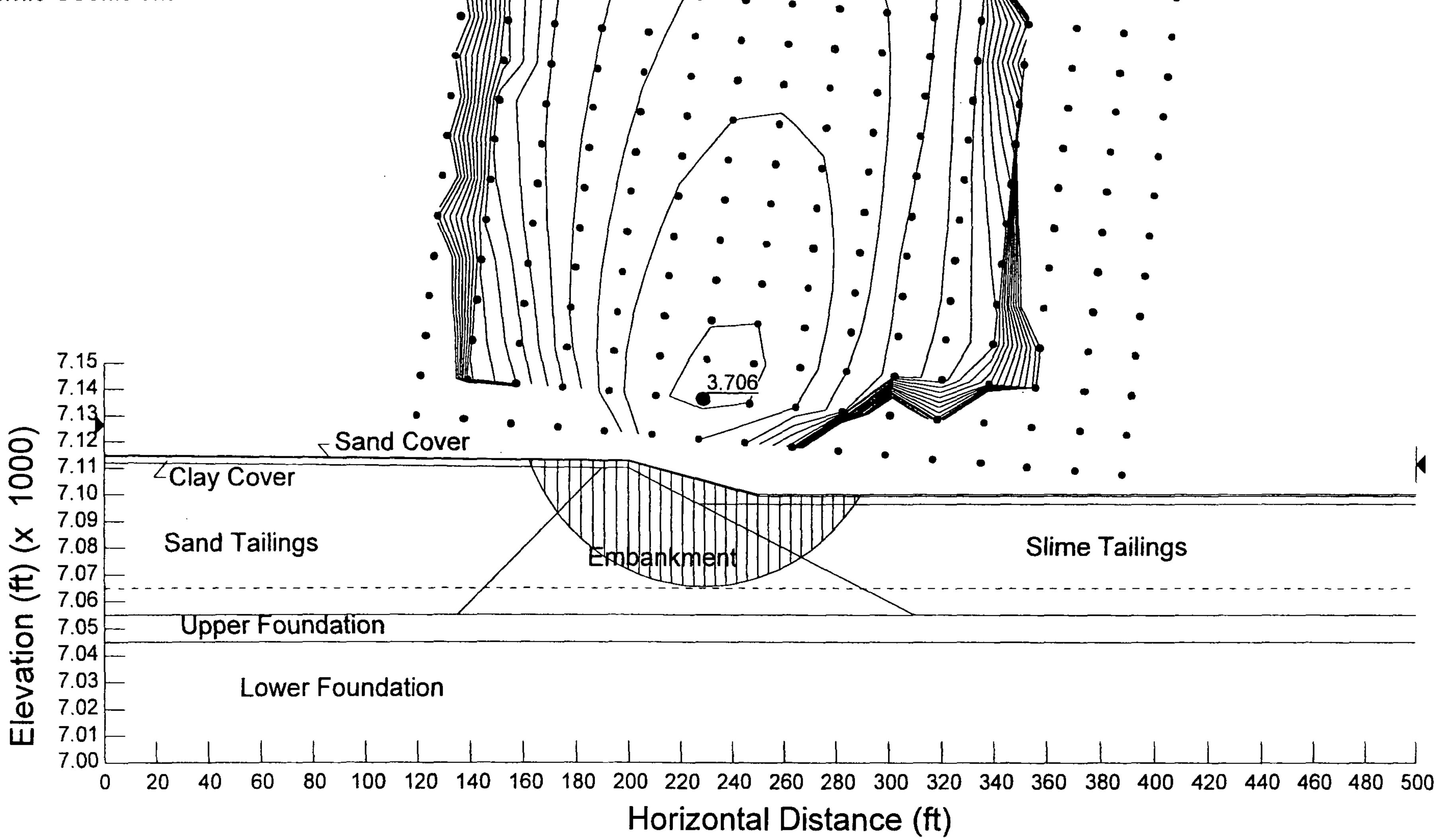
JANBU

Pathfinder Mines Co. - Shirley Basin, Wyoming
Dam No. 4 - High Water Conditions (Static Analysis)
96/10/29
File Name DM4-HIST.SLP
Analysis Method Bishop (with Ordinary & Janbu)
Direction of Slip Movement Left to Right
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0

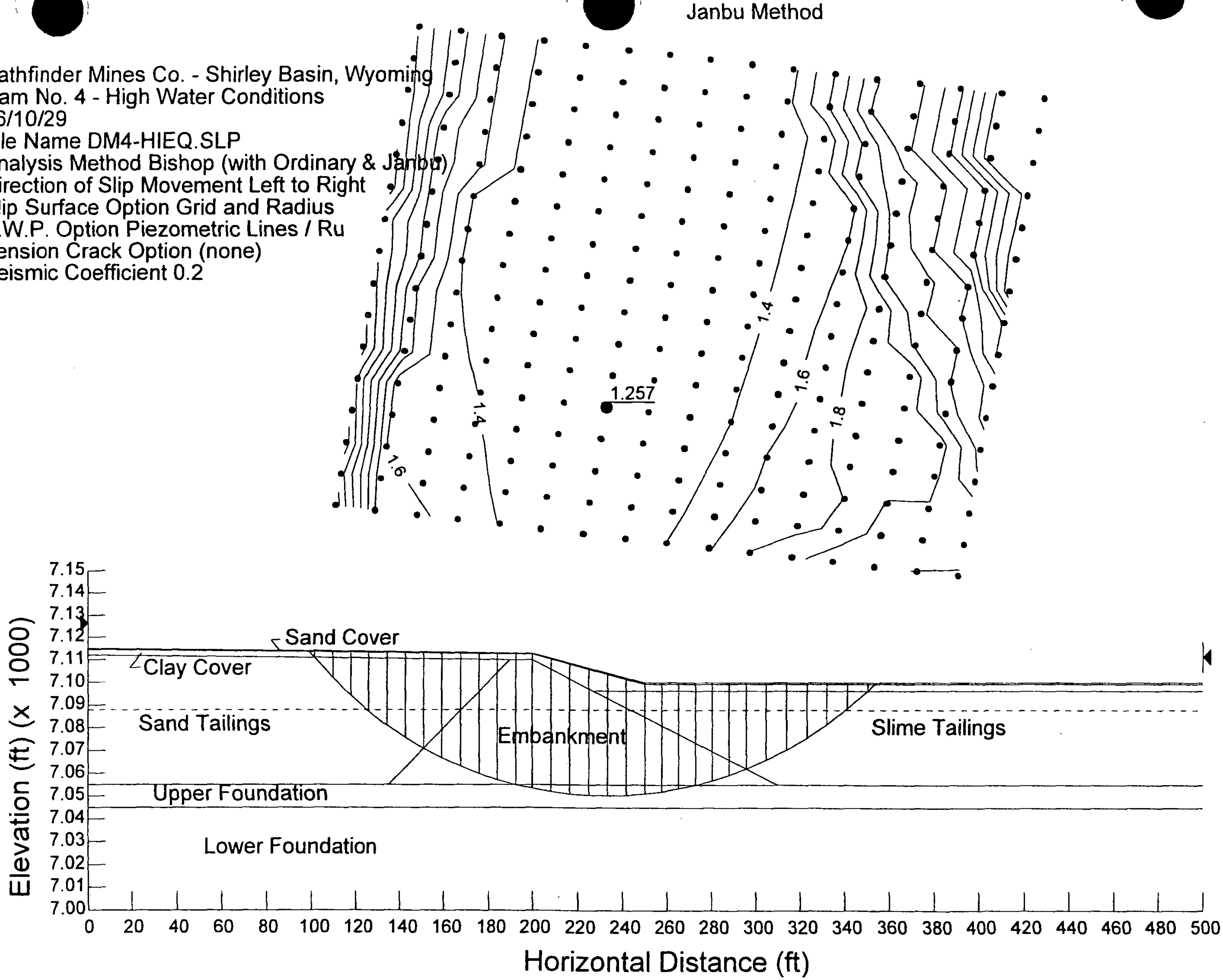


JANBU

Pathfinder Mines Co. - Shirley Basin, Wyoming
Dam No. 4 - Long Term Conditions (Static Analysis)
96/10/22
File Name DM4-LWST.SLP
Analysis Method Bishop (with Ordinary & Janbu)
Direction of Slip Movement Left to Right
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0

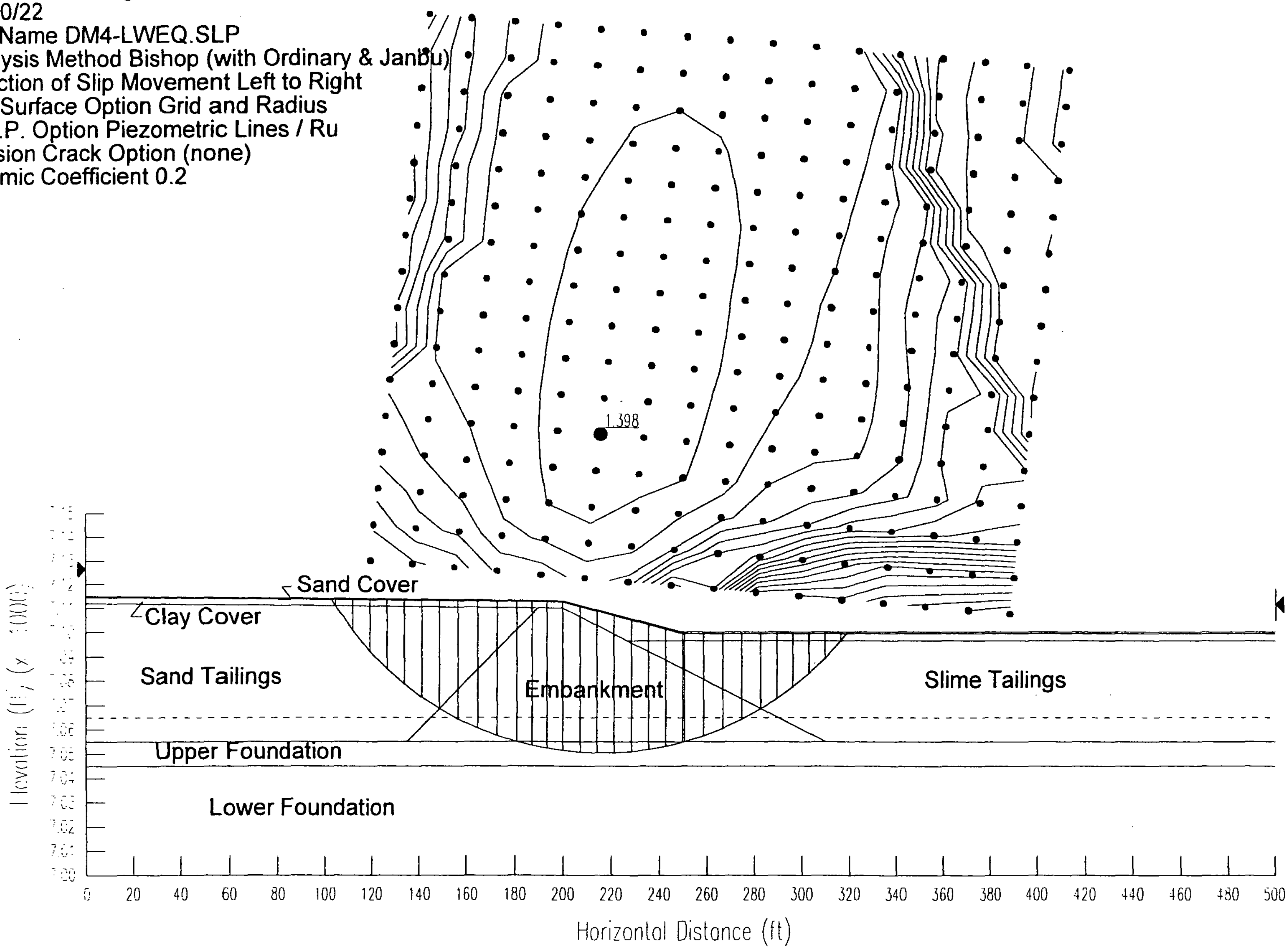


Pathfinder Mines Co. - Shirley Basin, Wyoming
Dam No. 4 - High Water Conditions
96/10/29
File Name DM4-HIEQ.SLP
Analysis Method Bishop (with Ordinary & Janbu)
Direction of Slip Movement Left to Right
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0.2



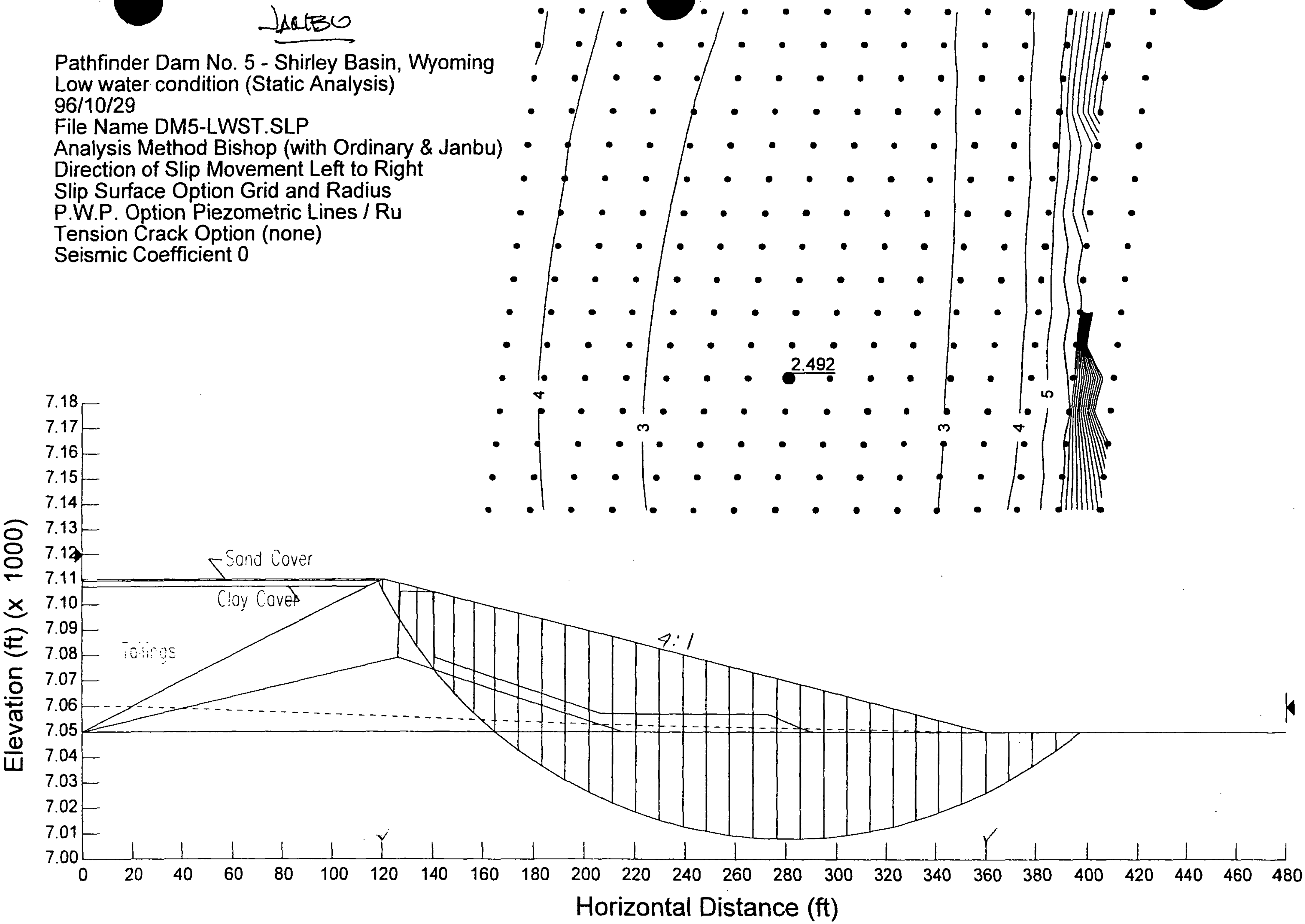
JANBU

Pathfinder Mines Co. - Shirley Basin, Wyoming
Dam No. 4 - Long Term Conditions (Static Analysis)
96/10/22
File Name DM4-LWEQ.SLP
Analysis Method Bishop (with Ordinary & Janbu)
Direction of Slip Movement Left to Right
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0.2



JANBU

Pathfinder Dam No. 5 - Shirley Basin, Wyoming
Low water condition (Static Analysis)
96/10/29
File Name DM5-LWST.SLP
Analysis Method Bishop (with Ordinary & Janbu)
Direction of Slip Movement Left to Right
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0



Janbu

Pathfinder Dam No. 5 - Shirley Basin, Wyoming
Low water condition
96/10/29
File Name DM5-LWEQ.SLP
Analysis Method Bishop (with Ordinary & Janbu)
Direction of Slip Movement Left to Right
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
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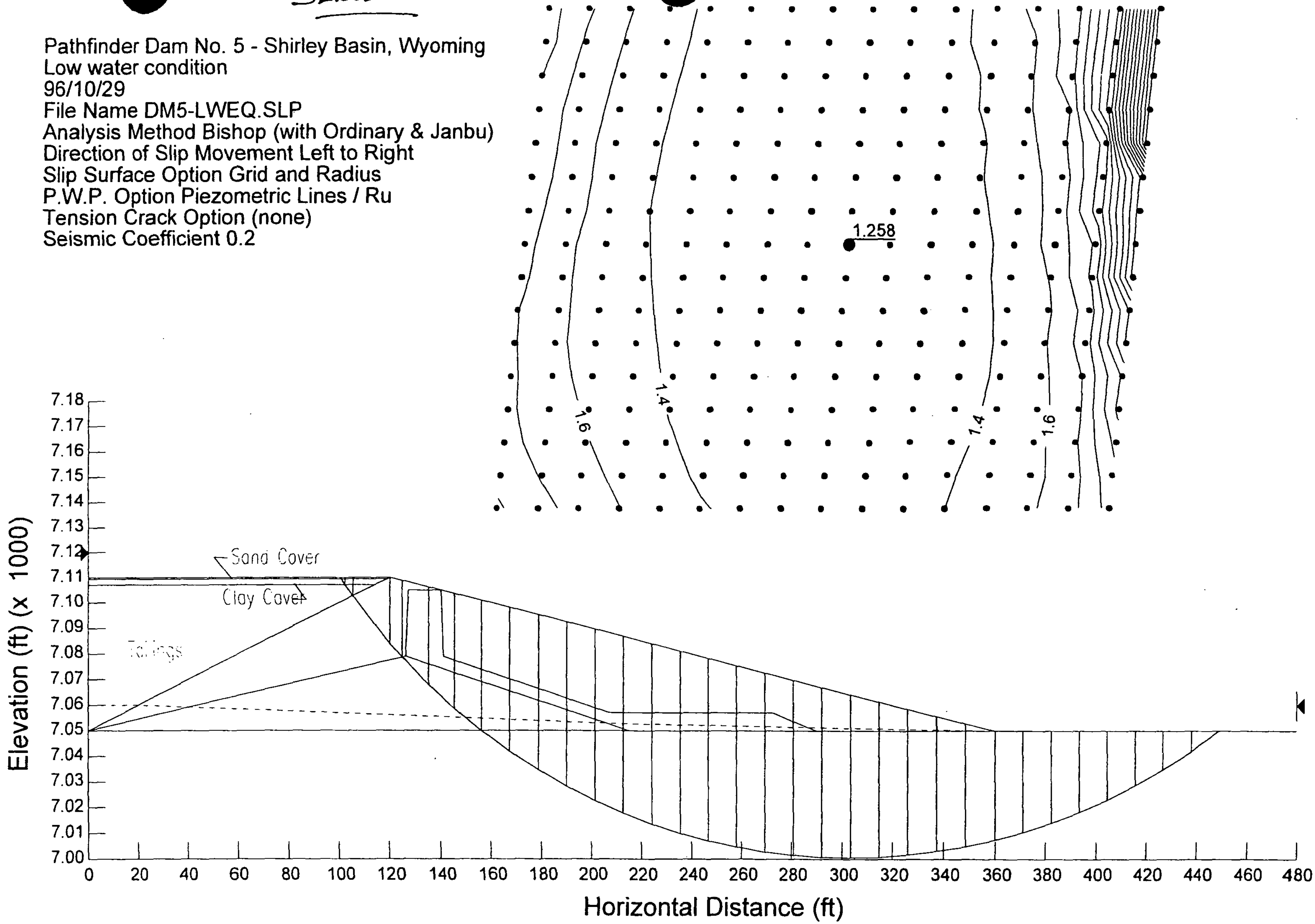

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Dam No. 4 - Rapid Draw Down Conditions (Static Analysis)
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Direction of Slip Movement Left to Right
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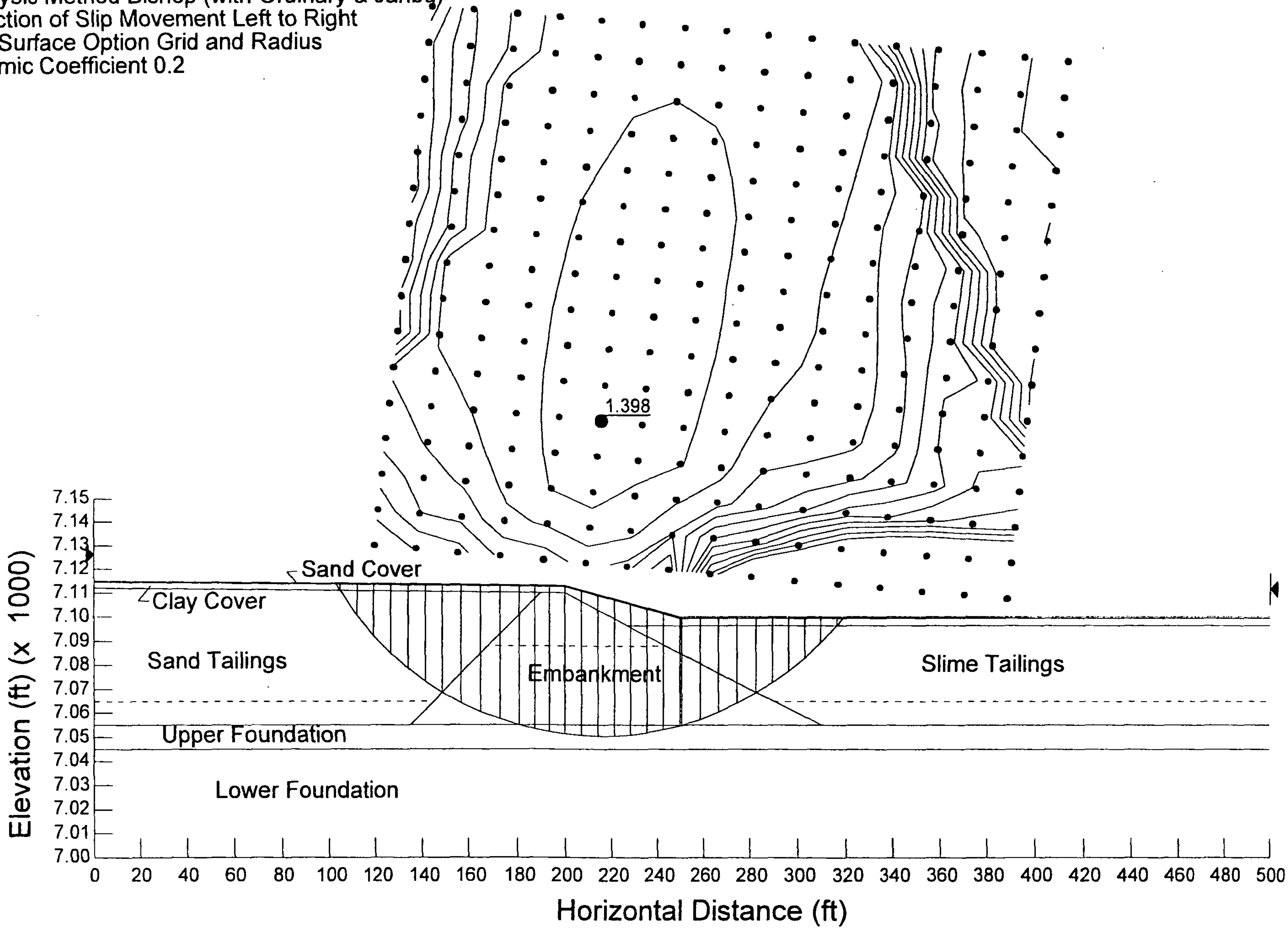
JANBU



Pathfinder Mines Co. - Shirley Basin, Wyoming
Dam No. 4 - Rapid Draw Down Conditions (Static Analysis)
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Slip Surface Option Grid and Radius
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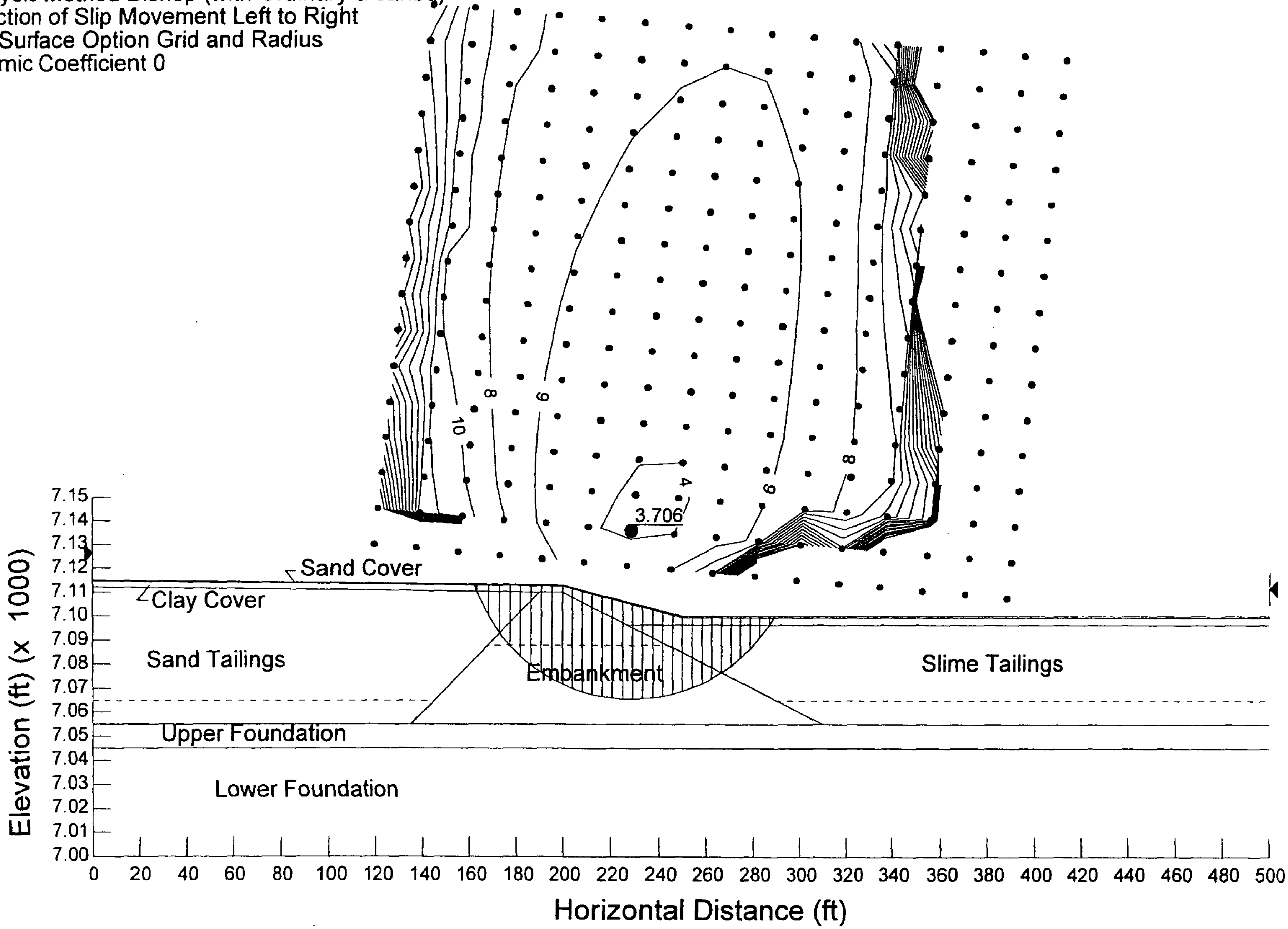
JANBU



THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
"SUPPLEMENTARY EXHIBIT A, APPROXIMATE SAND AND SLIME TAILINGS LOCATIONS. EXH6-3.DWG"

WITHIN THIS PACKAGE... OR BY SEARCHING USING THE

D-01

<u>**References**</u>

1. "Foundations and Earth Structures-Design Manual 7.2", Department of Navy Naval Facilities Engineering Command, May 1982.

2. "Characterization of Inactive Uranium Tailings Sites: Shiprock, New Mexico", prepared for Department of Energy, Albuquerque, New Mexico, prepared by the Geotechnical Engineering Program, Colorado State University, 1984.

3. Vick, Steven G.,"Planning, Design, and Analysis of Tailings Dams", John Wiley & Sons, 1983.

Basic Seismological Characterization for Pathfinder's Shirley Basin Mill Tailings Site

by

James C. Case
Wyoming State Geological Survey
August, 1997

Background

The U.S. Nuclear Regulatory Commission generated the "Final Standard Review Plan" to guide the reclamation of uranium mill tailings sites. The review plan clarifies federal regulations 10 CFR 40 Appendix A and 10 CFR 100 Appendix A. The Final Standard Review Plan has three steps to be completed in order to generate a seismotectonic stability analysis of a mill tailings site. The steps are as follows:

1) Determination of the Maximum Tectonic Province Earthquake (Floating Earthquake)
2) Identification of Capable Faults
3) Designation of Maximum Credible Earthquake

In order to satisfy the requirements of the NRC as set forth in the "Final Standard Review Plan", I have generated a basic analysis of the following items:

1) Deterministic Analysis on Nearby Active Faults with a Surface Expression
2) "Floating Basin Earthquake" Analysis for a Regional Tectonic Province
3) Designation of Maximum Credible Earthquake (Larger of Items 1 or 2)

Deterministic Analysis

In 1988, Geomatrix Consultants, Inc., completed a report titled "Seismotectonic Evaluation of the Wyoming Basin Geomorphic Province". The report area includes the Shirley Basin and Pathfinder's Shirley Basin Mill Tailings Site. Geomatrix assembled available information on known active faults in addition to conducting field investigations on poorly studied faults. Based upon the Geomatrix study, as well as unpublished information and reports at the Wyoming State Geological Survey, I have concluded that the active fault that could cause the greatest accelerations at the Shirley Basin Site is the Seminoe Mountain Segment of the South Granite Mountain Fault System. The nearest point on the Seminoe Mountain Segment is located approximately 53 kilometers west-southwest of Pathfinder's Shirley Basin Mill Tailings Site.

Geomatrix (1988) did not find evidence of late-Quaternary movement on the Seminoe Mountain Segment of the South Granite Mountain Fault System, and scarps that were present were found to be fault-line scarps due to differential erosion. The Seminoe Mountain Segment, however, is an extension of other segments of the South Granite Mountain Fault System that have been shown to be active in the late-Quaternary, and recurrently active over the last 500,000 years. The other segments of the South Granite Mountain Fault System are located to the west of the Seminoe Mountain Segment, and are all further from the mill tailings site.

Based upon the above analysis, I feel that the Seminoe Mountain Segment of the South Granite Mountain System is a conservative selection for the active fault nearest the site. Geomatrix (1988) did not assign a maximum magnitude earthquake to the Seminoe Mountain Segment, in large part because of poor exposure of the fault, lack of measurable surface offsets, and uncertainty in the actual length of the segment. Geomatrix estimated the length of the Seminoe Mountain Segment to be 36 kilometers. Such a fault length would result in a magnitude 6.85 earthquake if the entire length ruptured (Wells and Coppersmith, 1994). All other active segments of the South Granite Mountain Fault System, however, have been assigned a maximum magnitude of 6.5 to 6.75. Due to the uncertainties associated with the Seminoe Mountain Segment, I feel that a maximum earthquake of magnitude 6.75 is more reasonable than one of magnitude 6.85.

A magnitude 6.75 earthquake originating on the Seminoe Mountain Segment, located 53 kilometers from Pathfinder's Shirley Basin Mill Tailings Site, should result in a peak horizontal acceleration of approximately 0.05g (Campbell, 1987) at the site. This acceleration is conservative, considering the uncertainties associated with the Seminoe Mountain Segment.

Floating Basin Earthquake for a Regional Tectonic Province

NRC's Final Standard Review Plan requires that "For those earthquakes not associated with known tectonic structures (i.e., "floating" earthquakes) the largest event that has occurred in each of the tectonic provinces expected to influence the seismicity of the site should be identified". In other words, the largest event that has occurred and has not been tied to a specific fault system, or related structure, should be considered the "floating" earthquake for the tectonic province. The "floating" earthquake may be larger than the largest historic earthquake, and should be the largest "random" earthquake thought to have occurred in the last 35,000 - 50,000 years.

Lawrence Livermore National Laboratory (Bernreuter and others, 1994) included the Shirley Basin in a "Central Wyoming Seismic Zone", defined by 109.7° West longitude on the west, 105.5° West longitude on the east, 41.5° North latitude on the south, and 43.0° North latitude on the north. This "Central Wyoming Seismic Zone" is within an even larger tectonic province, defined by Geomatrix (1988), called the "Wyoming Foreland Structural Province". The "Wyoming Foreland Structural Province" is approximately defined by the Idaho-Wyoming Thrust Belt on the west, 104° West longitude on the east, 40° North latitude on the south, and 45° North latitude on the north.

Geomatrix (1988) estimated that the largest "floating" earthquake that may occur in the "Wyoming Foreland Structural Province" would have a magnitude in the 6.0 - 6.5 range, and used a magnitude 6.5 earthquake in their analysis. The average of the range of magnitudes suggested by Geomatrix for a "floating" earthquake in the "Wyoming Foreland Structural Province" is magnitude 6.25. A magnitude 6.25 "floating" earthquake is suggested by Lawrence Livermore National Laboratory (Bernreuter and others, 1994) for the "Central Wyoming Seismic Zone. I used a magnitude 6.25 "floating" earthquake in my analysis of Pathfinder's Shirley Basin Mill Tailings Site.

Once the "floating" earthquake has been determined for a tectonic province, it must be arbitrarily placed at a certain distance from a site in order to estimate what accelerations may be felt if such an earthquake occurs. NRC's Final Standard Review Plan defines the site-to-source distance for "floating" earthquakes as 15 kilometers.

A magnitude 6.25 "floating" earthquake place 15 kilometers from Pathfinder's Shirley Basin Mill Tailings Site would result in a peak horizontal acceleration of 0.15g at the site.

Maximum Credible Earthquake

Based upon the guidance supplied in NRC's "Final Standard Review Plan", the maximum credible earthquake on the nearest identified active fault would have a magnitude of 6.75. The maximum credible "floating" earthquake, not associated with a specific active fault, would have a magnitude of 6.25. Because the nearest identified active fault is 53 kilometers from the site, design accelerations should be based upon the "floating" earthquake. A peak horizontal acceleration of 0.15g should be used in the design of Pathfinder's Shirley Basin Mill Tailings Site.

Summary

A basic seismological characterization was conducted for Pathfinder's Shirley Basin Mill Tailings Site. Based upon guidance provided in the "Final Standard Review Plan" (U.S. Nuclear Regulatory Commission, 1993), a peak horizontal acceleration of 0.15g should be used in the design of the mill tailings site.

References

Bernreuter, D., McDermott, E., and Wagoner, J., 1994, Seismic hazard analysis of Title II reclamation plans: Report prepared by Lawrence Livermore National Laboratory for the U.S. Nuclear Regulatory Commission, 145 p.

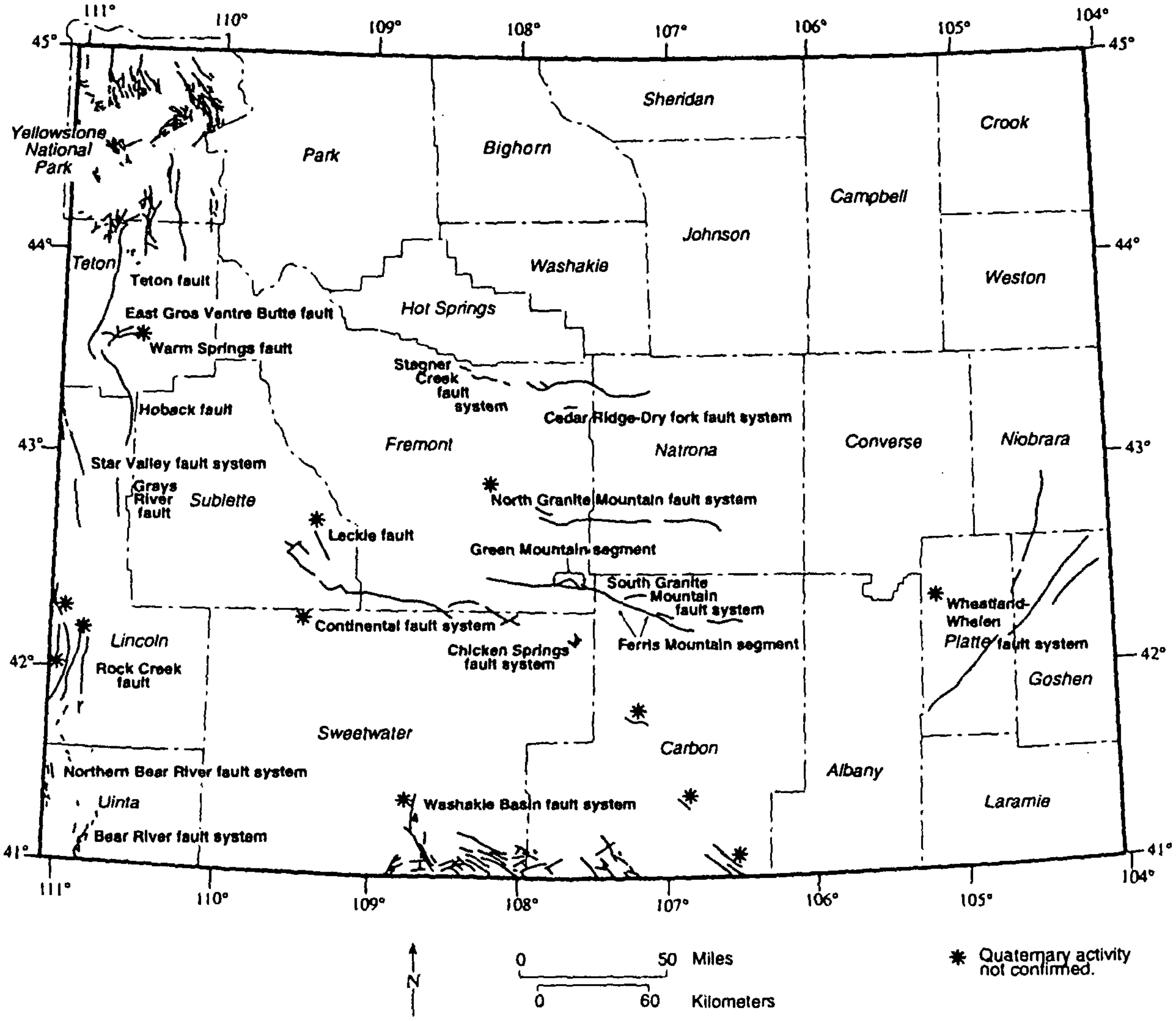
Campbell, K.W., 1987, Predicting strong ground motion in Utah, *in* Gori, P.L. and Hays, W.W., editors, Assessment of regional earthquake hazards and risk along the Wasatch front, Utah, Volume 2: U.S. Geological Survey Open File Report 87-585, p L1-L90.

Case, J.C., 1991, Earthquakes and active faults in Wyoming: Wyoming State Geological Survey unpublished report, 57 p.

Geomatrix Consultants, Inc., 1988, Seismotectonic evaluation of the Wyoming Basin geomorphic province: Report prepared for the U.S. Bureau of Reclamation, Contract No. 6-CS-81-07310, 167 p.

Wells, D.L., and Coppersmith, K.J., 1994, New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement: Bulletin of the Seismological Society of America, Vol. 84, No. 4, pp. 974 - 1002.

U.S. Nuclear Regulatory Commission, 1993, Final standard review plan, revision 1: U.S. Nuclear Regulatory Commission Report, 77 p., appendices.



SUSPECTED ACTIVE FAULTS IN WYOMING

References

1. Case, James C., "Basic Seismological Characterization for Pathfinder's Shirley Basin Mill Tailings Site", Report of Wyoming Geological Survey, August, 1997.

2. "Foundations and Earth Structures-Design Manual 7.2", Department of Navy Naval Facilities Engineering Command, May 1982.

3. "Characterization of Inactive Uranium Tailings Sites: Shiprock, New Mexico", prepared for Department of Energy, Albuquerque, New Mexico, prepared by the Geotechnical Engineering Program, Colorado State University, 1984.

4. Vick, Steven G.,"Planning, Design, and Analysis of Tailings Dams", John Wiley & Sons, 1983.

Hydro-Engineering
Responses to NRC Comments

Section 1- Geotechnical

Comment 4. Technical basis for settlement and subsidence calculations.

Response: It is important to point out that the predictive consolidation modeling was done with a very simplistic approach because it was intended for comparative purposes only. NRC personnel have repeatedly emphasized that demonstration of achievment of t_{90} with monitoring is the accepted standard which must be met before construction of the final cover. The following text addresses specific aspects of the predictive settlement calculation that were brought up in the comments.

(i) The compressive indices varied with the nature of the tailings but a universal composite compressive index was used to simplify calculations. The hydraulic spiggoting of tailings from many locations results in a tremendously heterogeneous tailings pile and it simply is not practical to characterize the tailings with the resolution that would allow a very local predicition of settlement. It is possible to distinguish between areas that are primarily slimes and primarily sands, as well as using gamma logs from wells to determine a rough proportion of sand or slimes at other locations. This information is used in developing a settlement monitoring program. However, because of the known heterogeneity and variability in the tailings placement, it is not worthwhile to do an elaborate predictive settlement analysis or sensitivity analysis. Rather, the NRC has indicated that it is preferrable to monitor settlement.

(ii) Like compressive index, the void ratio showed tremendous variability between tailings samples. A typical composite value was selected for simplicity.

(iii) At the time that the samples were taken and the subsidence analysis was done, much of the No. 4 and No. 5 Ponds was still covered by tailings solution, hence the total stress and pore water pressure estimates were based on assumptions of extreme initial and final conditions. The intial total stress was estimated as a linear stress distribution from the surface with an overburden unit weight of 125 lb/ft^3. The initial pore water pressure was assumed to be a hydrostatic pressure distribution for a completely saturated tailings profile. The final total stress was assumed to be a linear stress distribution from the surface with an overburden unit weight of 100 lb/ft^3. The final pore water pressure was assumed to be negligible throughout the profile.

Regarding the potential for differential settlement, the committment to delay construction of the final cover until settlement monitoring indicates t_{90} has been reached is considered adequate protection against cover damage by settlement. There is currently

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an aggressive tailings dewatering and solution evaporation program underway to accelerate consolidation. As discussed above, the heterogeneity of the tailings in combination with extremely complex drainage conditions makes local prediction of the rate and magnitude of settlement very difficult. As such, the settlement monitoring program appears to be a far more reliable means of insuring that the magnitude of differential settlement is acceptable. The only appreciable dynamic loading that will occur on the radon barrier will be during construction of the barrier and the overlying erosion protection layers. During the construction process, general grading and appropriate routing of construction traffic will eliminate areas where the cover could be compromised by the dynamic loading. With the demonstrated essential completion of primary consolidation, the strain on the cover will be very limited and cracking of the cover will be unlikely. In addition, the potential impacts on radon flux of small, strain induced cracks in the cover are trivial. As an example, the bare source flux for scenario #1 of the radon modeling in the TRP is 43 $pCi/m^2/s$ while the presence of the cover limits the radon flux to 6.0 $pCi/m^2/s$. Given this ratio of radon flux rates, roughly one-half of the surface area of tailings would have to be completely exposed by cracks to exceed the limiting flux of 20 $pCi/m^2/s$. This radon flux from the exposed area is subject to the nature of the tailings and cover, but it is difficult to imagine a scenario where the area of exposed tailings due to cracks would be measurable, much less constituting a signficant part of the total tailings cover area.

Comment 5. Problems with Table 5-12 and compressive index.

Response: Table 5-12 contains errors in the alignment of heading labels and is being replaced. As mentioned above, a single universal compressive index was used in the predictive analysis in the interest of simplicity.

Comment 6. Proposed embankment slopes.

Response: The embankment slopes will be reduced to 5H:1V.

Comment 7. Field testing of permeability.

Response: In addition to Table C.2-4, the reviewer is referred to Table C.2-1 which contains permeability results for samples taken from the South Dump test holes. The largest of the permeabilities from this sampling program was used in the infiltration calculations. There has always been some concern about validity of laboratory testing of permeability and it naturally follows that the focus of the concern is with situations where a very small permeability is desired. Unfortunately, satisfactory field testing of permeability requires post-construction testing or creation of a test pad. Even under field conditions, a permeability test causes some disturbance and may introduce substantial error, and it seems unlikely that the error would give a smaller indicated permeability. If the permeability used in the infiltration modeling is increased to 10^{-7} cm/sec, the maximum infiltration depths for the locations in Table 5-13 of the TRP increases to 3.01 inch. This depth of penetration is still acceptable and this calculation indicates that the permeability of the barrier material is substantially smaller than necessary. It should also be noted that the depth of infiltration is an iterative calculation, and the depth of penetration for locations in Table 5-13 of the TRP will converge to slightly smaller values if the number of computations is increased. It is unfortunate that, as the laboratory tests indicate less permeable material, the results become more and more suspect.

Section 2- Radon Attenuation

Comment 1. Quantities of clay barrier material.

Response: The South Test Hole (STH) and North Test Hole (NTH) sampling programs were intended to determine both the quantity and quality of the planned barrier material. The lithology logs for 11 test holes on the South Dump are presented in Appendix A and were used to determine the thickness of layers of suitable material. Cross-sections were developed using the test hole logs and this allowed computation of the available volume of suitable clay. This was done informally during the development of the TRP and is presented in a more formal manner in an attached report. The test holes covered an area that was expected to yield sufficient clay for the barrier but only covered a small percentage of the actual footprint of the south dump. Since the planned barrier material originated as a thick aquitard between the White River and Wind River aquifers, there is every reason to believe that the same clay is present in large quantities throughout the dump. If necessary, the borrow area can be expanded to provide clay for the barrier. The required volume of clay for the barrier is presented on page 10-2 of the TRP.

Comment 2. Radiological properties of tailings.

Response: With the recent coverage of the former pool area on the No. 5 Pond, additional sampling is possible and a minimum of eight radon flux measurements will be taken. The details of this sampling program are discussed later in this response. The thickness of the interim cover will also be determined and included in the radon modeling. A substantial thickness of interim cover has been applied to the former pool area of the No. 5 Pond, and it may be possible to reduce the planned three foot clay radon barrier thickness to the 2.5 foot clay thickness planned for the remainder of the No. 5 Pond. Current sampling coverage in Pond No. 4 is sufficient and operational

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adjustments will be made in cover placement or the placement of general fill if unexpected conditions are encountered. In order to clarify the methods used in radon modeling in the TRP, the following discussion describes the reasoning used in the original sampling and modeling and addresses some of the concerns of the reviewer.

In the tailings well sampling program (TW series), sampling at less than three feet was not done to prevent potential dilution of the samples with interim cover. Many of the pit samples were taken from shallower depths (see Table 2-1 of the TRP) and the greatest Ra226 activity for samples taken from depths less than three feet for the pit samples was 65.8 pCi/gm. The average Ra226 activity for all of the Pond 4 and Pond 5 shallow (less than three feet) pit samples was 29 pCi/gm, hence the reasoning for excluding samples with a Ra226 activity of less than 20 pCi/gm and the concerns for sample dilution by non-tailings material. Because the pit samples were located on the periphery of the ponds to determine the extent of tailings, they also represent limited tailings depths, and were not included in the radon emanation modeling for this reason. If all of the Pond 4 and Pond 5 tailings well and pit samples less than 20 feet from the surface are included, the average activity is 72 pCi/gm. This is still substantially below the value of 107 pCi/gm (average activity of 65 pCi/gm. plus one std. deviation) used in the scenario #1 modeling and corresponds closely with the average activity for scenario #1 of 65 pCi/gm. It should be noted that there are two errors in Table 3-1 of the TRP. The Ra226 activity for sample TW4-1B (25'-27') should be 728 pCi/gm rather than 7.28 pCi/gm and the sample for well TW4-1B (3' to 5') was omitted. This additional sample gave a total of eight that were actually used in calculating the average Ra226 activity. This table is corrected and replaced in this submittal.

The gamma logs were used as a very strong indicator of the nature and activity of tailings at the well or sampling locations, and were used in deciding which samples should be used in the radon modeling. As an example, Figure A.2-3 of the TRP presents the geophysical log for well TW4-1C and Figure A.3-3 presents a predicted Ra226 activity based on the gamma log. A sample was taken from this well at the 3 feet to 5 feet depth with a resulting Ra226 activity of 53.6 pCi/gm. This was a typical sandy tailings sample, and the gamma log indicates that the material is similar to a depth of roughly 18 feet. Below this there is a transition zone to what appears to be a slime zone extending from 25 feet to 45 feet depth. This is supported by the lithologic log on page A.1-3 of the TRP, although there is sometimes considerable lag and mixing of cuttings for tailings wells, as demonstrated by the five foot discrepancy between lithologic and geophysical logs. When this occurs, the geophysical log is considered more reliable in indicating depths of specific materials. The gamma log in Figure A.2-3 also presents a fairly typical tailings deposition pattern for the central tailings area. The depostion of fines (slimes) at great depth from the surface likely occurred early in the life of the pond, when spiggoting was done from the dam or extreme periphery of the pond. At this time, much of central tailings area was under ponded water. As the tailings sand filled in on the beach areas along the pond periphery, the spiggoting was moved inward on the pond. This crowded the pool area into its location at the time of development of the

TRP, and overlaid much of the initial slime pool with substantial depths of sandy tailings. The tailings dams were constructed across the upper end of the Mine Creek channel, and the presence of channels and other flow diverting features at the base of the ponds further complicates depositional patterns. With this in mind, an additional exhibit (Supplementary Exhibit A) has been developed showing areas of primarily sandy tailings, primarily slime tailings, and slime tailings overlain by significant depths of sandy tailings.

Most of the tailings well samples were taken from the top eight feet of tailings. The exceptions to this were when the gamma logs indicated a substantial change in the properties of the tailings, and two samples were taken from slime layers at depths greater than 25 feet to determine slime properties. The radon flux is more directly affected by the source materials near the surface unless the underlying materials have a substantially greater Ra226 activity. None of the gamma logs indicated a substantially greater activity for tailings at depths of 8 to 16 feet from the surface, so sampling was concentrated in the top eight feet. A brief sensitivity analysis shows that a two-fold increase in the Ra226 activity for the top eight feet of tailings for radon modeling scenario #1 of the TRP increases exit radon flux from 6.6 $pCi/m^2/s$ to 12.4 $pCi/m^2/s$. If the two-fold increase in Ra226 activity is moved to the bottom 8.4 feet, the increase in exit radon flux is from 6.6 $pCi/m^2/s$ to 7.4 $pCi/m^2/s$. It is apparent that, unless there is a reason to believe that the Ra226 activity is much greater at depths of 8 to16 feet, the properties of tailings from the 0 to 8 feet depth has more impact on the radon flux.

The measured emanation coefficients for the tailings samples are generally lower than published values for tailings. A series of simulations were conducted with the default emanation coefficient of 0.35 to evaluate potential impacts if the measured emanation coefficients are anomalously small. These simulations used average cover moisture content for the cover material, and average radium activity for the tailings. The remainder of the parameters were the same as the original modeling. The exit flux for scenario #1 increases to 8.3 $pCi/m^2/s$ and the exit flux for scenario #2 increases to 30.3 $pCi/m^2/s$ with these revisions and the dramatic change in emanation coefficient. Neither of the simulations includes the interim cover that is in place over much of the tailings. The recent placement of interim cover over slime areas of Pond No. 5 has added a minimum of one foot of clay to the tailings. If this interim cover is included in the scenario #2 comparative modeling with a conservative interim cover moisture content of 15%, the exit flux of 30.3 $pCi/m^2/s$ is reduced to 19.9 $pCi/m^2/s$. With either situation, if the proportion of the tailings area where slimes are present near the surface (roughly 40%) is considered, the average radon exit flux is still well below 20 $pCi/m^2/s$ and ranges from 12.9 $pCi/m^2/s$ to 17.1 $pCi/m^2/s$. The radon flux from the chimney drain is not included in this evaluation because the average depth of cover over the cycloned tailings in the chimney drain will likely exceed ten feet.

The preceeding discussion indicates that there are sufficient conservatisms incorporated in the radon modeling to insure that radon flux at the surface will be limited

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to less than 20 pCi/m^2/s. Additional sampling on Pond No. 5 as discussed below will allow further evaluation of the proposed cover configuration, but at present, the planned cover configuration is considered more than adequate.

A minimum of eight radon flux measurements will be taken on the No. 5 Pond. These samples will be distributed over the entire pond area, but there will be some concentration of sampling within the former pool area of the pond. These samples will be taken on top of the interim cover, which is constructed from a material similar to that of the eventual radon barrier, but is not subject to the quality control or compaction of the final cover. These samples should be a much more reliable means of predicting the eventual radon emanation from the tailings area. A radon flux measurement integrates all of the tailings and cover material properties that affect radon flux, and avoids concerns about quantifying those properties.

Comment 3. Sampling locations.

Response: The OP- sample designation refers to ore pad test holes where only gamma logs were taken. The locations of these test holes are shown on Exhibit 2-2 of the TRP and the gamma logs are presented in Appendix A. Text on Page 2-5 incorrectly states that OP- hole locations are shown on Exhibit 1-1. This text is corrected in this submittal. The NS- designation refers to two surficial wells that were installed near the north end of Pond No. 5. The location of these two wells was inadvertantly left off of Exhibit 1-1, and this exhibit is replaced in this submittal. Only geophysical logs were taken for these two wells, and these logs are presented in Appendix A of the TRP.

Comment 4. Buildings.

Response: No buildings will be left within the restricted area.

Comment 8. Radon barrier parameters.

Response: The cover material sampling plan was intended to identify quantity and quality of the available material. The test hole drilling logs were used in identifying the location and quantity of suitable materials, and then samples from the drill holes were tested. Quality control criteria were developed and included in Section 11.2. Samples were excluded from computations for the clay radon barrier if: they did not meet the quality control criteria, they were taken from the north dump which is only considered an auxiliary source, or the analysis was not complete. As an example, none of the three CP samples meets the gradation criteria which requires that 83% of the barrier material pass a #200 sieve, while the Set samples are lacking Atterberg limits testing. The ND and NTH samples were not included because they were taken from the North Dump. The remaining samples represent a fairly uniform clay material present in large quantities in the south dump. If all of the samples that meet the QA/QC gradation and density criteria (with the exception of those which do not have an organic matter content) are included in the averaging, the resulting mean moisture content is 21.59% and the mean maximum dry density is 96.54 lb/ft^3. This dry density has declined slightly from 99.26 lb/ft^3 for the original sample set, while the mean predicted long-term moisture content has increased substantially from 18.74%. If these values are substituted into the radon modeling, the increase in moisture content will more than offset the slight decrease in density, and the radon flux will decrease substantially. As a result, the selection process for the original radon barrier sample set excluded superior barrier materials based on location or incomplete testing results, as well as excluding unsuitable material. If the excluded superior barrier material samples represent a large volume of clay in the borrow area, the clay radon barrier will be of better quality than that used in the modeling.

Comment 9. Mill and ore pad area cover thickness.

Response: The mill rubble was buried in trenches and then covered with a minimum of three feet of the spoil from the trenches. Characterization of the mill rubble as an average "source" is not feasible, but the equivalent Ra226 activity for the mill rubble and overlying cover is expected to be much lower than that for the scenario #1 radon modeling. Gamma logs for the ore pad test holes (Appendix A of the TRP) indicate varying predicted Ra226 activites ranging from less than 5 pCi/gm to approximately 160 pCi/gm with source layer thicknesses ranging from 0 to approximately 9 feet. The "worst-case" ore pad radon source situation appears to be hole OP-7 presented in Figure A.3-23 of the TRP with an average predicted Ra226 activity of 160 pCi/gm extending to a depth of approximately 2 feet. If this source layer is substituted in the scenario #1 modeling with the maximum measured emanation coefficient for ore materials on the low grade waste pile of 0.166, the resulting exit flux is 10.2 pCi/m^2/s. The reclamation design for the ore pad area is being revised to leave more of the ore pad in place with appropriate cover. Radon flux measurements for the mill and ore pad area will be conducted shortly, and the results will be incorporated into the TRP. In conjunction with the radon flux measurements, samples of the existing mill area cover will be analyzed for moisture content. Like those from the No. 5 Tailings Pond, these radon flux measurements are expected to be a much better measure of the eventual radon emanation from the tailings than predictions based on materials properties.

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Pathfinder Mines Corporation
Shirley Basin Mine
Clay Borrow Volume Estimates

In the process of developing the Tailings Reclamation Plan (TRP) for Pathfinder Mines Corporation's (PMC) Shirley Basin Mine, an investigation of potential clay sources for the radon/infiltration barrier was undertaken. Eleven test holes were drilled in the Area 3 South Dump (see Figure 1) which provided the necessary lithology and samples to estimate the available volume of suitable material. The test hole logs are presented in the TRP and the information is only summarized on cross-sections in this report. Seven cross-sections were developed and presented in Figure 1. These cross-sections were constructed by superimposing test hole lithology for up to four holes that fell roughly in a line. Surface elevations were estimated from topography when the holes were drilled, and the eventual reclamation surface at each hole was also estimated and is presented in Figure 1. Since the holes are used in more than one cross-section, there was no labeling of individual cross-sections to avoid confusion. Rather, the sequence of hole numbers is used to indicate the cross-section location.

Samples from the test holes were used to estimate properties of the suitable material. The specifications for the radon/infiltration barrier are presented in the TRP and were derived from sample properties. Materials that meet the specifications can be used for the radon/infiltration barrier, while reject materials may be used for general fill or for the sandy capillary barrier layer.

The volume of available material was estimated by determining the thickness of suitable material from the cross-sections, and then interpolating the thickness between test holes. A grid system was then developed over the planned borrow area and the thickness and area of each cell were used to determine the volume of clay in each cell. The sum of the volumes for the cells was approximately 1.5 Myd^3. This estimate was done in a conservative manner but is still slightly greater than the required volume as estimated in the TRP. If additional clay is required, the expansion of the borrow area would be southeast from hole STH-3. The log of hole STH-3 indicates that there is a substantial thickness of clay at that location, and extension of the borrow in this area should yield a large volume of clay with only minor adjustments in the post-reclamation configuration.

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REPLACEMENT AND ADDITIONAL PAGES AND EXHIBITS

The following table itemizes the enclosed revisions to the Shirley Basin Tailings Reclamation Plan and indicates the replacement pages for the document currently on file with the NRC.

Volume I Revisions

New Text/Exhibit	Replace(s)
Volume I Cover Page	Volume I Cover Page
Page 2-5	Page 2-5
Page 3-5	Page 3-5
Page 5-83	Page 5-83
Exhibit 1-1	Exhibit 1-1

The text is copied double-sided and, in many cases, the unmodified adjacent page is replaced along with the modified page to preserve the numbering sequence. The revision date for each page is located in the lower right hand corner of the page.

PATHFINDER
A Cogema Resources Company

May 29, 1997

Mr. Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety & Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Docket No. 40-6622
License No. SUA-442
Shirley Basin Mill

The following comments and modified text pages (five copies of each) to the Tailings Reclamation Plan and supplemental Soil Cleanup Verification and Sampling Plan are submitted in response to your letter dated May 12, 1997, concerning the Soil Cleanup Verification Plan and associated items. Other aspects of the May 12 letter will be addressed in subsequent submittals. Reference below to "supplemental text" means the text of the soil cleanup verification plan.

Radon Attenuation.

Comment 4: The plan does not mention whether or not buildings will remain on the site.

Response: No buildings (excluding temporary huts over wells) will remain within the restricted area after decommissioning. In the area of windblown tailings cleanup, decontamination will be done under such temporary buildings during the general cleanup.

Comment 5: The proposed soil background Ra-226 value is not substantiated.

Response: The original data set has been modified to reflect samples only taken from the upper 15 cm. to 20 cm. of soil and at locations that should be reflective of background as seen on undisturbed ground and in mine related areas beyond the general area of the proposed cleanup. Based upon this narrower data set it appears that a background value of 3.0 pCi/g Ra-226 is still appropriate. This site is very proximate to an area of mine disturbance encompassing in excess of 3,000 acres that bounds the restricted area on three sides. As a result it is very appropriate to consider Ra-226 levels in the soils of the mine area when one considers background for the mill/tailings site. One would expect a disproportionate number of elevated Ra-226 shallow soil sample sites relating exclusively to the mine. Informational copies of the three earlier reports that have been utilized in developing the revised data set are included with this submittal. See modified text pages 2-2 and 2-3.

Comment 6: The plan does not address other radionuclides that may require cleanup.

Response: This site maintained close control of source/byproduct material handling such that no problems with uranium or thorium are anticipated in the general cleanup area. Virtually all contamination directly relates to wind dispersed tailings, and the Ra-226 cleanup criterium should also insure the cleanup of other radionuclides of interest. There were no releases of solution that would result in elevated U-nat or Th-230 levels. However, PMC will randomly select twenty percent of the final verification samples for analysis of U and Th-230 to demonstrate adequate cleanup of those radionuclides. See modified supplemental text page 10 and revised procedure 03.022.

Comment 7: Inadequate Gamma Survey Information.

Response: See modified text page 2-4 which references the Soil Cleanup Verification and Sampling Plan.

Comment 10: Section 11.8 does not reflect the Cleanup Verification Plan.

Response: It does not appear that the reviewer had the most current Section 11.8 (dated 5/20/96) which refers to a planned appendix that provides details of the soils cleanup verification. See enclosed modified text page 11-7 which formally incorporates the cleanup plan.

Soil Cleanup Verification and Sampling Plan.

Comment 1: PMC should indicate which document contains the background soil Ra-226 data.

Response: The background soil Ra-226 data is presented in the Reclamation Plan and is further addressed in Comment 5 under Radon Attenuation in this submittal. See modified supplemental text page 1.

Comment 2: PMC should confirm that the height of the detector that is mounted on the four-wheel drive vehicle is 18 inches, the same as the hand-held Ludlum 44-10.

Response: The detectors are mounted at a height of 18 inches above the ground surface on the four-wheel drive vehicle which is the same height as that used for the hand held correlation studies. See modified supplemental text page 5.

Comment 3: PMC should explain how the second study - meter at "normal height" and 36 inch diameter area sampled (page 3), relates to demonstrating that the average Ra-226 value in 100 m^2 area meets the standard.

Response: The study at specific points was done in uniformly contaminated and highly characterized areas. This was done in order to provide additional data to support our action levels. The point measurement locations were selected using the following criteria: a) the point measurement location must be in an area that has uniform count rates and therefore must not be affected by shine from nearby highly contaminated areas, b) the detector readings at the points must be in the anticipated range of interest. Since the soils directly beneath the detector have the primary influence on detector, the soil within the 36-inch diameter circle beneath the detector was carefully characterized by taking five samples from this circular area. The correlation was then done between the detector reading and the soil concentration.

In some ways this method of arriving at an action level more properly reflects what one expects upon final cleanup of a windblown tailings contaminated area. First, grid blocks sampled after the cleanup will normally be free of hot spots (uniformly contaminated or at background levels). Therefore by taking more samples near the detector in a uniformly contaminated area during the study, the sampling error has been minimized and the Ra-226 concentration is known very accurately. Also, the count rate can be determined very accurately by integrating the count over one minute or more. For exposure rate meters, the average exposure rate could be determined by watching the meter for a period of time or by writing down several measurements and taking the average. It might be argued that the point measurement study is the benchmark to which all other studies should be compared.

In the study of the entire 100 m^2 plots, the individual plots were not uniformly contaminated. This leads to concerns about sampling errors (and thus erroneous Ra-226 concentrations) and determining the average count rate or exposure rate. In some sense, this may represent the worst case situation after cleanup (rather than the norm). If this is the case, an action level determined from such a study should be highly conservative and apply to all situations within the windblown area with greater than a 95 percent confidence level.

As can be seen from the study results, both methods predicted essentially the same action level. This provides a high level of confidence that the action level has been accurately determined at the 95 percent confidence level.

Comment 4: PMC (page 6) considers two of the Ra-226 QA values determined by ELI (vendor lab) as outliers because they don't agree with other data trends.

a. PMC should indicate how future QA data will be discarded and why they have confidence in the vendor lab's QA/QC program.

b. PMC should have another lab analyze the two questionable samples.

c. PMC should insure that the soil sample mixing procedure is adequately implemented.

d. PMC should indicate what degree of agreement with the QA Ra-226 data is required to consider the gamma spectrometer data valid.

Response: PMC consulted with the vendor laboratory and believes that their sample aliquoting procedure was the cause for the different values for the two samples. Because of the large discrepancy between the results for these two samples, it is highly probable that the major contribution to the difference arises from an aliquoting error. Therefore an analysis by another laboratory would not be revealing. PMC believes that the problem has been resolved and has focused on establishing a very intensive QC check program for the verification samples as described below.

For future analyses, the vendor laboratory has agreed to process the entire sample before taking an aliquot for radiochemical analysis. PMC proposes to use the more costly radiochemical analysis method as the primary verification method (rather than the gamma spectral analysis as stated in PMC's April 3, 1997 Soil Cleanup Verification and Sampling Plan, Procedure 03.022.01) since good agreement with the field gamma spectrometry laboratory and samples sent to ORISE has been demonstrated. As a check on the primary vendor lab's QA/QC program, PMC will split all verification samples and submit twenty percent of the samples to another vendor laboratory for Ra-226 analysis as QC samples. PMC is not aware of any other cleanup program that submits twenty percent of the verification samples to a second vendor laboratory for analysis as a QC check on the primary vendor laboratory. This, along with the results from the on-site laboratory for each sample, should provide assurance that the laboratory results are accurate. SOP No. 03.022.01 has been revised to incorporate these changes and is enclosed.

The results from the two vendor laboratories will be evaluated by assuring that the error bars overlap at the three standard deviation level for all samples having measured Ra-226 concentrations greater than 1 pCi/g. That is, if the sample results for laboratories A and B are reported as $C_A \pm 3\sigma_A$ and $C_B \pm 3\sigma_B$, where σ is the standard deviation, PMC will conduct an investigation if the following condition is not met: $|C_A - C_B| \leq |3\sigma_A + 3\sigma_B|$. The investigation may include having one or both laboratories repeat their analyses. The reason for not including results for less than 1 pCi/g is that agreement at these very low levels is normally not a good indicator of laboratory quality and the above test almost always is met because of the large relative errors.

PMC and its on-site contractor have instituted a technician qualification program to assure that proper sampling and sample preparation procedures are followed.

Comment 5: Page 7 states that PMC will decide on the gamma survey method. PMC should indicate if the hand held Ludlum Model 19 data, using verification procedures, is as accurate and precise as the GPS-detector system.

Response: The Model 19 data is not as precise as the GPS-detector system. The primary reason for including this instrument in the study was to determine whether it was appropriate for use in excavation control activities. The Model 19 will not be used for verification measurements. See modified supplemental text page 8.

Comment 6: PMC proposes (page 9) to soil sample the 3 grids with the highest gamma level out of each 232 grids (1.3 %). This approach has been approved by NRC for other sites that used the GPS-gamma recording system. PMC should clarify what pattern the technician walks within the grid when using the hand-held instrument and justify that the one minute scan per grid detects sizable hot spots (adequate meter/operator response time).

Response: The GPS data is obtained by walking or driving parallel lines covering large areas with the position and count rate recorded and downloaded into a computer. The grid blocks are established within the GIS software. The traverse distance must be sufficient to obtain the minimum number of data values per grid block. In order to avoid repeating the survey, the traverse distance and speed are adjusted so that the data are uniformly spread across the grid blocks and that there are ample data points so that failure to meet the five (or seven in some cases) data points per grid block is very improbable. Normally, more than twelve data records per grid block are posted on the data maps.

To date, the one-minute integrated count method has not been used for verification. While demonstrated in this study to be equivalent to the GPS-recorded data, it will be used only if a few grids require verification and the GPS-recording system is not available. In that case, PMC will train the technician to scan the entire area looking for hot spots and remove the hot spots prior to making the measurements or taking the samples. In addition, gamma count rates will be recorded using the Ludlum Model 44-10 detectors at each of the sampling locations to document that the area has a uniform count rate.

Comment 7: Page 9 states that for windblown areas, a minimum of 5 data records have been shown to be sufficient. PMC should reference this demonstration and indicate if this statement is true for the Ludlum Model 19.

Response: PMC's on-site contractor, Environmental Restoration Group (ERG), applied this technique to another mill site (Homestake Mining Company, Grants Uranium Mill) where more than 1,000 acres were remediated using similar criteria. This criterion is being applied at PMC's Lucky Mc Mill site which is in the final stages of verification. This statement does not apply to the Model 19. Also see responses to Comments 5 and 6.

Comment 8: PMC should indicate if the data will be determined to be normally distributed before the "student t" test (page 10) is used.

Response: PMC will determine if the data are normally distributed. See modified supplemental text page 10.

Comment 9: PMC should indicate what subsurface soil sampling will be done besides the 3 feet or deeper areas mentioned in procedure 03.022.01.

Response: The reference to three feet in the procedure was a depth at which back filling would normally be done. Where back fill will be applied, the 15 pCi/g plus background Ra-226 concentration limit will be applied. This procedure was written for application to these irregularly shaped excavations. Unless there is reason to suspect that there have been man-made disturbances in an area, there are no plans to sample below the top six-inch layer. It has been our experience (e. g. ground-water cleanup piping trenches at the Lucky Mc Mill Site) that it is quite evident from examining the gamma contour maps where disturbances have resulted in contaminating subsurface soils.

Comment 10: Procedure 03.020.01 (page 3) indicates a minimum of 7 gamma records MAY be required near the mill site or other areas where localized "hot" spots may be present. PMC should consider revising this to WILL be required.

Response: This change has been incorporated into the enclosed revised procedure.

Comment 11: Procedure 03.020.01 indicates action levels for shielded detectors that do not agree with values on page 5 of the plan. PMC should provide a page correction for the procedure.

Response: See the enclosed revised procedure 03.020.01.

Comment 12: PMC should address reporting requirements. For example, Ra-226 data should include the counting error at the 95 percent confidence level and the minimum detectable concentration should be reported for the gamma spectrometer. Also, any grids requiring further cleanup based on soil sampling, should be reported for inclusion in the Completion Report.

Response: PMC will provide this in the Completion Report.

Comment 13: PMC should address the delineation of and surveying of the unaffected area. The discussion should mention any off-pile disposal, releases, wind rose, haul routes, and prior survey results.

Response: The boundaries of the contaminated areas that were cleaned will be shown on the final gamma survey maps included in the Completion Report. Gamma data will be provided beyond the cleaned areas for a minimum distance of 250 feet. Where appropriate, other supporting data will be provided to demonstrate that the affected area has been delineated. Other site features such as haul routes, off-pile disposal areas, and structures will be addressed in the Completion Report.

Comment 14: PMC performed the gamma-Ra-226 correlation with a 9 sample soil composite, but the verification procedure indicates a 5-sample composite. PMC should indicate why the correlation derived gamma action level is appropriate to apply to the verification procedure.

Response: The correlation studies were conducted in the windblown areas of the Shirley Basin site after removing a very thin vegetation layer. The reason for the removal of the vegetation layer was to provide a more homogeneous contaminant distribution, representing more closely the conditions of the final radiological survey. This study had one source of error that had to be considered. The scraped areas were 100 m^2 in size and normally were not uniformly contaminated. This leads to a relatively large sampling error. The condition that is expected to exist after cleanup is that each grid block will be at background or have uniformly distributed residual contamination. Sampling such a grid block can be done with a very small sampling error, regardless of the number of samples obtained. PMC therefore wanted to design the experiment such that the sampling error for the study was approximately the same as the sampling error anticipated in the final verification surveys. We compensated for the heterogeneity of the study plots by increasing the number of samples to nine rather than five, thus reducing the sampling error in the study. It is believed, however, that the sampling error associated with the studies will still be larger than the sampling error during the verification sampling. This is acceptable in that it leads to a conservatively derived action level.

We should note that the uniformity of the contamination in the areas that have been cleaned will be assured by examining the gamma data at levels near the action level. Indicated hot spots above the action level will be removed.

Comment 15: Given the low coefficients of correlation and the low Ra-226 values used in the gamma-Ra-226 correlation, PMC should indicate what checks on the correlation will be performed during verification.

Response: PMC believes that these studies were well designed and executed. The results reflect the normal errors one would anticipate, considering all the known influences. The study conditions were carefully designed to approximate those anticipated after cleanup . The action levels were obtained from the calculated 95 percent CL line and therefore considers the data scatter and lack of a perfect correlation. The results of all studies were internally consistent where expected, providing additional confidence that the study design was proper and the results valid.

While the average Ra-226 concentration for the plots was below the cleanup limit, the 95 percent CL action level determined from extrapolation agreed with that determined from the "point studies" which did have Ra-226 concentrations above the cleanup limit.

During cleanup, PMC expects that there will be very few grid blocks at or above the action levels. However, PMC will continue to evaluate the action levels based on the correlation with the results from the on-site gamma spectrometer. PMC recognizes that it is cost effective to reduce the action level early in the cleanup, if necessary, rather than run the risk of failure of the verification samples.

We hope that the above responses will lead to a quick approval of the Soil Cleanup Verification and Sampling Plan for the Shirley Basin mill site. In order to meet the license mandated schedule for completion of the windblown tailings retrieval we must begin actual cleanup activities next month. Pathfinder is particularly concerned about the potential for entering into an extended debate with the NRC about an appropriate background Ra-226 value. We are convinced that the suggested 3.0 pCi/g is reasonable and defendable. ERG will begin the initial gamma survey of the site on June 2, 1997. Please call me if there are any questions.

Sincerely,

Tom Hardgrove

T. W. Hardgrove
Coordinator of Mine Environmental Affairs

Enclosures

cc: E. L. Nugent
J. D. Wadsworth
R. W. Poyser
K. R. Baker, ERG
P. Mackin, CNWRA

PATHFINDER

A Cogema Resources Company

November 20, 1996

Mr. Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Re: Docket No. 40-6622
License No. SUA-442

Dear Mr. Holonich:

Enclosed please find five copies of an evaluation of the static and seismic slope stability and liquefaction potential of the previously submitted Shirley Basin Tailings Reclamation Plan. Accompanying the evaluation are revised reclamation plan text sheets for pages 6-3 through 6-5 and Section 9.0 which reference the evaluation. The seismic analysis represents one of the specified additional submittals to which you referred in your letter dated June 14, 1996. The soils cleanup protocol is currently under development and will be submitted in the near future.

We look forward to the receipt of NRC's review comments on the enclosed materials.

Sincerely,

Tom Hardgrove

T. W. Hardgrove
Coordinator of Mine Environmental Affairs

Enclosures
cc: E. L. Nugent
J. D. Wadsworth
R. W. Poyser
Hydro-Engineering
Inberg-Miller Engineers w/o encl.

Pathfinder Mines Corporation • 935 Pendell Boulevard • P.O. Box 730 • Mills, Wyoming 82644
Tel: (307) 234-5019 Fax: (307) 473-7306

PATHFINDER
A Cogema Resources Company

May 22, 1996

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Re: Docket No. 40-6622
License No. SUA-442

Dear Mr. Holonich:

Enclosed please find five sets of a revision to Pathfinder's Shirley Basin Tailings Reclamation Plan. This revision reflects changes that are appropriate in light of the NRC's approval of Pathfinder's Lucky Mc Mine Tailings Reclamation Plan, particularly as it applies to cover design and erosion protection. The Shirley Basin plan was modified so that the design methods are consistent between the two sites. This should facilitate the review and approval of the Shirley Basin plan. The concept of making the two plans consistent was previously discussed with Ted Johnson of your staff.

The identification and cleanup protocol for contaminated soils will be the subject of additional field investigation at Shirley Basin during the summer of 1996. A proposal on contaminated soils cleanup will be submitted to the NRC later this year. Additionally, a consultant is presently evaluating the seismic stability of the reclamation plan, and a submittal on that subject will be made upon completion of the evaluation.

Refer to the enclosed replacement directions sheet for the proper integration of the revisions into the previously submitted plan. Pathfinder is ready to aid the NRC staff in whatever way we can to facilitate its review of the enclosed plan.

Sincerely,

Tom Hardgrove

T. W. Hardgrove
Coordinator of Mine Environmental Affairs

Enclosures
cc: E. L. Nugent
J. D. Wadsworth
R. W. Poyser
Hydro-Engineering

Pathfinder Mines Corporation • 935 Pendell Boulevard • P.O. Box 730 • Mills, Wyoming 82644
Tel: (307) 234-5019 Fax: (307) 234-5321

REPLACEMENT AND ADDITIONAL PAGES AND EXHIBITS

The following table itemizes the enclosed revisions to the Shirley Basin Tailings Reclamation Plan and indicates the replacement pages for the document currently on file with the NRC.

Volume I Revisions

New Text/Exhibit	Replace(s)
Volume I Cover Page	Volume I Cover Page
Volume I Table of Contents	Volume I Table of Contents
Pages 1-1 through 1-4	Pages 1-1 through 1-4
Exhibit 1-1	Exhibit 1-1
Exhibit 1-2	Exhibit 1-2
Pages 2-1 through 2-8	Pages 2-1 through 2-8
Pages 4-1 through 4-4	Pages 4-1 through 4-4
Entire Section 5 incl. Figures, Tables and Exhibits	Entire Section 5 incl. Figures, Tables and Exhibits
Pages 6-1 through 6-6	Pages 6-1 through 6-6
Pages 8-1 and 8-2	Pages 8-1 and 8-2
Pages 9-1 through 9-4	Pages 9-1 through 9-4
Entire Appendix E	Entire Appendix E
New Appendix F	

Volume II Revisions

New Text/Exhibit	Replace(s)
Volume II Cover Page	Volume II Cover Page
Volume II Table of Contents	Volume II Table of Contents
Pages 10-1 through 10-4	Pages 10-1 through 10-4
Pages 10-13 through 10-26	Pages 10-13 through 10-26
New Figure 10-6 (page 10-27)	
New Figure 10-7 (page 10-28)	
Exhibits 10-1 through 10-7	Exhibits 10-1 through 10-7
New Exhibit 10-8	
Pages 11-1 through 11-7	Pages 11-1 through 11-7
New Figure 11-1 (page 11-8)	

The text is copied double-sided and, in many cases, the unmodified adjacent page is replaced along with the modified page to preserve the numbering sequence. The revision date for each page is located in the lower right hand corner of the page.

5/22/96

SHIRLEY BASIN MINE
TAILINGS RECLAMATION PLAN

SOURCE MATERIAL LICENSE NO. SUA-442

VOLUME I

SUBMITTED TO:

U.S. NUCLEAR REGULATORY COMMISSION
OCTOBER, 1993

REVISED:
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NOVEMBER 20, 1996
MAY 29, 1997
SEPTEMBER 10, 1997
NOVEMBER 24, 1997
SEPTEMBER 8, 1999

PREPARED FOR:

PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE
SHIRLEY BASIN, WYOMING

PREPARED BY:

HYDRO-ENGINEERING

Professional Engineer (Civil)
Thomas G. Michel
8335
WYOMING

GEORGE L. HOFFMAN
HYDROLOGIST

THOMAS G. MICHEL, Ph.D.
ENGINEER/HYDROLOGIST

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1.0 INTRODUCTION

This reclamation plan has been developed with respect to the requirements in 10 CFR 40, Appendix A. Guidelines from the Nuclear Regulatory Commission (NRC) have also been used in the preparation of the reclamation plan. This plan covers the reclamation of Pathfinder Mines Corporation's Shirley Basin mill area, tailings facilities, and solution pond. Volume II, which contains Sections 10, 11 and 12, represents complete construction specifications for the project.

1.1 Description of Mill and Tailings Disposal Sites

Exhibit 1-1 shows the location of Pathfinder's Shirley Basin mill and tailings sites. The tailings area is directly in the center of the map, with solution pond No. 3, Tailings Pond No. 4, and Tailings Pond No. 5 distinguished by a heavy line around each of these three areas. Solution Pond No. 3 is in the southwest portion of the tailings and is the site presently being used for byproduct material disposal. Tailings Pond No. 5 is the eastern most pond and Tailings Pond No. 4 is between Ponds 3 and 5. The mill area is adjacent to and just southwest of the Tailings No. 4 and No. 5. Decontamination and decommissioning of the mill is described in the mill decommissioning plan submitted to the NRC in June, 1992. The No. 3 pond basin has been used to contain only tailings solution, but this pond, as well as portions of pond basin 4, will be used for byproduct material disposal and will continue to be used as such until closure of the site. At that time, the byproduct material disposal area will be covered and included in the covered tailings area. Tailings thicknesses in Ponds 4 and 5 range up to 54 ft. The mill area to be reclaimed with cover material includes approximately 13.7 acres, and post-reclamation tailings piles No. 4 and 5 cover 110.7 and 149.5 acres, respectively. Approximately 14.1 acres of No. 3 Pond will be included in the tailings encapsulation system. All other areas will be restored to the radium cleanup standard. The proposed restricted area boundary is shown on Exhibit 1-1 relative to the cleanup areas.

The mill area includes an ore pad immediately south of the mill. The ore pad was mined prior to cessation of ore processing. any residual contaminated material in the ore pad area will be excavated and placed in the tailings during reclamation activities. The mill ore pad is approximately 600 feet wide and 900 feet from northwest to southeast. A low-grade waste pile, which has some contaminated materials in it, is located immediately to the west of Solution Pond No. 3. This material will also be placed in the tailings pond. The windblown area is to the northeast of the No. 5 tailings. An area of cleanup exists between the mill and the Area 2/8 pit. The majority of this area has been affected by the haulage of the ore from the pit to the mill.

Uranium milling started at this site in 1971 and continued until the last ore was processed in 1992. A total of some 8,564,130 tons of ore were milled at the Pathfinder Shirley Basin site. The mill utilized conventional acid leaching process. Exhibit 1-1 also shows the restricted area boundary associated with the facility.

1.2 Summary and Reclamation Plan Objectives

The objectives of the reclamation plan are to develop a reclamation scheme that will stabilize the tailings for at least 1000 years, and restore the mill and tailings pond area to 10 CFR Part 40, Appendix A standards. This plan also involves the restoration of areas which have been contaminated by windblown tailings or activities associated with processing of ore. Those areas which will be reclaimed to meet 10 CFR Part 40, Appendix A protection standards are presented on Exhibit 1-2. The restoration areas are delineated by approximate boundaries. Ground survey control during construction will be used to precisely identify contaminated areas. The cross hatched area will be covered to meet the reclamation goals while the dotted area will be cleaned up to meet the release standards. The areas shown with pluses will be cleaned up with the mine reclamation.

The reclamation plan objectives will be met in the mill area by covering materials with elevated radioactivity. Mill rubble will be buried in trenches and covered with general fill or possibly low grade ore overlain by the tailings radon/infiltration barrier cover system. The ore pad will be excavated to reduce radioactivity to 8 pCi/g. The excavated materials will be placed in tailings. The low grade waste pile will be placed in tailings and that site reclaimed to 8 pCi/g.

The depth of tailings materials in the western portion of Tailings Pond No. 4 is expected to be relatively small. Those materials will be excavated and placed in other portions of Tailings Pond No. 4 or in Tailings Pond No. 5. Pond No. 3 will also be restored in the same manner with the byproduct disposal area being covered to meet the reclamation goals.

The reclamation plan for the solid tailings area utilizes present topography as much as practicable and add necessary cover materials of compacted clay, topsoil and/or rock mulch to produce an erosionally stable surface. The drainage design is intended to limit contributing areas to the tailings and to limit the size of individual drainage basins. This will minimize overland and channel flows. Portions of Tailings Pile No. 4 and Tailings Pile No. 5 with very flat slopes will be reclaimed without rock mulch cover. More than one-half of the No. 4 tailings pile will be rock mulched to maintain the stability of the cover. A larger portion of the No. 5 tailings area will be covered with rock mulch. The dam outslope areas for the No. 3 and No. 5 dams will be reduced to a maximum of 5H:1V and covered with rock mulch to protect the slopes. Rock riprap will be used to stabilize all channel sections in the immediate area of the tailings and on steep channel sections in surrounding areas. Controlled discharge rock channel sections will be used the outlet from the No. 3 Solution Pond, and the north outlet from the No. 5 Tailings Pond. These structures will reduce downstream flows during peak flow periods and enhance erosional stability of the area. Drainage from areas north and south of the tailings is diverted away from the tailings, with incorporation of surge pond storage to enhance erosional stability.

An area of windblown contamination exists to the east and northeast of the No. 5 tailings. This material will be excavated and placed in one of the tailings piles.

(Revised 05/20/96)
(Revised 09/08/99)

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

"EXHIBIT 1-2, RECLAMATION AREAS FOR THE SHIRLEY BASIN MILL AND TAILINGS, EXH1-2.DWG"

WITHIN THIS PACKAGE... OR BY SEARCHING USING THE

D-02

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

"EXHIBIT 1-1, LOCATION MAP OF THE SHIRLEY BASIN MILL AND TAILINGS WITH SAMPLING SITES, EXH1-1.DWG"

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D-03

2.0 RADIOLOGICAL SURVEY

In order to estimate average background radiological activity in the vicinity of the mill, tailings disposal and solution pond areas, and to define areal extent of elevated radioactivity, a radiological survey was undertaken. Included in this effort were a surface gamma survey, a test-hole drilling and logging program and a backhoe (test) trenching and radiometric testing program. Tailings samples were collected with Shelby tubes advanced with a drill rig. Bagged samples were collected from test holes and backhoe pits during the course of these programs for laboratory analysis.

Exhibit 1-1 is a map of the restricted area showing locations of test holes, test pits and other soil and tailings sample sites. The following naming sequence was used to distinguish sample types:

Prefix TW- indicates a tailings well drill site. Two wells were completed at most locations with the drill holes approximately 20' apart.

Prefix STH- indicates an Area 3 south dump test hole for cover material analysis.

Prefix NTH- indicates an Area 3 north dump test hole for cover material analysis.

Prefix NS- indicates a surficial well drill site on the north side of the No. 5 tailings.

Prefix P- indicates a backhoe test pit.

Prefix LGW- indicates a low grade waste pile test hole.

Prefix BP- indicates a below pond tailings sample.

Prefix TS- indicates a topsoil sample.

Prefix BGS- indicates a background gamma and radium sample.

Prefix GS- indicates a surface gamma and radium sample.

Prefix O- indicates a low grade waste pile backhoe pit.

Prefix OP- indicates an ore pad test hole.

Suffix R indicates an air quality sampling location.

Two hand-held gamma meters were used during the course of this study. Both instruments measure in microrems per hour (μR/hr). Instrument #1, as indicated in Table 2-1, was used for the test pit gamma survey and instrument #2 was used for all remaining gamma surveys. Prior to the beginning of this study, instrument #2 was calibrated by Romaelab.

2.1 Background Radiological Analysis

A background Ra-226 activity is needed to allow differentiation of naturally occurring radiological activity and that resulting from uranium milling activities. In order to determine the background activity, a sampling program was undertaken and past radiological studies were reviewed. The sample results are summarized below (see Exhibit 1-1 for sample site locations). Samples designated "R" were collected routinely in fulfillment of the environmental monitoring program. Location 07R is at the Heward Ranch some three miles east of the mill site.

LOCATION	RA-226 (pCi/g)	LOCATION	RA-226 (pCi/g)
BGS-1	0.32	From Skinner 1982:	
BGS-2	0.35	BG (<2.0 mm)	3.0
BGS-3	0.43	D_4 (<2.0 mm)	3.0
BGS-4	0.48	D_5 (<2.0 mm)	2.0
04R (1992)	1.6		
07R (1992)	1.7	From Whicker 1981 and 1982:	
04R (1993)	4.4	Background	2.54
07R (1993)	2.2	Sample #1	3.1
04R (1994)	2.0	Sample #42	3.84
07R (1994)	1.8	Sample #45	2.29
04R (1995)	2.0	Sample #4	10.65
07R (1995)	2.1	Sample #24	21.83
04R (1996)	2.2	Reclamation Area (S_r)	9.73
07R (1996)	1.8		

[See Exhibit 2-1 for location]

Overall Average for the Above Data = 3.56 pCi/g Ra-226.

In addition to the results on the left of the above table, the results of two previous studies are summarized on the right. Skinner (1982) presents a background Ra-226 activity of 3 pCi/g for the Shirley Basin site. Whicker (1981) presents a background soil Ra-226 activity from 2.29 to 3.84 pCi/g (samples "Background" and numbers 1, 42, and 45). The samples from mine reclamation areas as reported in Whicker (1981 and 1982) are represented by sample numbers 4, 24, and S_r. The overall average of the three sets of data is representative of a significant amount of sampling of background conditions at this site. As one might expect at a mill site located very close to an uranium mine, there is a great deal of variability in soil Ra-226 levels. Due to the proximity of the mine it is appropriate to factor the Ra-226 content of mine soils into the determination of background. The average of the three sets of data is 3.56 pCi/g. The radiological analyses support a background Ra-226 activity of 3 pCi/g. Therefore, the proposed release standard is background activity (3 pCi/g) plus 5, or 8 pCi/g.

2.2 Surface Gamma Survey

Hand-held gamma instruments were used to conduct a preliminary gamma survey for the mill, tailings disposal and solution pond areas. A series of transects were established between points of known location. Gamma measurements were taken at 100-foot intervals along each transect. Additional measurements were taken at points of interest such as high readings. Exhibit 2-1 presents the surface gamma data measured for the Shirley Basin site.

Samples of surface soil were collected in conjunction with the surface gamma survey. These samples were analyzed for Ra-226 activity. A correlation and regression analysis was done to relate laboratory Ra-226 activity, in pCi/g, to field hand-held gamma activity, in microrems per hour (μR/hr). This relationship was developed to enable estimation of the areal extent of contamination and provide initial guidance for determining areas to be reclaimed. Actual reclamation extent will be confirmed based on analyses made during reclamation. Figure 2-1 shows a plot of field gamma versus lab Ra-226 with a line of best fit. For this particular fit, the largest gamma and radium value was eliminated as a high leverage point. Elimination of this point moved the intercept at gamma = 0 from 7.96 to -0.104 pCi/g, which gave a much better relationship for values of gamma less than 50 μR/hr, which is the area of interest for windblown cleanup. The correlation coefficient for this relationship is 0.92, and the standard error of estimate is 16.6 pCi/g. Based on this relationship, the reclamation criterion Ra-226 activity of 8.0 pCi/g corresponds to a hand-held gamma meter value of 19.5 μR/hr. Exhibit 2-1 presents the surface gamma readings collected at this site with the 20 μR/hr contour. Note that this was a preliminary evaluation. A more detailed evaluation of the gamma/Ra-226 relationship at the site was conducted during September of 1996. The results of that evaluation are found in the supplemental "Soil Cleanup Verification and Sampling Plan for the Shirley Basin Mill Tailings Site", April, 1997. That document provides the guidance for the cleanup of contaminated soils at the Shirley Basin site.

2.2.1 Mill Area

Exhibit 2-1 presents gamma values in the mill area. The Ra-226 activity reclamation criterion is 8.0 pCi/g.

The ore pad drilling program was undertaken to determine the depth of contaminated material. Sixteen holes were drilled throughout the ore pad area to a depth of 22 feet, and gamma logs were taken for each hole. The location of ore pad test holes is presented in Exhibit 2-2. Gamma logs and predicted radium activity are presented in Appendix A. The gamma logs indicate depth of elevated radioactivity ranges from a few inches to approximately 8 feet. This material will be excavated until the radium level reaches 8 pCi/g and placed in tailings. The area near the mill (see Exhibit 2-1) will be reclaimed as part of the tailings area, therefore no gamma survey was done.

The gamma survey indicated the area west of the mill and south of the tailings ponds is contaminated in some regions. The expected depth of contamination is small and this area is proposed for cleanup. Contamination of windblown tailings in the area west of the mill is expected to be very thin because the prevailing winds are from the southwest. Mine haulage through this area had the greatest potential for contamination of the area. Cleanup within the restricted boundary will be treated as part of the tailings reclamation while cleanup south of the restricted boundary will be part of the mine reclamation. The windblown area west of the solution pond will be reclaimed to the edge of the Area 2/8 pit limit as part of the tailings reclamation, while the area below the pit crest will be part of the mine reclamation. The low grade ore pile located between the tailings and the Area 2/8 pit will be excavated and placed in tailings.

2.2.2 Windblown Tailings

Surface gamma readings from the area surrounding the edge of the tailings are presented on Exhibit 2-1. The windblown areas appear to be east and north of the No. 5 tailings area. Gamma values in this area are generally less than 16 μR/hr. Exhibit 1-2 presents the preliminary limits of the area contaminated with windblown tailings which require restoration to the 8.0 pCi/g standard of radium. The estimated average cleanup depth of the windblown areas is 2 inches, but the limitations of machinery used to remove this material will likely necessitate removal of a slightly greater thickness.

2.3 Test Holes

Fifteen test holes were completed in tailings on Ponds 4 and 5, three were completed adjacent to the tailings, sixteen were completed in the ore pad area, five were completed in the low-grade waste pile and the rest were advanced in the nearby overburden piles (North and South dumps). Exhibits 1-1 and 2-2 show the locations of all 59 holes.

Samples of drill cuttings were collected at 5-ft intervals for tailings and some of the cover materials, and Shelby tube samples were taken in the tailings ponds test holes.

Table 2-1 presents a summary of all radiological analyses for test-hole samples. Corresponding values of downhole gamma are also presented on Table 2-1. Copies of laboratory reports are included in Appendix D. Appendix A contains lithologic logs, geophysical logs and downhole profiles of estimated Ra-226 activities.

A correlation and regression analysis was made relating downhole gamma measurements, in counts per second (cps), to laboratory measured Ra-226 activity (pCi/g). This analysis was done to provide guidance for reclamation planning purposes on the vertical extent of contamination. Figure 2-2 is a plot of Ra-226 versus gamma with two lines of best fit. The relationship for gamma values less than 560 cps was determined with a zero intercept linear regression, and the relationship for gamma exceeding 560 cps was determined with a standard linear regression. Based on these relationships, a gamma reading of approximately 565 cps corresponds to the restoration standard for Ra-226 of 8.0 pCi/g.

2.4 Test Pits

Forty-seven backhoe pits were dug in the mill and tailings area to determine the location and depth of tailings or contaminated material (see Exhibit 1-1 for locations). Typically, pits were dug to a depth of 5 to 7 feet. Hand-held gamma readings were taken at 0.5' and 1' intervals and some bagged samples were collected. Twenty-four of the backhoe pit bagged samples were sent to the laboratory where they were analyzed for radium (Ra-226) activity. Table 2-1 presents a summary of laboratory results for the backhoe pit samples. Copies of the laboratory radiological reports are included in Appendix D and the backhoe pit gamma profiles are presented Appendix B.

A correlation of radium-226 and the hand-held gamma readings from the backhoe pits was attempted. However, the smearing effect of gamma values on the exposed pit face made such an analysis meaningless. The gamma values and corresponding radium-226 values are presented in Figure 2-3 and it is apparent that readings for a specific layer are biased by the activities in adjacent layers. With this in mind, the gamma profiles were used qualitatively as an indication of the presence of tailings and the depth of tailings. For example, Pit P4-11A indicates the presence of tailings to a depth of at least 3' with a transition to background gamma between 3' and 5' in depth. This particular area will be progressively excavated until the tailings are removed as indicated by final radium-226 sampling. At other locations, the tailings depth was too great to allow cost effective removal, and these were included within the covered tailings area.

The backhoe pits served to identify areas where the depth of tailings or depth of contamination is limited. In particular, the gamma profiles from the test pits indicate that there is only a small thickness of contaminated material in the No. 3 solution pond and on the west side of Tailings Pond 4. Contaminated soils in these areas will be excavated to meet the radium standard. The area reclaimed in this manner will not be included in the covered tailings area which is subject to the radon barrier standard. The limit of subsoil contamination from the pits below the ponded surface of Pond No. 4 on the west side is unknown at this juncture because the tailings solution prevents access to areas below the water line. Therefore, the restoration area shown in Exhibit 1-2 will be modified as necessary to ensure restoration to the appropriate standard.

2.5 BELOW POND SAMPLING

A program to sample the tailings that are presently covered by ponded water was conducted. Twelve samples were taken from a boat with a tube sampling device. The pond sampling locations (BP-) shown on Exhibit 1-1 are approximate due to the nature of the sampling technique. The samples indicate Ra-226 activities for the material near the base of the ponds ranges from 34.6 to 737 pCi/g. The results of this sampling program are discussed in section 4.

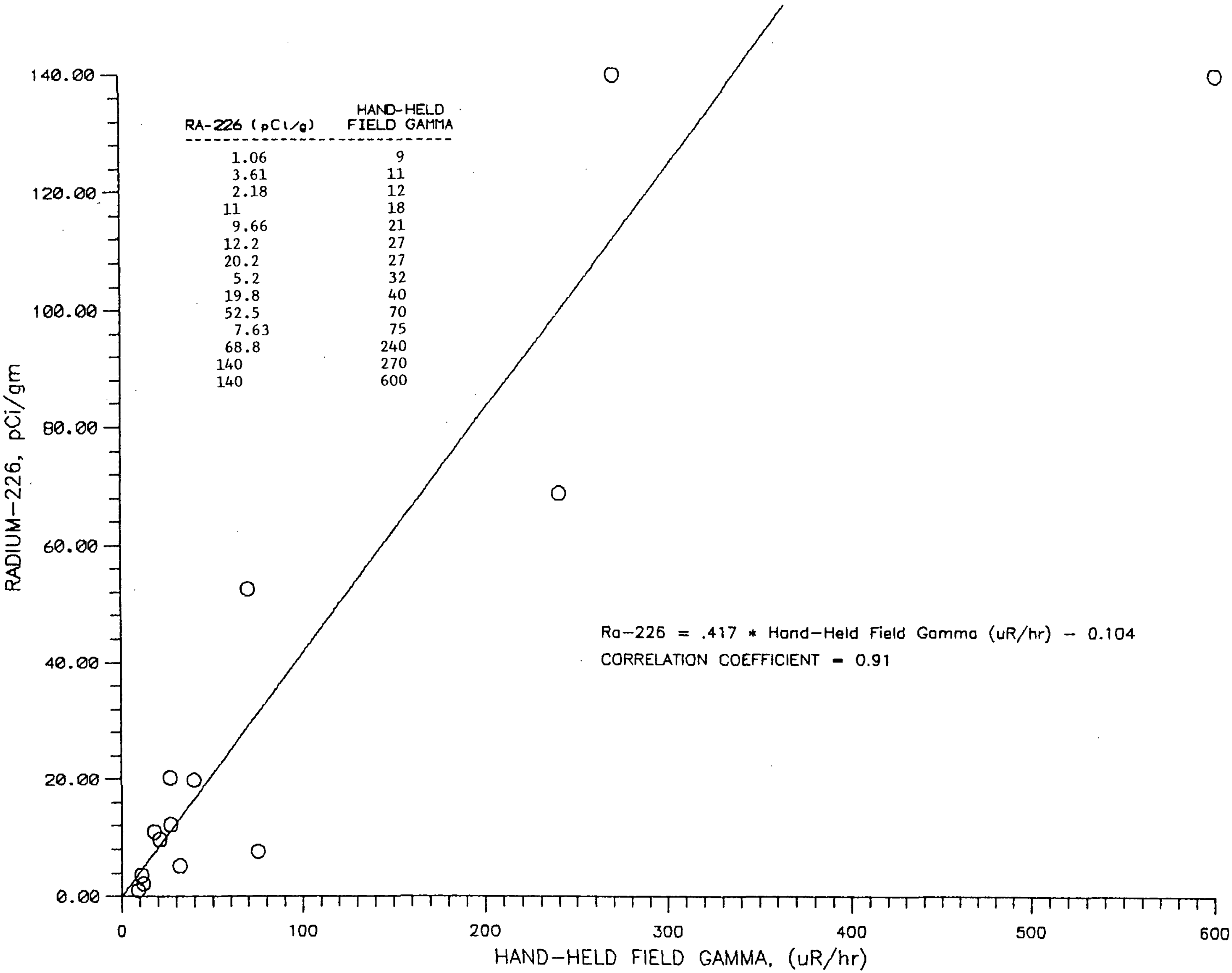

FIGURE 2-1. RADIUM-226 VERSUS HAND-HELD GAMMA.

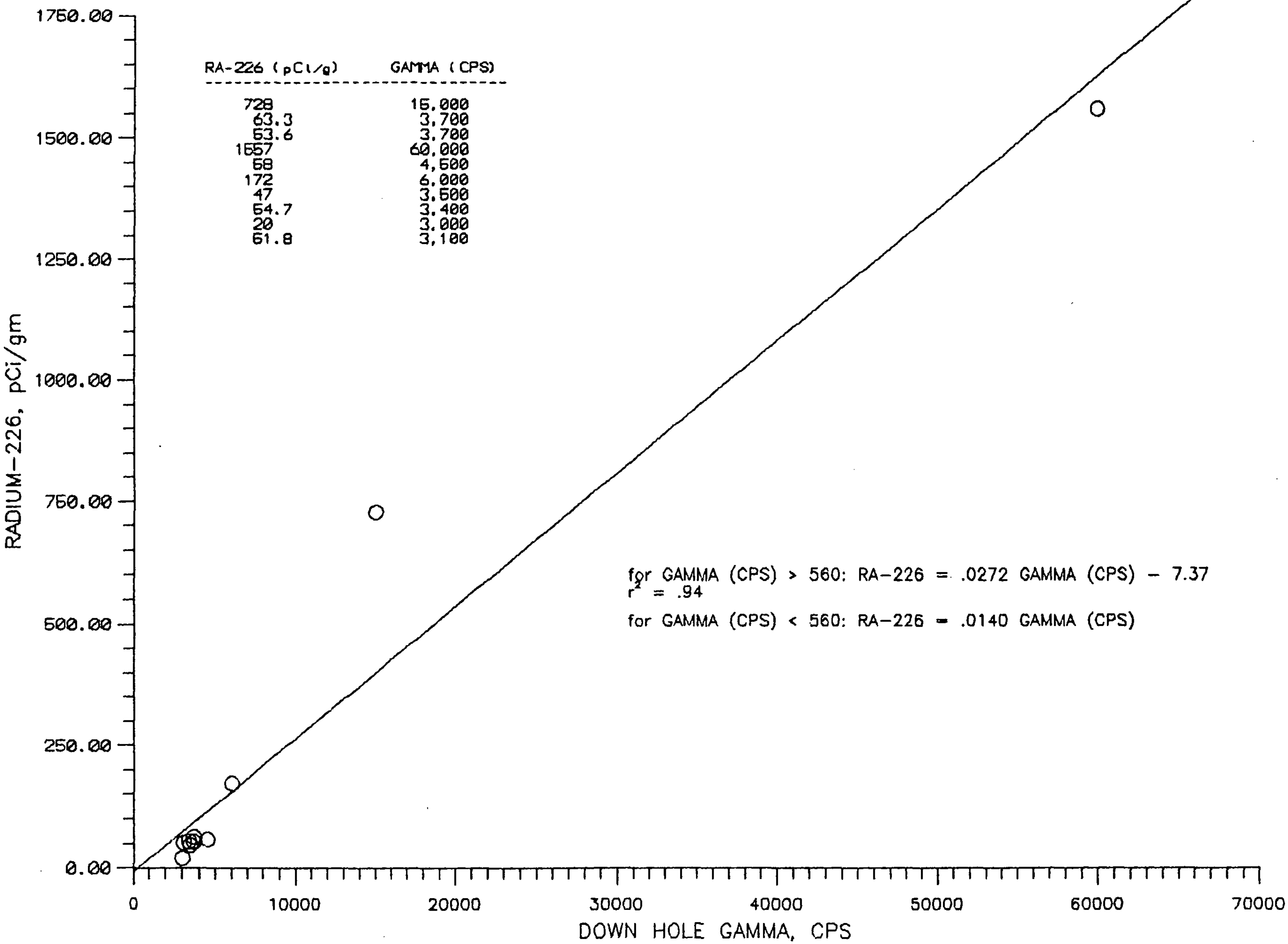

FIGURE 2-2. RADIUM-226 VERSUS DOWN HOLE GAMMA.

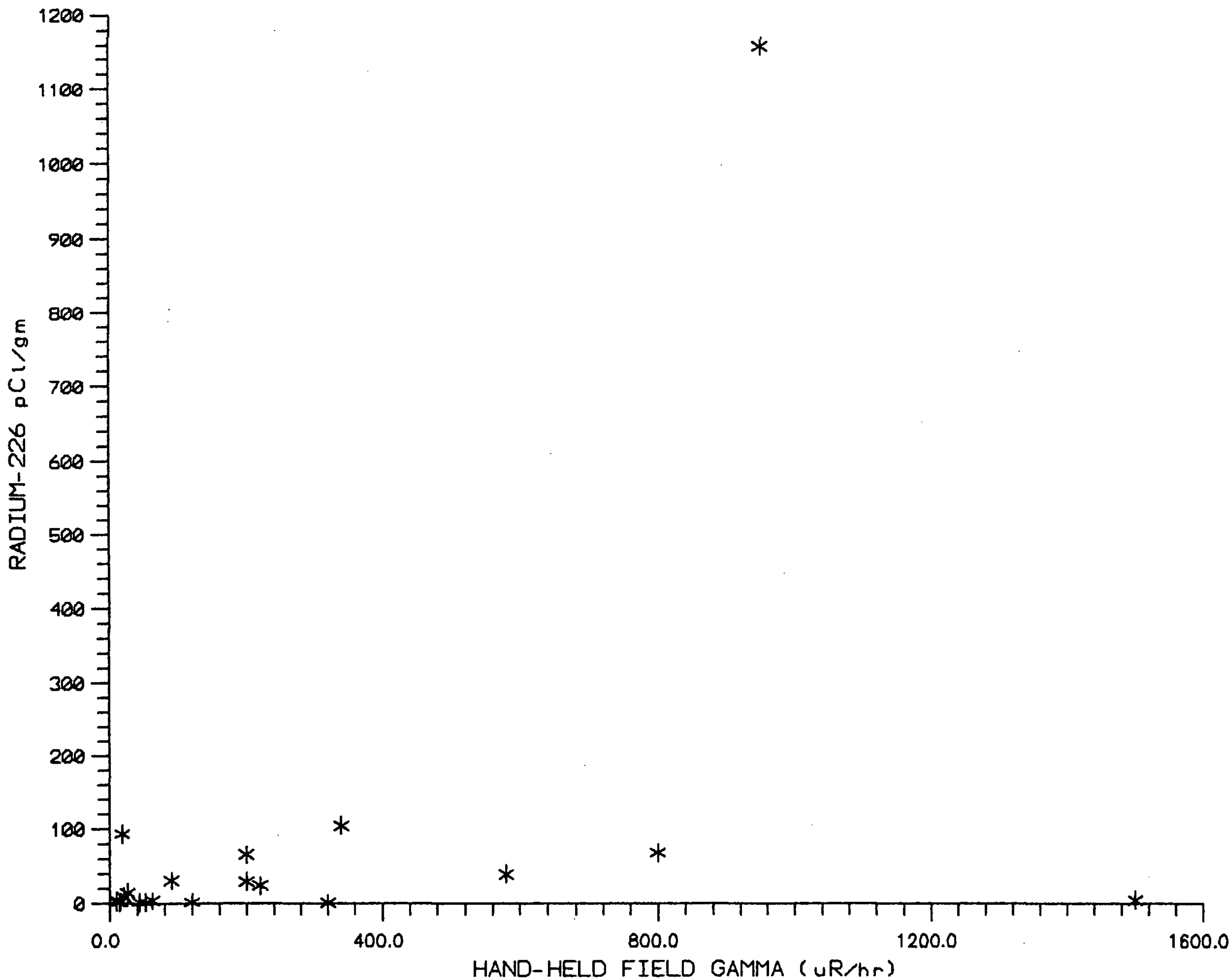

FIGURE 2-3. RADIUM-226 VERSUS TEST PIT HAND-HELD GAMMA READINGS.

TABLE 2-1. SUMMARY OF GAMMA AND RADIUM-226 ANALYSES.

SAMPLE ID	RA-226 CHEMICAL pCi/gm	U-NAT FIELD pCi/gm	GAMMA FIELD (μR/hr) (ins. #1)	GAMMA FIELD (μR/hr) (ins. #2)	DOWN HOLE GAMMA cps
TW4-1B 25´-27´	728				15,000
TW4-1B 3´-5´	63.3				3,700
TW4-1C 3´-5´	53.6				3,700
TW4-2C 40´-42´	1557				60,000
TW4-4B 5´-7´	58				4,500
TW4-5B 5.5´-8´	172				6,000
TW5-1B 4´-6´	47				3,500**
TW5-1B 6´-8´	54.7				3,400**
TW5-2B 3´	20				3,000
TW5-3 6´-8´	51.8				3,100
O-1 90"-96"	15	43.5	90		
O-2 108"-114"	194	158	280		
O-2 66"-72"	32.2		140		
P3-1 0"-6"	14.9	1.2	26		
P3-1 48"-54"	1.9	1.6	14		

TABLE 2-1. SUMMARY OF GAMMA AND RADIUM-226 ANALYSES (continued).

SAMPLE ID	RA-226 CHEMICAL pCi/gm	U-NAT FIELD pCi/gm	GAMMA FIELD (μR/hr) (ins. #1)	GAMMA FIELD (μR/hr) (ins. #2)	DOWN HOLE GAMMA cps
P4-12B 18"-24"	1.7		43		
P4-12B 78"-84"	Ø.3		1Ø		
P4-12C 24"-3Ø"	3Ø.9		9Ø		
P4-1ØA Ø"-6"	29.9		2ØØ		
P4-1ØA 78"-74"	1.9		12Ø		
P4-6A 6Ø"	1.Ø		32Ø		
P4-8A 24"-3Ø"	4Ø		58Ø		
P4-5D 42"-48"	4.7		15ØØ		
P4-12B 36"-42"	9.6		2Ø		
P4-12C 6"-12"	4.2		62		
P4-12C 48"-54"	23.8		22Ø		
P4-12A 36"-42"	93.5		18		
P4-8B 48"	1Ø5		34Ø		
P4-8A Ø"-6"	65.8		2ØØ		
P4-5D 38"-42"	1157		95Ø		

TABLE 2-1. SUMMARY OF GAMMA AND RADIUM-226 ANALYSES (continued).

SAMPLE ID	RA-226 CHEMICAL pCi/gm	U-NAT FIELD pCi/gm	GAMMA FIELD (μR/hr) (ins. #1)	GAMMA FIELD (μR/hr) (ins. #2)	DOWN HOLE GAMMA cps
P4-4D 36"-42"	68.7		800		
P4-12B 48"-54"	2.1	20.4	14		
P4-12B 72"-78"	4.2	2.3	10		
P4-12C 72"-78"	1.8	11.9	52		
P4-8A 48"-54"	1.0		42		
P4-8A 60"-66"	0.4		42		
P4-8A 78"-84"	0.3		26		
STH-6 20′-27′	2.05				
NTH-1 60′-67′	2.99				
STH-5 40′-47′	2.26				
GS-1 surface	1.06			9	
GS-2 surface	12.2			27	
GS-3 surface	5.2			32	
GS-4 surface	7.63			75	
GS-5 surface	140			600	

TABLE 2-1. SUMMARY OF GAMMA AND RADIUM-226 ANALYSES (continued).

SAMPLE ID	RA-226 CHEMICAL pCi/gm	U-NAT FIELD pCi/gm	GAMMA FIELD (μR/hr) (ins. #1)	GAMMA FIELD (μR/hr) (ins. #2)	DOWN HOLE GAMMA cps
GS-6 surface	68.8			240	
GS-7 surface	11			18	
GS-8 surface	9.66			21	
GS-9 surface	20.2			27	
GS-10 surface	19.8			40	
GS-11 surface	3.61			11	
GS-12 surface	2.18			12	
GS-13 surface	52.5			70	
GS-14 surface	140			270	
BP-1	214			35*	
BP-2	34.6			14*	
BP-3	66			16*	
BP-4	102			14*	
BP-5	55			14*	
BP-6	438			20*	
BP-7	206			22*	
BP-8	481			30*	
BP-9	394			60*	

TABLE 2-1. SUMMARY OF GAMMA AND RADIUM-226 ANALYSES (continued).

SAMPLE ID	RA-226 CHEMICAL pCi/gm	U-NAT FIELD pCi/gm	GAMMA FIELD (µR/hr) (ins. #1)	GAMMA FIELD (µR/hr) (ins. #2)	DOWN HOLE GAMMA cps
BP-10	414			27*	
BP-11	737			120*	
BP-12	565			31*	
BGS-1	0.32			10	
BGS-2	0.35			11	
BGS-3	0.43			11	
BGS-4	0.48			9	
STH-6 20'-27'	2.05				
NTH-1 60'-67'	2.99				
STH-5 40'-47'	2.26				

* Gamma readings taken outside of bagged samples.
** Estimated from adjacent well log.

TABLE 2-2. DEPTHS OF TAILINGS IN TEST HOLES

HOLE DESIGNATION	TAILINGS DEPTH (FT)
TW4-1C	44
TW4-2C	44
TW4-3C	49
TW4-4C	28
TW4-5C	34
TW5-1C	53
TW5-2C	38
TW5-3	43

3.Ø MATERIALS PHYSICAL PROPERTIES

Physical and radiological properties of tailings, and various cover materials have been determined. Results of these determinations are presented and discussed below. Laboratory reports of materials' physical properties are presented in Appendix C, and radiological reports are included in Appendix D. The sampling programs were discussed in Section 2.Ø.

3.1 Properties of Tailings

Samples of tailings were collected by a variety of methods, including shelby tube samples taken during drilling, grab samples taken during test pit analysis, and below pond samples taken from a boat. A summary of the tailings physical and radiological properties is presented in Table 3-1. The shelby tube samples are designated with a TW prefix, the pit samples are designated with a P prefix for the tailings area and an O prefix for the low-grade waste pile, and the below pond samples are designated with a BP prefix. For the purposes of this analysis, the tailings pit samples (P prefix) were considered tailings if the radium 226 activity was in excess of 2Ø pCi/gm. The 2Ø pCi/gm threshold was intended to exclude samples which were diluted with non-tailings material from the radon flux simulations.

Those samples which can be considered clayey tails or slimes are TW4-2C, 4Ø-42' and P4-5D, 36"-42". Sample TW4-3C, 42-43' is also considered a slime layer, but no radiological properties were determined for it. The below pond samples (BP prefix) all appeared to be made up of very fine materials, but some of the samples were taken from an area where very little tailings deposition occurred and the proportion of tailings material within the sample is unknown. The actual sample may have been a combination of tailings fines and natural soils. This is expected to be the case with samples BP-2 through BP-5 which were taken from the west side of Tailings Pond No. 4 where no sand tailings were placed. The pit samples from the low-grade waste pile (O prefix) represent residual ore and other contaminated materials.

The value of the emanation coefficient for the samples ranged from Ø to Ø.1934. There appeared to be no correlation between the gradation of the material and the value of the emanation coefficient. The emanation coefficient for the low-grade waste pile samples was more consistent and slightly greater than average emanation coefficients for tailings samples. Duplicate emanation coefficient measurements were made at reconstituted moisture contents for four of the tailings samples (TW4-1B, 25′-27′; TW4-5B, 5.5′-8′; TW4-2C, 4Ø′-42′; and TW5-2B,3′). This was done because Nielson et al. (1982) indicates that the emanation coefficient varies with moisture content of the sample. The emanation coefficient for the original samples was determined at the as-received moisture content, which was well in excess of 6% for all samples. The emanation coefficients for each sample changed dramatically when duplicate measurements were made, but there did not appear to be any correlation with change in moisture content. The differences in emanation coefficients for the duplicate samples are attributed to natural variations inherent in the measurement technique. It is interesting to note that the average emanation coefficient for those samples with duplicate measurements was Ø.Ø71 for measurements at natural moisture content and Ø.Ø84 for measurements at reconstituted moisture content. Both values are reasonably consistent with the overall sample average of Ø.Ø86.

3.2 Properties of Cover Materials

Potential sources of cover material include the South Dump and North Dump. The cover material properties are presented in Table 3-2. The samples designated with a CP, Set, and STH prefix were taken from the South Dump and the samples designated with a prefix of ND or NTH were taken from the North Dump. The STH and NTH samples were taken in a drilling program for the dump piles and lithology for each of the holes is presented in Appendix A. The remainder of the samples were taken from backhoe pits or at the surface. Based on the lithologic logs and the properties presented in Table 3-2, it appears that a bluish gray clay is present in the

South dump in adequate quantities to be used as the primary cover material. The same material is present in the North dump in lesser quantities, but the primary borrow area is the South dump and the bluish gray clay in the North dump will not be used as cover unless volume or economic considerations make it a viable alternative. Those samples which are representative of the proposed clay cover material are the STH-2, STH-4, STH-5, STH-6 and STH-11 samples presented in Table 3-2. The NTH-5, 20′-27′, sample is representative of the same type of material from the North Dump.

Rawls and Brakensiek (1982) presented an empirical technique for determining long-term volumetric moisture content of soil corresponding to the 15-bar soil water retention value, which is as follows:

$$VMC = 0.026 + 0.005\ z + 0.0158\ y$$

where:

VMC = volumetric moisture content,
z = % of clay in the soil, and
y = % of organic matter in the soil.

Volumetric soil moisture content can be converted to moisture content by weight (Wc) by utilizing the following equation:

$$Wc = 100\ (VMC)(pw)\ /\ pc$$

where:

pw = density of water (unity) and
pc = density of soil.

The predicted long term moisture content for each cover material as calculated by this method is presented in Table 3-2. The predicted long-term moisture content for the five samples representative of the proposed cover material varied from 16.6 to 21.7% with a mean of 18.74%.

3.3 Rock Testing

Rock quality testing for two general rock sources was conducted on a total of four samples. Petrographic analysis was conducted on one sample of granite and one sample of sandstone. The petrographic analysis indicated that the granite was of good quality with no serious deleterious conditions, while the sandstone was of questionable quality.

Rock durability analysis was conducted on three samples of the granite and one sample of the sandstone. Tests conducted were: Los Angeles Abrasion (100 revolutions, ASTM C-535), Specific Gravity (surface saturated dry, ASTM C-127), Absorption (in conjunction with Specific Gravity test), and Sodium Sulfate Soundness (5 cycles, ASTM C-88). The results are presented on Table 3-3 with calculated rock durability scores. Values from Table D1 in the Staff Technical Position (STP) (NRC, 1990) were interpolated in computing these scores. The durability testing indicates the granite is of very good quality while the sandstone (Rock D) was of fair to good quality. The granite will be used for rock mulch and riprap in the tailings reclamation area.

The proposed filter material for rock mulch rock and riprap is crushed granite and finer screen materials from the rock processing operations. Rock and filter sizing and gradation criteria are discussed in Section 11.

TABLE 3-1. TAILINGS PHYSICAL AND RADIOLOGICAL PROPERTIES.

SAMPLE	NATURAL MOIST (%)	RA-226 (pCi/g)	DENSITY (lb/ft3)	DENSITY (g/cm3)	CALC. POROS-ITY	-200 SIEVE PERCENT	NAT. MOIST EMAN-ATION COEFF	RECON. MOIST. EMAN-ATION COEFF
TAILINGS SAMPLES								
TW4-1B 25' - 27'	36	728	85	1.36	0.49	50	0.0166	0.1513 @ 20%
TW4-4B 5' - 7'	20	58	93	1.49	0.44	8	0.0552	
TW4-5B 5.5' - 8'	16	172	91	1.46	0.45	16	0.1934	0.099 @ 6%
TW4-1C 3' - 5'	20	53.6	94	1.51	0.43	5	0.1246	
TW4-2C 40' - 42'	80	1557	55	0.88	0.67	77	0.0041	0.087 @ 20%
TW4-3C 42' - 43'	62	----	62	0.99	0.63	100		
TW5-2B 3'	27	20	89	1.43	0.46	6	0.0699	0 @ 6%
TW4-1B 3' - 5'		63.3					0.1423	
TW5-1B 4' - 6'		47					0.1005	
TW5-3 6' - 8'		54.7					0.0254	
TW5-1B 6' - 8'		51.8						
PIT SAMPLES								
P4-12C 24" - 30"		30.9						
P4-10A 0" - 6"		29.9						
P4-8A 24" - 30"		40						

TABLE 3-1. TAILINGS PHYSICAL AND RADIOLOGICAL PROPERTIES (continued).

SAMPLE	NATURAL MOIST (%)	RA-226 (pCi/g)	DENSITY (lb/ft^3)	DENSITY (g/cm^3)	CALC POROS-ITY	-200 SIEVE PERCENT	Nat Moist. EMAN-ATION COEFF	Recon. Moist. EMAN-ATION COEFF
P4-12C 48"-54"		23.8						
P4-12A 36"-42"		93.5						
P4-8B 48"		105						
P4-8A 0"-6"		65.8						
P4-5D 36"-42"		1157						
P4-4D 36"-42"		68.7						
ORE SAMPLES								
O-1 90"-96"		15					0.153	
O-2 108"-114"		194					0.166	
O-2 66"-72"		32.2					0.113	
BELOW POND SAMPLES								
BP-1		214						
BP-2		34.6						
BP-3		66						
BP-4		102					0.0221	
BP-5		55						
BP-6		438						

TABLE 3-1. TAILINGS PHYSICAL AND RADIOLOGICAL PROPERTIES (continued).

SAMPLE	NATURAL MOIST (%)	RA-226 (pCi/g)	DENSITY (lb/ft^3)	DENSITY (g/cm^3)	CALC POROS-ITY	-200 SIEVE PERCENT	Nat Moist. EMAN-ATION COEFF	Recon. Moist. EMAN-ATION COEFF
BP-7		206						
BP-8		481						
BP-9		394					0.1658	
BP-10		414						
BP-11		737					0.0034	
BP-12		565						

TABLE 3-2. COVER MATERIAL PHYSICAL PROPERTIES.

Sample	Depth (ft)	Nat. Moist (%)	Org. Matter (%)	Liquid Limit (%)	Plast. Index (%)	Gradation +#4 (%)	Gradation -#4 +#200 (%)	Gradation -#200 (%)	Class.	100% Proctor (lb/ft³)	95% Proctor (lb/ft³)	Clay -.002 (%)	Spec. Grav.	Rawls Theta (%)	Rawls W.C. (%)
CP-1	10	14	4.14	56	29	0	25	75	CL	92.8	88.16	8	2.63	13.1	9.2
CP-2	10	16	3.72	50	26	0	25	75	CL	96.4	91.58	6	2.61	11.4	7.8
CP-3	10	15	2.76	52	27	0	23	77	CL	94.9	90.155	8	2.67	10.9	7.5
Set 1	1		8.8			0	13	87	CL	92.5	87.875	48	2.68	40.3	28.6
Set 2	1		8			0	9	91	CL	93	88.35	40	2.672	35.1	24.8
Set 3	1		7.1			0	11	89	CL	95	90.25	62	2.702	44.7	30.9
STH-2	60-67	18	7.2	54	34	0	17	83	CH	102	96.9	24		25.8	16.6
STH-4	30-37	15	6.2	61	40	0	8	92	CH	100.7	95.665	38		31.3	20.4
STH-5	40-47	9	6.2	58	35	0	7	93	CH	99.2	94.24	41		32.8	21.7
STH-6	20-27	6	5.9	45	25	0	17	83	CL	103.1	97.945	30		26.8	17.1
STH-7	40-47		4.2	57	37	0	45	55	CH	110	104.5	12	2.36	15.2	9.0
STH-11	20-27	13	10.4	64	37	0	4	96	CH	91.3	86.735	12		24.8	17.9
ND-1	10	30	3.6	59	33	1	22	77	CL	92.4	87.78	6	2.68	11.2	8.0
ND-2	10	25	2.7	64	36	0	27	73	CL	89.4	84.93	7	2.69	10.3	7.6
ND-3	10	35	3.7	75	40	1	23	76	CL	83.2	79.04	5	2.6	10.9	8.6
ND-4	10	36	3.1	69	36	0	25	75	CL	82.7	78.565	5	2.66	9.9	7.9
ND-5	10	23	3.3	61	33	0	14	86	CL	94.5	89.775	26	2.66	20.7	14.4
ND-6	10	23	2.6	65	34	1	27	72	CL	91.2	86.64	7	2.63	10.2	7.3
NTH-1	60-67			65	38	0	15	85	CH	96.8	91.96	29	2.31	17.1	11.6
NTH-3	140-14	6		42	27	10	61	29	CL	117.7	111.815	1	2.36	3.1	6.0
NTH-5	20-27	16	10	65	42	0	10	90	CH	94.1	89.395	31		33.7	23.5
NTH-5	120-12	10		55	39	7	45	48	CH	108.5	103.075	2		3.6	6.0

TABLE 3-3. ROCK DURABILITY PROPERTIES AND SCORING.

SAMPLE	L.A. ABRASION % LOSS	SODIUM SULFATE SOUNDNESS % LOSS	S.S.D. SPECIFIC GRAVITY	ABSORPTION %
Rock A (Granite)	2.2	0.04	2.64	0.12
Rock B (Granite)	2.8	0.11	2.64	0.14
Rock C (Granite)	2.8	0.08	2.65	0.08
Rock D (Sandstone)	4.2	0.18	2.65	2.47

ROCK SCORING

SAMPLE	L.A. ABRASION SCORE x WT	SODIUM SULFATE SOUNDNESS SCORE x WT	S.S.D. SPECIFIC GRAVITY SCORE x WT	ABSORPTION SCORE x WT	TOTAL	SCORE %
Rock A (Granite)	9.4 x 1	10 x 11	7.8 x 9	9.9 x 2	209.4	91
Rock B (Granite)	9.1 x 1	10 x 11	7.8 x 9	9.8 x 2	208.9	90.8
Rock C (Granite)	9.1 x 1	10 x 11	8 x 9	10 x 2	211.1	91.8
Rock D (Sandstone)	8.4 x 1	10 x 11	8 x 9	2 x 2	194.4	84.5

4.0 RADON BARRIER

The tailings area radon barrier will consist of a layer of compacted clay as described in Section 3.2 and an overlying sandy layer which will act as a capillary barrier. The cover material properties were summarized in Table 3-2. The radon barrier cover will be applied to tailings pile areas, byproduct material disposal areas, mill site, and mill rubble disposal areas. The cover will be designed to limit the radon surface flux when averaged over the entire cover area to 20 pCi/m^2/s.

The RADON computer program, described in NRC Regulatory Guide 3.64 (1989), was used to predict the cover thickness required to achieve the radon flux standard. Topsoil materials and rock mulch/filter materials were not included in the radon barrier simulations.

4.1 RADON MODELING TAILINGS PHYSICAL AND RADIOLOGICAL PROPERTIES

Because of the variability in tailings properties, two scenarios were considered in the radon flux modeling for the tailings area. The first scenario uses the near surface samples taken during the well drilling program. This is considered representative of the currently exposed tailings radon flux. The second scenario uses the tailings properties indicated by the below pond sampling program. The measured radiological properties of tailings samples were summarized in Table 3-1. A summary of the results of each simulation is presented in Table 4-1.

4.2 RADON MODELING COVER MATERIALS

The clay cover material is best represented by samples STH-2, 60'-67'; STH-4, 30'-37'; STH-5, 40'-47'; STH-6, 20'-27'; and STH-11, 20'-27' as presented in Table 3-2. These samples appear to be representative of the bulk of the material in the South Dump that will be used to cover tailings. Sample STH-7, 40'-47' was deliberately selected as a sandy lense within the borrow area and is an example of the type of material which could be used as the sandy capillary barrier at the top of the radon barrier. The lithologic logs for the South Dump borrow area test holes indicate that selective handling of the cover material will be required.

Model inputs for the cover material properties were computed as conservative average properties from the borrow area samples. The average long-term moisture content as calculated by the method presented by Rawls and Brakensiek (1982) for the five clay samples indicated above was 18.74%. The standard deviation of the moisture content for the same five samples was 1.97%. The minimum estimated long-term moisture content is 16.6% for the samples and the average moisture content minus one standard deviation gives a moisture content of 16.77%. The moisture content of the sandy cover material was estimated as 6% to give a worst case scenario. Since the RADON model is particularly sensitive to moisture content of the cover material, this represents a very conservative condition.

The average density of the clay cover material was estimated as 1.5 gm/cm^3 (based on 95% proctor density of samples). The average density of the sandy cover material was estimated as 1.59 gm/cm3. Porosity of the clay cover was calculated as 0.43 and the porosity of the sandy cover was assumed to be 0.40. The diffusion coefficient for tailings and cover materials is calculated by the model.

4.3 RADON MODELING SCENARIO ONE

The first scenario was based on properties for the exposed near-surface tailings as determined from shelby tube samples taken during the tailings drilling program. For the purposes of this modeling, the properties of samples TW4-2C, 40'-42'; and TW4-1B, 25'-27' were excluded from computations. This was done because these samples were taken from depths of 25 feet below the surface and greater and are not considered representative of near-surface tailings. Gamma logs for each of the tailings wells (Appendix A) indicate that the near-surface samples are representative of the gamma emission to a depth of at least 20 ft.

The average radium activity for eight tailings well samples (TW prefix) with the exclusion noted above was 65.05 pCi/gm with a standard deviation of 42.2 pCi/gm. The average emanation coefficient for all samples was 0.086, and a value of 0.10 was considered a conservative input for the model. The average plus one standard deviation was considered a conservative estimation technique for the radium activity, yielding an activity of 107 pCi/gm as an input for the RADON model. The average density of the tailings was assumed to be 1.59 gm/cm^3 and the porosity was assumed to be 0.40. The long-term moisture content of the tailings was assumed to be 6%.

The clay cover material was assumed to have a moisture content of 16.77% (the average moisture content minus one standard deviation), a density of 1.5 gm/cm^3 (95% proctor for proposed cover material) and porosity of 0.43 (calculated from other cover material properties). The results in Table 4-1 indicate that 2.5 ft of clay cover overlain with 0.5 ft of sandy cover is sufficient to limit radon flux for this scenario to 6.6 $pCi/m^2/s$.

4.4 RADON MODELING SCENARIO TWO

The second modeling scenario utilizes the average activity of 309 pCi/g for the below pond tailings sampling in tailings ponds 4 and 5. These samples represent the more active fine materials and the tailings moisture content was assumed to be 12%. The thickness of these fine materials was assumed to be 500 cm, although it is unlikely that the fines would be deposited to this thickness. All other properties were the same as those described in scenario one.

The resulting radon flux with the a cover consisting of 3 feet of clay overlain by 0.5 feet of sandy cover is 14.7 pCi/m²/s.

4.5 RESULTS AND DISCUSSION

The results of the RADON model runs are included as Table 4-1. A three feet thick cover system consisting of a 2.5 feet thick clay cover and a 0.5 feet thick sandy capillary barrier will be more than adequate for the exposed tailings. This cover system will also be used in the mill area. An additional 0.5 feet of clay will be added for areas of the tailings that are currently below the pond water level.

The chimney drain for the No. 5 tailings dam was constructed with sand tailings and must be addressed in terms of radon flux modeling. The chimney drain was constructed as shown in Figure 4-1 and the sandy tailings will be excavated as shown to provide a minimum of 3.5 feet of cover with reclamation contours. The section shown in Figure 4-1 is approximately the location where the maximum depth of tailings will have to be excavated. An additional RADON simulation was conducted to demonstrate that excavation of tailings at the top the dam followed by covering with material graded from the dam outslope will limit radon flux to below 20 pCi/m²/s. The tailings properties were assumed to be the same as those used in scenario one, and the cover material was assumed to be a very sandy material (moisture content = 6%) to give a very conservative radon flux condition. The resulting radon flux for 3.5 feet of cover with graded sand from the dam outslope is 17.8 pCi/m²/s. The majority of the chimney drain will have 15 to 20 feet of cover, and the radon flux will be much less than the maximum predicted value of 17.8 pCi/m²/s.

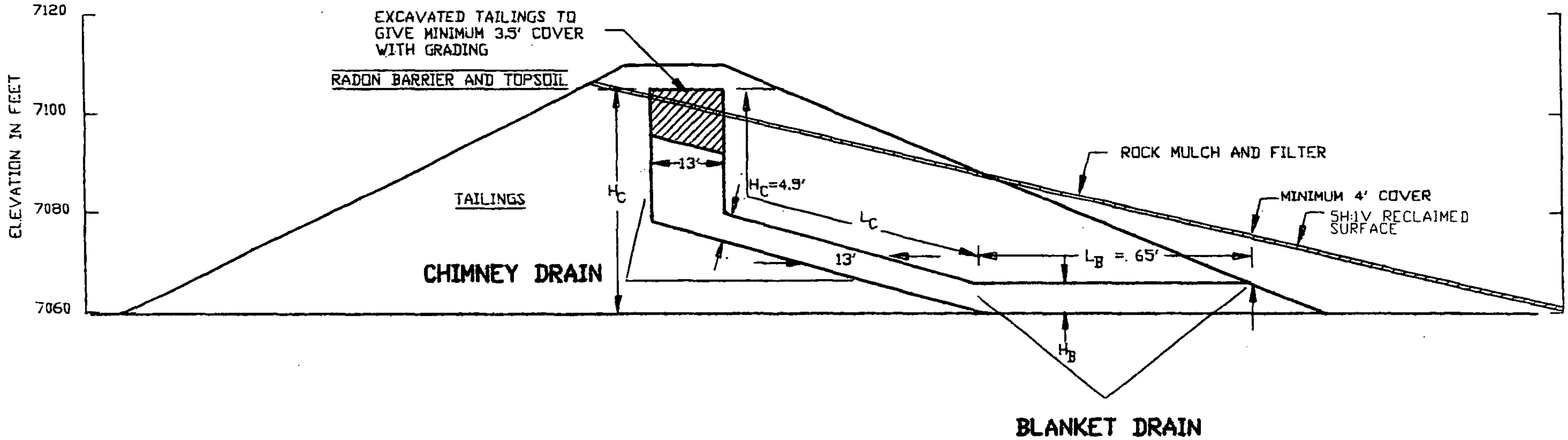

FIGURE 4-1. POND 5 DAM CROSS SECTION WITH RECLAIMED COVER AND EROSION PROTECTION

TABLE 4-1. RADON PROGRAM INPUT PARAMETERS AND RESULTS.

SCENARIO LAYER	THICKNESS (ft)	POROSITY	MASS DENSITY (g/cm³)	RA-226 (pCi/g)	EMAN-ATION COEFF	MOISTURE CONTENT (%)	EXIT RADON FLUX FROM LAYER (pCi/m²/s)
1 TAILINGS-SAND	16.4	.40	1.59	107	0.100	6	13.0
CLAY COVER	2.5	.43	1.5	0	0.350	16.77	6.7
SAND COVER	0.5	.40	1.59	0	0.350	6	6.6
2 TAILINGS-SAND	16.4	.40	1.59	309	0.100	12	36.0
CLAY COVER	3.0	.43	1.5	0	0.350	16.77	14.8
SAND COVER	0.5	.40	1.59	0	0.350	6	14.7
CHIMNEY DRAIN							
TAILINGS-SAND	16.4	.40	1.59	107	0.100	6	25.1
COVER	3.5	.40	1.60	0	0.350	6	17.8

5.0 RECLAIMED SURFACE DESIGN

The tailings reclamation plan is designed to minimize the areas of cut and fill and to utilize existing topography to form drainages. The majority of the tailings surface will be protected with rock mulch cover and the remainder will consist of very flat non-rock mulch areas at the crest of some drainage basins on the tailings surface. The drainage area from the mill, tailings disposal and adjacent drainages has been divided into five major basins with 34 subbasins. The reclaimed surface maps, Exhibits 5-1, 5-1A and 5-1B, show the drainage basin and subbasin divides. Exhibit 5-2 presents major drainage basins designated by color and settlement monument locations. The major basins are designated: West Tailings Drainage Area, South Drainage Area, North Drainage Area, East Tailings Drainage Area, and Southeast Tailings Drainage Area.

Those subbasins in the mill area and other areas south of the tailings have been given a DM- prefix, followed by a sequence number. Similarly, those subbasins on Ponds 3, 4, and 5 have been given D3-, D4-, and D5- prefixes, respectively, followed by sequence numbers. The subbasins in the north drainage areas have been designated with a N- prefix. None of the N drainage areas drain or discharge runoff across tailings. Likewise, subbasins DM-1 through DM-6A are routed to the south away from tailings. Non-tailings drainage area which is incorporated into the actual tailings drainage is very limited.

A non-rock mulch cover is planned for subbasin D4-1 on the No. 4 tailings. This non-rock mulch cover extends into adjoining portions of subbasins D4-2, D4-3, D4-5 and D5-1 (See Exhibits 5-1, 5-1A and 5-1B). A non-rock mulch cover is also proposed for subbasins D5-3 and portions of subbasins D5-1, D5-4, D5-2A, D5-2B, and D5-5. In the mill area, a portion of drainage areas D5-7, DM-7 and DM-9 will be reclaimed with the clay cap and a non-rock mulch cover. The remainder of the tailings and byproduct disposal areas will be covered with rock mulch. With the exception of side slopes on control structures, the maximum slope on the reclaimed surface of the tailings area is 4H:1V. The 4H:1V slopes will be present only on the channel side slopes. The outslope on the tailings No. 5 dam and the upstream side of the solution pond No. 3 dam will be reduced to a steepest slope of 5H:1V and will be covered with appropriately sized rock mulch for erosion protection.

A drainage channel is included on the northern boundary of the tailings No. 5 dam and the north side of the solution pond No. 3. These channels are formed by excavating through the dam and are the outlets for Pond 5 and Pond 4, respectively. An excavated channel on the west side of the Industrial Pond will limit maximum permanent water level elevation in the pond to 7110 ft-msl. The permanent pond will serve as a source of recharge to the Surficial aquifer and as a surge and detention pond for runoff. The west side of Pond 4 will also contain a depression which will retain water for some time following a runoff event. This depression will be located over a non-tailings area and will also provide recharge to the Surficial aquifer.

5.1 Cut and Fill Areas

The majority of the rock mulch areas will not require a significant amount of cut or fill, except for the radon barrier cover placement. A large amount of fill is planned for the southern portion of subbasin D4-3 and the lower portions of subbasin D5-1 (see Exhibit 5-1). This fill will consist of the low-grade waste material located to the west of Solution Pond No. 3, windblown and other cleanup materials, residual ore, equipment and rubble, and excess tailings from surface contouring.

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(Revised 09/08/99)

In areas where cut and fill activity is limited, the design contours will closely approximate the existing contours plus the cover thickness. These areas include the majority of the windblown cleanup area, and subbasins DM-1, DM-3, DM-4, DM-5, DM-6, and DM-7. A detailed discussion of volumes is included in Section 8.0.

5.2 Drainage Design

Objectives in the drainage design included: reduction of basin drainage area to decrease the potential for erosion, diversion of non-tailings runoff away from the tailings, maximization of contributing drainage areas for the Area 2/8 and Area 3 reservoirs, and utilization of runoff storage areas as surge ponds to reduce peak flows. Discharge is routed off of the tailings in several directions to achieve these objectives.

Runoff from the tailings, mill, and adjoining areas is discharged at several points. The majority of the surface runoff from the tailings area discharges to the Area 2/8 reservoir through the channel section which passes through the former No. 3 Solution Pond and down the reclaimed mine slope. The center section of Pond 5 (subbasin D5-1) discharges through the channel to the north with eventual discharge to Spring Creek. Runoff from the No. 5 dam outslope (basin D5-4) also discharges to the Spring Creek drainage. Runoff from the southern portion of Pond 5 and portions of the mill area discharge to the east into the mine Area 3 reservoir. The areas south of the mill discharge into the Area 3 reservoir. Only a very small portion of the covered mill area discharges to the southeast and this area is considered a non-tailings drainage area. The specifics of the channelized flow runoff analysis are included in Section 5.2.2.2 and Appendix E. A general flow schematic is given in Figure 5-4.

The general drainage pattern for discharge to the Area 2/8 reservoir is as follows:

> Runoff from subbasins DM-2 through DM-6A is collected and routed through storage in the Industrial pond and a surge pond formed by a channel/berm. Runoff from subbasin DM-1 flows into the south drainage channel downstream of the surge ponds.
>
> Runoff from subbasin D5-2A is routed through storage in subbasin D5-2A and into subbasin D5-2B.
>
> Runoff from subbasins D4-1, D4-2, D4-3, D4-4, D4-5, D4-6, DM-7, DM-8, D5-2A, D5-2B, and D3-1 is collected and routed through storage in Pond 3. Subbasin D4-4 has a small depression which will retain water outside of the covered tailings area during smaller runoff events.
>
> Runoff from the north subbasins N-5 through N-12 will be collected and routed through a surge pond designated as subbasin N-13. Subbasins N-5 and N-6 are routed through storage in shallow depressions within each respective basin. Subbasins N-5 through N-8 are also routed through a constructed surge pond in subbasin N-8.

The general drainage pattern for discharge to Spring Creek is as follows:

> Runoff from subbasin D5-1 will be routed through storage in Pond 5.
>
> Runoff from subbasin D5-5 will be combined with runoff from storage in Pond 5 and discharged to Spring Creek.
>
> Runoff from subbasin D5-4 will be discharged to a channel at the toe of the No. 5 dam outslope for eventual discharge to Spring Creek through the old Mine Creek channel.

The general drainage pattern for discharge to the Area 3 reservoir is as follows:

Runoff from subbasin DM-9 will be routed through storage in subbasin DM-9.

Runoff from subbasins D5-3 and D5-7 and runoff from storage in subbasin DM-9 will be routed through storage in the subbasin D5-3 channel.

Runoff from subbasin D5-6 will be routed through storage and combined with runoff from storage in the subbasin D5-3 channel and runoff from drainage basin DM-10. Eventual discharge is to the Area 3 reservoir.

Runoff from the dump piles (North dump and South dump) will be routed through storage south of the mill and eventually discharged to the Area 3 reservoir.

5.2.1 Design Storm

The design storm to qualify for 1000 year protection, as required by the NRC Staff Technical Position, is the PMP (Probable Maximum Precipitation). The PMF (Probable Maximum Flood) is derived from a critical combination of PMP and storm distribution. The 1-hour, 1-sq. mi. storm was selected as a conservative precipitation event for the Shirley Basin mill and tailings area. The depth of precipitation for this event is 10.15 inches as presented by Hydrometeorological Report 55A (HMR-55A) (Hansen and others, 1988). An adjustment was made for altitude based on an average Shirley Basin mill area altitude of 7100 ft+msl. The adjustment factor for this altitude was 0.89, giving a PMP of 9.03 inches. No adjustment was made for basin area.

The storm distribution for overland flow computations was taken from HMR-55A (page 200). This storm distribution places the highest intensity interval at the beginning of the storm with decreasing intensity as the storm continues. The tabulated values of percentage of precipitation occurring in a given interval are presented below.

Duration (hr)	Fraction of 1 hr Precip.
1/4	0.68
1/2	0.86
3/4	0.94
1	1.00

The values above were fitted with a polynomial to determine cumulative precipitation for time periods less than one hour. This in turn gave average intensities for periods up to one hour. The polynomial equation is:

$$P = 9.03 * (0.076222 * t - 0.00265185 * t^2 + 4.34568E-05 * t^3 - 2.63374E-07 * t^4)$$

where : P is the precipitation in inches
t is the time of concentration in minutes

The intercept for the polynomial fit was very small and was discarded.

Cumulative precipitation values were used in conjunction with the time of concentration of overland flow to determine required precipitation intensities. This storm distribution was used only for overland flow computations, and is very conservative for the short time of concentration characteristic of most overland flow paths. The minimum time of concentration for intensity calculations as recommended by NUREG/CR-4620 is 2.5 minutes, giving a maximum intensity of 37.85 in/hr. The cumulative precipitation curve is presented in Figure 5-1.

A significantly different precipitation distribution was used for channelized flow design. This storm distribution placed peak intensity near the middle of the storm, with a general bell shaped intensity curve (Figure 5-2). This storm distribution gives very conservative runoff values when the time of concentration is longer, as is the case with small drainage basins on the tailings surface.

A 1000-year return period storm was also considered in the tailings drainage design. This design storm was considered for rock sizing on areas adjacent to the tailings where a failure of the drainage system would not have impacts on tailings stability. The precipitation for the 1000-year return period storm was determined using rainfall records from the Shirley Basin townsite. The data used were collected by the National Weather Service, a division of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). The approach taken was to search hourly precipitation records published by NOAA for maximum yearly one-hour precipitation events from 1962 to 1984. Each value was arranged in descending order and a plotting position was calculated. The plotting position used is that recommended by Yevjevich (1972, p. 90):

$$P = m/(N + 1)$$

where:

P = plotting position,
m = ordered sequence of values, and
N = sample size of ungrouped data.

The inverse of the plotting position is the recurrence interval. Figure 5-3 presents listings of m, plotting position, recurrence interval and maximum hourly precipitation value for the Shirley Basin Townsite. The one-hour, 1000-year rainfall depth from this analysis is 3.2 inches. The storm distribution used in the HEC-1 analysis was a hypothetical storm (PH designation) which produces a triangular precipitation distribution. Table 12 of

Miller et al. (1973) was used to determine the five-minute and 15-minute rainfall depths of 0.928 and 1.824 inches, respectively.

5.2.2 Runoff Calculations
5.2.2.1 Overland Flow

Runoff from overland flow on rock protected areas was calculated with the Rational Formula:

$$Q = CiA$$

where:

- C = runoff coefficient
- i = rainfall intensity, in/hr
- A = drainage area, ac

The C value was estimated as 0.8 and Kirpich's (1940) method was used to calculate the time of concentration for flow paths. Kirpich's equation is expressed as:

$$tc = (11.9\ L^3 / H)^{.385}$$

where:

- tc = time of concentration in hours
- L = drainage length in miles
- H = elevation difference (in feet)

The C value of 0.8 was selected as representative of a rock mulch layer underlain by a relatively coarse filter material. In reality, the rate of infiltration into the rock mulch and filter material should be so great that several inches of precipitation would be required to produce any runoff at all. The C value of 0.8 is representative of the rock mulch and filter in a nearly saturated condition prior to the PMP, a very conservative combination of events.

A series of flow paths was selected on the proposed reclaimed tailings and mill area surface. In general, these represented a more extreme overland flow condition based on slope and slope length. The paths were also selected to achieve complete areal coverage for reclaimed surfaces. Each flow path was divided into sections of uniform slope for the runoff analysis. Flow paths were extended to the approximate point where overland flow would meet channel flow under an estimated channel flow depth of one foot. The Rational Formula was used to compute discharge for each segment. The time of concentration and area/unit width was summed while moving down gradient on each flow path, thus providing a cumulative discharge. For flow paths with very short time of concentration, this is essentially a summation of peak flows. As total time of concentration increased, the precipitation intensity decreased slightly, and thus the rate of discharge is slightly less than a summation of peak flows.

The overland flow paths for rock mulch and non-rock mulch areas are presented in Exhibits 5-1, 5-1A and 5-1B. The characteristics and design rock sizes are presented in Table 5-2. The rock design methods are discussed in Sections 5.3.1 and 5.3.2. An additional analysis was conducted by determining the maximum unit discharge that specific rock sizes could withstand on the channel side slopes. This analysis revealed: the rock mulch (D_{50}=0.150 ft) will withstand a unit discharge of 0.200 cfs/ft on a 4H:1V slope and a unit discharge of 0.630 cfs/ft on a 8H:1V slope, the small riprap (D_{50}=0.400 ft) will withstand a unit discharge of 0.880 cfs/ft on a 4H:1V slope, and the intermediate riprap (D_{50}=0.600 ft) will withstand a unit discharge of 1.62 cfs/ft on a 4H:1V slope. These guidelines were employed in sizing rock in the channels on the tailings surface. In some cases, the side slopes of channels on the tailings area are much less than 10H:1V. The maximum unit discharge flowing into a 4:1 channel was estimated to be 0.334 cfs/ft (overland flowpath O5-4A) and rock sizes for the channels upstream of hydrologic cross-sections HC4-2 and HC5-9 was increased to the small riprap size as a measure of conservatism.

The Horton/NRC method (Horton, 1936) was used to design non-rock slope areas. Both non-rock and rock-protected slopes are presented in Exhibit 5-1. A C value of 0.9 and a concentrating factor (F) of 2.5 were used in the analysis. The method of determining time of concentration and precipitation intensity was discussed earlier. Manning's roughness coefficient was set at 0.025, representing a relatively smooth earthen surface (Chow, 1959). The Horton/NRC equation was rearranged to allow computation of the critical or allowable slope length for a given combination of slope, precipitation intensity, and allowable shear stress. This equation is expressed as:

$$L = (65\ t^{(5/3)})/(P\ F\ n\ Ss^{(7/6)})$$

where:

L = critical or allowable slope length in ft
t = allowable shear stress (lb/ft^2)
P = design precipitation intensity
F = flow concentration factor
n = Manning's roughness coefficient
Ss = stable slope in ft/ft

The solution is iterative due to dependence of the design precipitation intensity on slope length. A spreadsheet program was developed to determine the allowable slope length for a series of flow paths on overland areas. These paths were selected to represent maximum slope and slope length, while providing sufficient coverage of the area. The actual slope length is then compared to the allowable slope length to assure non-exceedance.

The proposed final cover material (radon barrier) is a clay overlain by a sand layer, filter, and rock mulch or topsoil. Several samples of the clay cover were analyzed for physical properties, including gradation, Atterberg limits, dispersion, permeability, etc. Four topsoil samples from two stockpiles were also analyzed for gradation and Atterberg limits. Based on the results of these analyses, the topsoil material ranges from a silty sand to a sandy lean clay. Using the relationships from Temple (1987), the computed allowable topsoil shear stress ranged from 0.074 lb/ft^2 to 0.097 lb/ft^2. The parameters used and calculation for each sample are:

TS-1, Silty Sand (SM), PI=31, Estimated void ratio = 0.48
C_e=1.42 - 0.61 e = 1.127, τ_{ab} = 0.058, τ = 0.074

TS-2, Silty Sand (SM), PI=21, Estimated void ratio = 0.48
C_e=1.42 - 0.61 e = 1.127, τ_{ab} = 0.058, τ = 0.074

TS-3, Clayey Sand (SC), PI=25, Estimated void ratio = 0.48 C_e=1.42 - 0.61 e = 1.127, τ_{ab} = 0.076, τ = 0.097

TS-4, Sandy Lean Clay (CL), PI=19, Estimated void ratio = 0.56 C_e=1.42 - 0.61 e = 1.08, τ_{ab} = 0.0706, τ = 0.082

The average allowable shear stress for the four topsoil samples is 0.082 lb/ft^2 and this value was selected for use in the Horton/NRC equation.

Actual and allowable slope lengths for non-rock mulch areas are presented in Table 5-3. For the purposes of computation, some contributing rock mulch areas were included in the flow paths. In particular, the downstream side of rock mulch berms were included in some paths and do not meet the allowable slope-length criteria for non-rock mulch areas. Rock mulch will be applied to the top and immediate downstream areas of these berms to a point at least 10 feet beyond the break in slope, thereby reducing slope length and runoff rate to acceptable levels. Some of the very mildly sloping areas on the tailings have differential elevations which are not adequately shown by the contour interval, and these elevation differences are presented in Table 5-3 for appropriate paths.

5.2.2.2 Channelized Flow

Peak flows and runoff hydrographs resulting from the design storm (see Section 5.2.1)(1-hr, 1-mi^2 PMP = 9.03 in.) were determined for the mill, tailings and solution pond area subbasins using the U.S. Soil Conservation Service (SCS) Dimensionless Unit Hydrograph option of the Army Corps of Engineers' (ACOE, 1985) HEC-1 computer model. The cumulative 1-hr PMP rainfall distribution (see Section 5.2.1 and Figure 5-2) was input to the model in one-minute increments.

The SCS Dimensionless Unit Hydrograph option of HEC-1 requires input of basin time of lag (tL) and SCS runoff curve number (CN). The time of lag for each subbasin was estimated using the following equation:

$$tL = 0.6tc$$

where:
tL = time of lag, in hours,
tc = time of concentration, in hours.

Time of concentration was determined using the Kirpich (1940) formula described in Section 5.2.2.1.

The runoff curve number was developed by SCS to define infiltration losses during a precipitation event. CN is dependent on the hydrologic soil group as defined by SCS, vegetation, land use and antecedent moisture condition (AMC). The majority of the non-tailings drainage areas are mine overburden piles or surface disturbance areas. The exposed materials range from well drained sands to poorly drained clays. For these areas, hydrologic soil group C was judged to be a conservative soil type. Hydrologic soil group C was also considered to be an appropriate soil classification for tailings areas where topsoil will be placed. Because the rock mulch and underlying sandy filter blanket will be well drained, hydrologic soil group A is considered to be appropriate in the areas where it will be placed.

SCS presents tables of representative curve numbers in TR-55 (SCS, 1986) based on average runoff condition (AMC II), cover type, hydrologic condition and hydrologic soil group. SCS' National Engineering Handbook, Section 4, Hydrology (SCS, 1972) presents ranges of curve numbers for varying antecedent moisture conditions. For estimating peak flows from the PMP, it is deemed appropriate to use AMC III, indicating wet conditions prior to occurrence of the PMP event.

In areas where native material is prevalent, or where the ground surface will be reclaimed with native materials, a CN of 91 was selected. Where rock mulch will be placed, a CN of 85 was used. In drainage basins where more than one cover material type will be placed, a weighted average based on relative areas was used. The CN used for each subbasin is given on Table 5-1.

The HEC-1 model allows determination of runoff hydrographs from individual subbasins, combining hydrographs from the separate subbasins, and routing individual or combined hydrographs to downstream points. Channel routing was considered, but the incorporation of surge pond storage and flow control structures tended to make lag due to channel routing inconsequential. However, the severity of the PMF event does result in very large flow depths for overland flow. These flow depths represent runoff storage which is not incorporated in the HEC-1 modeling. This results in extremely conservative (large) peak flowrates for channels.

Table 5-1 presents basin characteristics for each mill, tailings disposal pond and adjacent area subbasin. Appendix E presents HEC-1 input files and schematic diagrams of the stream network systems as they were modeled. Hydrographs for the 1-hr, 1-mi^2 PMP runoff event for the mill, tailings disposal and solution pond area subbasins are also presented in Appendix E.

In storage or surge pond areas, level-pool flood routing was used in the HEC-1 modeling. The storage volume was determined by measuring areas and depths within the ponded areas. These areas were taken directly from contours on Exhibit 5-1. The stage/discharge relationship for the flow control structures was determined with Manning's equation, using a constant n value of 0.05. A comparison was made with stage/discharge as predicted by HEC-2, with no significant differences (see Section 5.2.3.2 for more details).

5.2.2.3 Adjacent Area Drainage

The north area drainage (subbasins N-5 through N-14) and south area drainage (subbasins DM-1 through DM-6A) are adjacent to the tailings, but do not discharge to the tailings area drainage system. These channels are designed to accommodate a less severe storm than the PMF without impacting tailings drainage.

Potential impacts to the tailings are eliminated in one of two ways. In the case of the south drainage, the low slope drainage channel to the south has sufficient capacity to accommodate PMF flows. A berm between this drainage and the tailings area precludes flow from the southern drainage to the tailings area. Migration of any gullies will be along the channels or directly away from the channels and consequently, away from the covered tailings.

In the case of the North drainages, there is sufficient channel capacity to accommodate a 1000-year storm without overtopping. A more severe event will overtop either the surge pond in subbasin N-8, or the channel at the base of subbasin N-11. The lowest point on the berm that forms the surge pond in subbasin N-8 is at the north end of the basin, Failure at this point will discharge water down the reclaimed overburden pile north of the tailings. Fortunately, this overtopping point is at the upstream end of the surge pond, and a short-term overtopping would not short circuit the north drainage. Overtopping of the channel at the base of subbasin N-11 will eventually result in gully migration away from the tailings, However, the allowed overtopping in subbasin N-8 limits the flow through subbasin N-11 and should prevent overtopping in the lower channel under almost all circumstances.

Subbasin N-14 drains to the north through a channel constructed upgradient of the reclaimed access road. This channel is protected by a series of rock checks. These rock checks will be constructed with the intermediate riprap as shown in Figure 10-7. They will impound very small volumes of water upstream of the check and will serve as effective grade control for the minor channel. The reclaimed access road is deliberately sloped into the outslope of the reclaimed overburden pile both for safety reasons and to create an overbank channel. This channel will have sufficient capacity to carry the PMF. A small V-channel is used to capture runoff from subbasin N-12. The drainage area for this channel is very small. In the unlikely event of channel failure, migration of gullies would be directly away from the tailings.

5.2.3 Channel Conveyance Characteristics

Locations of channel cross-section sites and channel control structures in the mill and tailings disposal pond areas are shown on Exhibit 10-2. The channel cross-section sites have been designated with an "HC" prefix, which indicates hydrologic cross section. The "HC" prefix is followed by an "N", "4", "5", "S" or a "T", which indicates whether the site is in the north drainage, Pond 4 area, Pond 5 area, the south drainage which flows from the industrial pond area to the 2/8 reservoir or the confluence of all drainage to the 2/8 reservoir ("T" represents total), respectively. Finally, the cross-section designation is completed with a sequence number, which generally increases while moving downstream on the drainage. Stream profiles and their locations are presented in Exhibit 10-5.

5.2.3.1 Manning's Channel Conveyance

Manning's equation was used to estimate channel conveyance characteristics at each hydrologic cross section. This equation is as follows:

$$Q = (1.49/n)\ R^{2/3}\ S^{1/2}\ A$$

where:

Q = discharge, in ft^3/sec,
n = Manning's roughness coefficient,
R = hydraulic radius, in feet,
S = channel slope, in ft/ft, and
A = cross-section area, in ft^2.

Hydraulic radius is defined as the area of flow divided by the wetted perimeter. Manning's roughness coefficient was calculated using the Abt (1987) method for channels with a slope less than 10 percent, and it was calculated using the U.S. Army Corps of Engineers (ACOE) method for channels with slopes greater than 10 percent. The Abt method of determining Manning's n is as follows:

$$n = 0.0456\ (D_{50} \times S)^{0.159}$$

where:

n = Manning's roughness coefficient
D_{50} = the screen diameter through which 50% of the rock passes, in inches
S = channel slope in ft/ft

The ACOE method of determining Manning's n is as follows:

$$n = R^{.1667}/(21.95(\log_{10}\ (R/D_{50})) + 23.85)$$

where:

n = Manning's roughness coefficient
D_{50} = the screen diameter through which 50% of the rock passes, in feet
R = the hydraulic radius, in feet

The Stephenson (1979) method was used to determine rock sizes for slopes greater than or equal to 10% and the Safety Factors method was used to determine rock sizes for slopes less than 10%. Section 5.3 should be reviewed for a detailed discussion of riprap characteristics.

For each of the outlet locations, there is at least one area with a potential surge pond area upstream of a channel constriction. Channel-control structures or low-slope channels will be constructed at these sites in order to dampen peak flows. No permanent ponding over covered tailings will occur. However, there will be the potential for permanent ponding in the existing Industrial pond and the depression in basin D4-4. At channel control site HCT-1, retention time following the PMP runoff event is estimated to exceed 30 hours. However, the time that water will be impounded over buried tailings upstream of control site HCT-1 is estimated to be less than 20 hours. This is the longest time period for which ponding is expected over covered tailings. The hydrographs for subbasins and combinations of subbasins are presented in Appendix E.

Channel geometry and conveyance characteristics for all of the cross-section locations are presented in the Table 5-4 and the Manning's section of Table 5-5. The column labeled 'energy gradient' in both tables was taken from HEC-2 modeling of non-uniform flow. The rock sizing in Table 5-4 was done by the methods discussed in following sections using the energy gradient rather than the channel slope. At cross-section location HC4-13, the design rock is slightly larger than the target rock D_{50}. This cross section is located with the surge pond at maximum PMF stage, and a very slight undersizing is not significant. At two cross-section locations (HC4-9 and HC5-11) the required rock D_{50} is larger than the target rock D_{50}. Rock at both of these locations was sized by the Safety Factors Method using the energy gradient rather than the channel bottom slope. In both cases the channel bottom slope is much smaller than the energy gradient and the target rock size would be more than adequate if the channel bottom slope were used in rock sizing. The use of the energy gradient in the Safety Factors method is highly questionable, and it typically gives very conservative rock sizes in gradually to rapidly varied flow regimes. For this reason, the Stephenson method was used for rock sizing presented in the Manning's section of Table 5-5. Two rock porosities were used in these calculations. A rock porosity of 32.5% was considered appropriate for channel riprap, while a porosity of 45% provides a more conservative rock sizing.

The primary tailings area drainage features are the V-notch control sections located at cross-sections HC4-5, HC4-7, HCS-6, HCT-1, HC5-3, HC5-10, HC5-11, and HC5-13. With the exception of sections HC4-7 and HC5-13, the control structures are 50+ feet long V-notch sections with 2:1 side slopes and a base slope of 0.002 ft/ft. Sections HC4-7 and HC5-13 are relatively minor features and are at least 30 feet long. Channel sections HC5-1 and HC5-2 have side slopes that are much milder than 20H:1V and are essentially a swale type design. The channel sections downstream of cross-sections HC4-11 and HC4-12 are at very low slopes and the runoff will overtop the channel and be stored in the overbank area. The remainder of the channels will be simple and trapezoidal in shape with 4H:1V side slopes and bottom widths ranging from 20 to 50 feet. Figure 10-1 presents a channel cross section depicting the typical trapezoidal shape, 4H:1V side slopes and variable bottom width. Low slope channels on the tailings surface which serve as overland flow collectors have a less defined channel shape and typically have side slopes that are much less than 4H:1V. Riprap is also shown on this figure in a conceptual manner, with details of rock type and required size being given for each channel reach on Table 5-4. Figure 10-2 is a cross section sketch of HCT-1, the V-notch control with 2:1 side slopes.

Exhibits 10-2 and 10-5 through 10-8 show channel reaches where riprap will be required in the mill and tailings disposal pond areas. The differing patterns on these exhibits depict different rock types which will be used. Sections 3.3 and 5.3 present more detailed information on riprap properties and characteristics.

The control section HC4-7 is intended to allow discharge to the small depression in subbasin D4-4 during low flow events and is only two feet in height. During more extreme events, the entire control structure will be submerged by storage upstream of control section HCT-1.

There are three locations where major channels converge at angles between 45° and 135°. The first is immediately upstream of cross section HC5-11 where the channel is discharging into a surge pond upstream of a V-notch control. The second is the confluence of channels D, I, and M in the surge pond in the former No. 4 Pond. The potential for erosion by flowing water at these confluences is eliminated by ponding. The third location is the confluence of channels A and D. Channel A is a very minor channel, and it is unlikely that the short duration peak flow could create a significant wave affect.

5.2.3.2 HEC-2 Channel Conveyance

In order to simulate PMF water-surface profiles in channels in the tailings reclamation area, the U.S. Army Corps of Engineers model, HEC-2, was utilized (ACOE, 1982). The HEC-2 model is intended for calculating water-surface profiles for steady and gradually varied flow in natural or man-made channels. Both subcritical and supercritical flow profiles can be calculated.

The following channels, the locations of which are shown on Exhibit 10-5, were simulated with HEC-2: A, D, H, I, M, N, O, P and Q. Exhibit 10-5 presents longitudinal profiles for these channels. Exhibits 10-6 through 10-8 present profile location details at a larger scale. Cross sections included in the simulated channels include: HCT-1, HCT-2, HCT-3, HC4-1, HC4-2, HC4-3, HC4-5, HC4-6, HC4-9, HC4-10, HC4-11, HC4-12, HC4-13, HC5-1, HC5-2, HC5-3, HC5-4, HC5-5, HC5-6, HC5-7, HC5-8, HC5-9, HC5-10, HC5-11, HC5-12 and HC5-14. Channel C and other off-tailings channels were not simulated with HEC-2. During the PMF, some erosion in these channels would be possible. However, because they are located off of the tailings, any potential erosion would not threaten exposure of the tailings. Other channels, including B and G, have a relatively uniform slope, and Manning's equation calculations and HEC-2 results are essentially the same. Therefore, HEC-2 simulation was not considered necessary for these channels.

In some of the simulated channels, some cross sections shown on Exhibit 10-5 were not included in the HEC-2 simulations. These include, for example, HC4-7 and HC4-8. The channel reaches in and near these locations are very flat, they are generally upstream from channel control structures, and they will therefore be subject to backwater conditions at low flows, as well as during the PMF. These cross sections are shown on Tables 5-4 and Table 5-5 as being ponded.

Cross-section HCT-1, located on Channel H, is a V-notch control section with ponding upstream of the section and is used to verify the stage-discharge rating table used in the HEC-1 simulation of the tailings area. The following table shows the comparison between the HEC-2 generated stage-discharge relationship at HCT-1 and that generated using Manning's equation.

DISCHARGE	HEC-2 STAGE (n = 0.035)	HEC-2 STAGE (n=0.05)	MANNING'S EQN STAGE (n =0.05)
(cfs)	(ft)	(ft)	(ft)
100	3.9	4.2	4.2
200	5.0	5.3	5.4
300	5.8	6.2	6.3
500	7.1	7.4	7.6
800	8.4	8.8	9.1
1000	9.2	9.5	9.9
1500	10.7	11.1	11.5

Based on the above comparison, it is concluded that use of Manning's equation is adequate in determining stage-discharge relationships at channel controls.

The HEC-2 channel analysis was conducted with a constant Manning's n of 0.035. This was done for the sake of simplicity and to avoid iteration between rock sizing, adjustment of Manning's n, and re-analysis with HEC-2. The rock sizing for the HEC-2 analysis was done with the Stephenson method and a constant Manning's n. This was also done to simplify the HEC-2 design procedure. Varying both the rock sizing method and the Manning's n requires numerous simulations with successive adjustments in channel geometry and slope conditions. In general, the HEC-2 simulations indicated that the transition areas downstream of the control structures were critical areas due to steeper energy gradients in the gradually varied flow profile.

The results of the HEC-2 analyses are presented in Table 5-5, which is divided into two parts. The first part gives PMF channel conveyance characteristics at channel cross-section locations based on Manning's equation. The second part gives channel conveyance characteristics based on HEC-2 simulations. In the HEC-2 analysis, many intermediate cross sections were simulated, in addition to the "HC" cross sections. These intermediate cross sections are designated with a channel descriptor letter prefix, and the channel station. For example, A-200 is located in Channel A at station 2+00. The channel stations are shown on Exhibits 10-5, 10-6, and 10-7, and are given in feet. Therefore, A-200 is located at station 2+00 and is 200 ft upstream from the downstream end of Channel A.

The channel geometry, riprap sizing, and channel transition design are shown on Exhibit 10-2. The HEC-2 simulations revealed the need for more gradual transitions and larger riprap immediately downstream of the control sections. Changes in channel geometry in the transition areas are gradual. For example, the channel geometry gradually changes from a V-notch with 2H:1V side slopes at station H-1470 to a trapezoidal channel with 40 ft. base width and 4H:1V side slopes at station H-1280 (Table 5-5). The energy gradient was used in the sizing of the riprap for these areas. In all cases, the energy gradient was significantly greater than the channel bottom slopes immediately downstream of the control. The use of energy gradient to size riprap in these areas should provide a very conservative design.

In general, channel conveyance characteristics determined using HEC-2 and Manning's equation compare very well in relatively uniform stream reaches, because the energy gradient closely approximates the channel bottom slope. In areas where the stream profile is changing rapidly because of changing bottom slope or channel constrictions due to control structures, HEC-2 is better able to account for those changes.

HEC-2 input files used to simulate Pathfinder's tailings reclamation channels and the resulting output files were furnished to the NRC on a disk due to the volume of tabulated data. The input file listings are also included in Appendix F.

5.3 Rock Design and Placement

Rock erosion protection is used in channel sections and on the tailings surface as a rock mulch. The source of rock is a granite outcrop. Rock properties are discussed in Section 3.3.

5.3.1 Rock Mulch Design

Overland flow paths discussed in a previous section were used in determining discharge for rock mulch design and sizing. The segmentation of the flow paths into uniform slope segments will allow the use of more than one mulch size on each flow path (see Table 5-2). However, for construction purposes, the use of one mulch in a specific area was the preferred solution. Where this was the case, the mulch was sized or designed for the extreme condition. Thus, the rock mulch is conservatively designed for much of the tailings surface. The Safety Factors method was used for rock design for slopes of less than 10%, and the Stephenson (1979) method was used for slopes of 10% and greater. The Abt (1987) method was used to determine Manning's n for all rock mulch areas. The parameters that were used in the rock mulch design include:

Safety Factor (SF method) = 1.05
Rock Porosity = 0.45
Specific Weight of Rock = 165 lb/ft^3
Rock Shape = Angular

According to NUREG/CR-4620 (Nelson et al. 1986), a safety factor slightly greater than 1 is sufficient for PMF applications. Rock porosity is dependent on percentage of fines and placement procedures. A study by Abt et al. (1987) used small D_{50} riprap with porosities ranging from 0.44 to 0.46. The riprap use by Abt et al. (1987) was fairly uniform and the granite is expected to yield similar surface porosities for rock mulch. Specific gravities

(SSD) for the granite ranged from 2.64 to 2.65, giving a specific weight of 165 lb/ft^3.

There are very few areas where overland flow from a non-tailings area flows onto a tailings protection area. Flow lengths for these areas are limited to 450 feet, and the flow from these areas will not compromise the final tailings cover. In the overland flow analysis, these non-tailings segments were included in determination of peak flow.

The granite will be mined from a quarry area located approximately 15 miles northeast of the mill. The final gradation of the mined material is unknown and is expected to vary with depth and required processing techniques. The majority of the rock is expected to require blasting and crushing to produce the desired product. Gradation of the processed granite will be monitored during construction, and processing or design adjustments will be made if necessary.

The eventual rock mulch configuration will be dictated by crushing and processing limitations and construction constraints. The minimum placement thickness for a layer of rock mulch or filter material is 3.6 inches. The areas where rock mulch will be used are shown on Exhibit 5-1 and Exhibit 10-2. The rock mulch will be placed to a thickness of 2.0 times the D_{50}, or the D_{100}, whichever is greater. The D_{100} thickness requirement may be waived if the rock can be placed to achieve a smooth uniform surface. At the base of the reclaimed No. 5 dam outslope, the rock mulch will extend through a drainage channel at the base of the slope or a rock toe will be installed. The design of the rock toe is detailed in subsequent sections.

The rock mulch size presented on Exhibit 10-2 in Volume II is a minimum D_{50}. If placement or rock crushing constraints require a larger rock, larger rock may be substituted for smaller rock with appropriate adjustments in thickness and filter requirements.

The filter layer may consist of a dual filter design or a single filter design. Where a dual filter is employed, the lower filter layer will consist of a sandy material from the dump piles. Gradation requirements for the filter are discussed in a later section. The upper filter will consist of the crushed granite which has been subjected to additional crushing and processing or screenings from the granite crushing operation. Where a single filter design is employed, the filter will consist of a crushed and processed granite.

5.3.2 Rock Riprap Design

The riprap design was done with the same rock sizing methods used for rock mulch design with the exception of the HEC-2 and non-uniform analyses, where the Stephenson method was used exclusively. The Abt (1987) method was used to determine Manning's n for slopes of less than 10%, and the Army Corp. of Engineers (ACOE) method was used to determine Manning's n for slopes greater than or equal to 10%.

For all areas discharging from or through the tailings drainage, the peak PMF discharge was used in sizing channel riprap. Tables 5-4 and 5-5 list channel conveyance characteristics for the PMF. Rock riprap designs for off-tailings drainage areas are not included in the tables because these areas are not subject to PMF design criteria. Four design rock sizes (D_{50}'s of 0.150 ft., 0.400 ft., 0.600 ft, and 1.200 ft.) are presented in Table 5-4 for channel cross-section locations. The rock sizes are designated rock mulch, small riprap, intermediate riprap, and large riprap.

End protection structures are included just downstream of cross-sections HCT-1, HC5-5 and HC5-14 and at the Mine Creek outlet of subbasin 5-4. Channels and riprap upstream of these cross-sections are designed according to peak PMF runoff.

5.3.3 Non-uniform Flow Channel Rock Sizing

Determination of appropriate rock sizes in non-uniform flow is problematic in that all rock sizing methods were developed for uniform flow conditions or indirectly incorporate the assumption of uniform flow. The Stephenson method, which was used for rock sizing in channels where HEC-2 water surface profiles were developed, is expressed as:

$$D_{50} = [\frac{q(\tan\theta)^{7/6} n_p^{1/6}}{C g^{1/2}[(1-n_p)(G_s-1)\cos\theta(\tan\phi-\tan\theta)]^{5/3}}]^{2/3}$$

where:

D_{50}	=	required rock diameter in feet, (50% of the rock must be larger than this),
q	=	maximum flow rate per unit width,
θ	=	angle of channel bottom from horizontal,
ρ	=	angle of friction for the rock,
n_p	=	rockfill porosity,
G_s	=	specific gravity of the rock,
g	=	the acceleration of gravity, and
C	=	empirical factor which varies from 0.22 for gravel to 0.27 for crushed granite.

The assumption of uniform flow is implicit in the use of γ, the channel bottom angle. Since sin(γ) and tan(γ) are approximately equal to channel bottom slope expressed in rise/run, the channel bottom slope is often substituted for sin(γ) and tan(γ).

Under non-uniform flow conditions, intuition suggests that shear stress can increase, particularly when the energy gradient is greater than the bottom slope. To compensate for this, it has been suggested that the larger of the channel bottom slope or the energy gradient be used for rock sizing. However, this substitution can be inappropriate when the actual increase in shear stress is calculated.

The equation describing shear stress on a channel base was developed from the momentum equation for open channel flow. Barfield et al. (1981) presents a functional form of this equation on a per unit width basis as:

$$\frac{\gamma y_1^2}{2} - \frac{\gamma y_2^2}{2} + W\sin\theta - R_f = \rho q (V_2 - V_1)$$

where:

γ = unit weight of water,
y_i = flow depth at point i (i = 1 is upstream station and i = 2 is downstream station),
W = weight of water in the control volume between station 1 and 2,
θ = angle of the channel bottom from horizontal,
R_f = resistance force exerted on the flow by the channel base,
ρ = the density of water, and
V_i = velocity at station i.

For the entire channel cross-section, resisting force (R_f) can be approximated as the product of shear stress (τ), wetted perimeter (P) and control volume channel length (L). This assumes that shear stress at the free water surface is negligible, which adds some degree of conservatism. Weight of the water in the control volume (W) is the product of the cross-sectional area of flow (A), the length of the control volume (L), and the specific weight of water (γ). These relationships are expressed below, along with a conversion from density to specific weight.

$$R_f = \tau P L$$

$$W = A L \gamma$$

$$\rho = \frac{\gamma}{g}$$

When these relationships are substituted into the momentum equation with a conversion from a unit width basis to the cross-sectional flow area (multiplication by average flow width, b_a) and expressed in terms of shear stress, the result is:

$$\tau = \frac{1}{PL}\left[\frac{\gamma}{2}(y_1^2 - y_2^2) + A\,L\,\gamma\,\sin\theta - \frac{\gamma\,q}{g}(V_2 - V_1)\right]$$

Uniform flow conditions result when $y_1 = y_2$ and $V_1 = V_2$. Incorporation of these expressions and the substitution of S for $\sin\theta$ and hydraulic radius (R) for A/P results in:

$$\tau = \frac{\gamma\,A\,L\sin\theta}{P\,L} = \gamma\,\frac{A}{P}\sin\theta = \gamma\,R\,S$$

For wide trapezoidal channels with shallow flow depths, the flow depth (y) is often substituted for the hydraulic radius (R). This is not appropriate for channels where the ratio of channel base width (b) to flow depth (y) is less than 10. Use of the flow depth rather than the hydraulic radius grossly overestimates shear stress for V-notch channels and channels with a b/y ratio less than 5.

The Stephenson rock sizing method presented earlier does not use shear stress directly. Rather, the method uses the channel bottom slope and a unit discharge (q) which indirectly represent the shear stress. For non-uniform flow conditions, the most appropriate means of adjusting rock size for increased shear stress is to determine an equivalent slope for the non-uniform flow conditions. Although the use of energy gradient is appealing because of its simplicity, the following example indicates that use of energy gradient is not appropriate.

An example channel section from channel H was chosen to illustrate the adjustment of slope for non-uniform flow conditions. The increased shear stress was determined at station 1357, a transition area where the channel base width is expanding. The bottom slope of the channel is approximately 0.002 ft/ft, and the energy gradient from the HEC-2 model was 0.034 ft/ft. The shear stress calculated by the uniform flow shear stress equation was 0.212 lb/ft^2 using the bottom slope and 3.61 lb/ft^2 for the energy gradient. The shear stress calculated by the non-uniform flow shear stress equation was 3.21 lb/ft^2. This illustrates that there is an increase in shear stress when the energy gradient is much greater than the bottom slope, but that using the energy gradient in the definition of shear stress for uniform flow typically overpredicts that increase in shear stress. The determination of the equivalent slope for the increased shear stress is accomplished by rearranging the uniform flow shear stress equation as:

$$S = \frac{\tau}{\gamma R}$$

Using the increased shear stress of 3.21 lb/ft^2, the equivalent slope for station 1357 is 0.0302 ft/ft. This slope can be used in rock sizing methods to compensate for increased shear in non-uniform flow.

For V-notch channels or transition areas where the depth to base width ratio for the channel is fairly large, the shear stress distribution varies dramatically across the channel. To compensate for this, both an average unit flowrate and a maximum unit flow rate will be used in the Stephenson rock sizing method. Maximum unit flow rate will be calculated as the product of average velocity and maximum flow depth. For V-notch channels, maximum unit discharge can be more than three times the average unit discharge.

There is an increase in shear stress and required rock size in channel bends. This increased shear stress can be estimated using a method presented by USACOE, (1970). This method is based on Plate 34 of USACOE (1970), which is a figure relating the ratio of increased shear in bends to the ratio of channel bend radius divided by water surface width. The equation for this ratio of shear stress for smooth channels is given as:

$$\frac{\tau_b}{\tau_o} = 2.65\left(\frac{r}{w}\right)^{0.5}$$

where:

τ_b = maximum boundary shear in bend,
τ_o = average boundary shear,
r = center-line radius of channel bend, and
w = upstream water surface width of bend.

Unfortunately, this equation does not produce results that correspond with the figure in Plate 34 of USACOE (1970) and the correct form of the equation should be:

$$\frac{\tau_b}{\tau_o} = 2.65\left(\frac{w}{r}\right)^{0.5}$$

For rough channels, the plotted data indicates that the constant 3.1 should be substituted for the constant 2.65 in the preceding equation. However, there are only two data points for a very small r/w ratio (less than 1.6) to support the rough channel constant, and these values were determined from a two foot wide flume. Very little confidence can be placed in the increased constant (3.1) and results derived with this form of the equation should only be used in a qualitative manner. Using this equation with the alternate constant, the minimum w/r ratio is 0.104. Below this value there is no increase in shear stress due to the channel bend.

All of the shear stress and rock sizing adjustments discussed above are included in the channel riprap design (Table 5-6). The Stephenson method was used to determine required rock size for each section on channels analyzed with the HEC-2 program. Manning's n was set at 0.035 to avoid iteration between flow characteristics and rock sizing. The parameters used in the rock sizing were a granite specific weight of 165 lb/ft^3 and rock layer porosity of 32.5%. The specific weight values were from measured properties and the porosity estimate was taken from Stephenson (1979), who gives porosity values ranging from 15% to 40%. Table 5-5 also includes the target rock D_{50} to show compliance with rock size requirements at each station in each channel.

5.3.4 Hydraulic Jump Analysis

The potential effect of hydraulic jumps in the channel was evaluated. Potential locations for hydraulic jumps were determined by noting all slope transitions from mild to steep slopes while moving upstream in the channels. These locations include: Channel D at Stations 0 to 200, Channel H at Stations 0 to 300, Channel H at Stations 1700 to 1900, Channel M at Stations 100 to 350, Channel Q at Stations 130 to 250 and Channel Q at Stations 1350 to 1500. The potential for a hydraulic jump in Channel H downstream of the control structure between Stations 1050 and 1300 was also evaluated. It was found that formation of a jump at this location is unlikely (see Table 5-7), and that the rock at this section is already grossly oversized. With the exception of Channel H at Stations 0 to 300 and Channel Q at Stations 130 to 250, the potential hydraulic jump locations occur in a ponded or backwater area. The depth of ponding is such that a jump will be completely submerged.

Table 5-7 presents the results of the hydraulic jump analysis for the sections listed above. The flow characteristics for the channel section were determined assuming uniform flow at three different flowrates. These flowrates were: peak PMF flow, 1/2 peak PMF flow and 1/10 peak PMF flow. This was done to identify potential migration of the jump under various flow conditions and to determine threshold jump formation conditions. The downstream backwater condition for the very flat plain discharge area for channel H was not considered.

The location of the hydraulic jump is indicated in Table 5-7 by the bold, underlined values in the Froude number column. These values bracket the transition through critical flow (Froude number equal to 1). The station values corresponding to these noted Froude numbers therefore bracket the location of the jump. In some cases, Froude numbers approaching one were designated with underlining to indicate that a jump could occur at that location with only a slight change in flow conditions.

For each jump location, a turbulent flow rock size was determined by multiplying average unit flowrate by 1.5 and sizing rock for that unit flowrate using the Stephenson method. The channel bottom slope was used in the rock sizing, along with rock characteristics discussed in earlier sections. The target rock size and design rock size (for maximum unit flowrate) were taken from the analysis summarized in Table 5-5 and included in the columns 10 and 11 of Table 5-7.

The last column in Table 5-7 lists the ratio of target rock size to design rock size. The turbulent design rock D_{50} was used for jump locations. This ratio is essentially an adequacy ratio of the rock for the more severe turbulent condition. The ratios for the Channel H and Channel Q jumps indicate that the rock is more than adequate to withstand additional shear stress occurring near the jump.

5.3.5 Standing Wave and Confluence Analysis

The potential for development of wave pileup or standing waves at channel confluences was evaluated by examining all major confluences for characteristics that could result in occurrence of significant wave action. The PMF hydrographs presented in Appendix E were examined to determine whether the duration of severe hydraulic conditions for key sites warranted quantitative analysis.

As an example PMF duration condition, the hydrograph for channel cross section HC4-9 was examined (see Figure E-1). The confluence of Channels A and D is located just downstream of this cross section. The peak PMF flow of approximately 180 cfs occurs approximately 45 minutes after the start of the storm. At times ten minutes before and after the peak flow, the approximate flows are 48 and 88 cfs, respectively. This gives a indication of the extreme brevity of the peak flows. Preliminary calculations indicate that the 1000-year return period storm will produce peak flows that are 10% to 25% of the PMF peak flows. Given the very low probability of occurrence for the PMF and the extremely short duration of peak PMF flows, a quantitative analysis for this condition does not seem worthwhile. Rather, a qualitative assessment of the vulnerability of critical confluences should be sufficient.

The locations of major confluences evaluated were as follows: confluence of Channels A and D, confluence of Channels P and O, confluence of Channels D and I, and confluence of Channels M and I. For the confluences listed, only the confluence of Channels A and D occurs under non-ponded conditions. Channel A is considered a minor channel and the flow depth is approximately 1 foot at the confluence. It is unlikely that wave action resulting from this limited flow depth could be significant.

5.3.6 Scour Analysis

The potential for scour downstream of the rock aprons or end protection structures was evaluated with several methods. End protection structures are used on all applicable channel sections and a rock toe is used where there is a transition from rock mulch to non-rock areas. The scour potential was evaluated at these areas by up to six methods. Unfortunately, most scour evaluation techniques were developed for continuous flows under hydraulic conditions that are dramatically different than those that occur in the tailings basin. Only one method (United States Department of Transportation or USDOT, (FHA, 1983)) appears to be of some use in evaluating scour for these conditions.

The use of surge ponds and control sections in the drainage design results in only four locations where tailings area drainage is released from a riprap channel to a non-protected sloping channel. These are the downstream ends of channels H, D, Q and the end drainage from subbasin 5-4. This downstream grade control will produce a tailwater condition which limits scour depth.

An attempt was made to evaluate scour potential for channels using three traditional methods that were intended for continuous flows with a large flow depth, such as a dam spillway. These methods are the Schoklitsch, Eggenberger, and Jager formulas (Barfield et al., 1983) which are presented below in the same order as listed.

$$d_s = S + h_d = 4.75 \frac{H^{0.2} q^{0.5}}{D_{90}^{0.32}}$$

$$d_s = S + h_d = C \frac{H^{0.5} q^{0.6}}{D_{90}^{0.4}}$$

$$d_s = S + h_d = 6 H^{0.25} q^{0.5} \left[\frac{h_d}{D_{90}}\right]^{1/3}$$

where:

d_s = distance between downstream water level and bottom of scour hole (meter),
h_d = downstream water depth (meter),
H = vertical distance between the upstream and downstream energy grade line (meter),
q = unit discharge (meters^2/sec),
D_{90} = the particle size for which 90 percent of the material is finer (mm), and
C = constant which is 22.8 for existing conditions.

Unfortunately, the head difference, H, was very sensitive to hydraulic conditions for the PMF condition and it was not possible to get the methods to yield results without highly artificial manipulation of the hydraulic conditions. This is primarily a result of the small flow depths and the limited elevation differences. With this manipulation, it was determined that the methods were not appropriate and that the results were of no value.

The use of the continuous flow scour analysis technique for the highly infrequent and extremely short duration flows for the design condition is a gross misapplication of methodology. The extreme sensitivity of the method to flow conditions also indicates that the methods are not appropriate. By the same reasoning, flow regime methods such as Lacey's stable channel design procedures should not be used for highly ephemeral channels. In addition to the difficulty of relating scour depth to a deviance from the stable channel slope, the use of a very short duration PMF design peak flow is not consistent with the intent of producing a stable channel design under steady flow.

Alternative methods for calculation of the scour include the USDOT method and an earlier method which will be designated the Federal Highway Administration (FHA) methods. Both methods where intended for protection of culvert outlet areas and should therefore produce conservative designs for riprap to earthen transitions where there is no distinct change in channel geometry.

In fact, both methods are very similar and it appears that the USDOT method is an update of the FHA method. The USDOT method includes both a peak flow duration and a base flow duration and should be most applicable for these highly ephemeral flow conditions. Two versions of the USDOT equation are provided for cohesive and non-cohesive base materials.

The USDOT cohesive, USDOT non-cohesive, and FHA formulations are as follows:

$$D = \frac{A}{2}^{0.5} \alpha \left[\frac{\rho V^{2}}{\tau_{c}}\right]^{\beta} \left(\frac{t_{1}}{t_{0}}\right)^{\theta}$$

$$D = \frac{A}{2}^{0.5} \alpha \left[\frac{Q}{\left(g^{0.5}\left(\frac{A}{2}\right)^{0.5}\right)^{2.5}}\right]^{\beta} \left(\frac{t_{1}}{t_{0}}\right)^{\theta}$$

$$D = \frac{A}{2}^{0.5} \alpha \gamma \left[\frac{Q}{\left(\left(\frac{A}{2}\right)^{0.5}\right)^{2.5}}\right]^{\beta} (t_{1})^{\theta}$$

where:

D	=	Scour depth (feet),
A	=	Flow area (square feet),
g	=	acceleration of gravity,
t_1	=	time of peak flow (minute),
t_0	=	base time of flow (minute),
Q	=	flowrate (cfs),
V	=	flow velocity (fps),
τ_c	=	critical shear stress (lb/ft^2)
ρ	=	fluid density,
$\alpha,\beta,\theta,\gamma$	=	scour dimension coefficients that are specific to the method.

The base soil condition is expected to range from a very cohesive shale and clay material to a graded sand. The critical shear stress, τ_c was estimated for a cohesive clay as 0.12 lb/ft^2.

Scour depths in Table 5-8 were calculated for the cohesive clay and shale using α, β, and θ coefficients of 1.37, 0.18 and 0.10. Additional scour depths were calculated for a graded sand with a D_{50} of 2.0 mm. using α, β, and θ coefficients of 0.75, 0.85 and 0.07. For the FHA method, the α, β, θ, and γ coefficients of 0.76, 0.375, 0.10 and 1.0, respectively, where taken from Table 7.8 of Barfield et al. (1983). The results of calculations for both methods are presented in Table 5-8.

Peak flow and base flow durations in Table 5-8 were taken directly from hydrographs for each channel cross section. The duration of the peak was defined as the time during which the flow exceeded 90% of the peak flowrate. The duration of the peak and base flow were arbitrarily set at 10 and 60 minutes for the overland flow paths. The overland flow paths were used to determine required depth of the toe at the edge of the rock mulch.

Uniform flow conditions were assumed for the scour analysis. The Manning's n for rock areas was set at 0.035 and the n value for earthen areas was set at 0.015. The calculated scour depths for these design conditions are presented in Table 5-8. The required depth of the end protection structures for channels H, N and Q is 4.5, 4.5 and 7 feet, respectively. as indicated by the USDOT. The channel N end protection structure was extended to a depth of 15 feed for conservatism. The natural channel downstream of the end protection structure for the outlet of subbasin D5-4 is at a very mild slope, and a end protection depth of 4.5 feet should be more than adequate. The two feet deep rock toe designated for overland rock to non-rock transitions is more than adequate as indicated by Table 5-8. Lateral flow along the rock toe is not expected to be a problem because upland drainage area has been deliberately limited.

5.3.7 Sedimentation Analysis

Potential sedimentation in channels and surge ponds in the tailings area is nearly eliminated by exclusion of non-tailings sediment, the potential for accumulation of detrimental volumes of sediment in tailings drainage channels is virtually nil. A qualitative discussion of sediment accumulation impacts for key drainage basins follows.

There is potential for accumulation of sediment in the surge pond located in subbasin D4-4. Subbasin D4-4 is not within the tailings area. Sediment may accumulate in the surge pond at the base of the subbasin, but this storage volume was not considered in flood analysis and this accumulation will not adversely affect flood analysis based on level-pool flood routing. Depth of sediment in the surge pond will have to approach 12 feet before the sediment will completely fill the surge pond.

There is a small portion of subbasin D3-1 that is not within the tailings protection area. The configuration of the confluence of channels G and I will result in the discharge of the majority of the sediment down channel H. Likewise, there is a small portion of the drainage area for channel Q that is not within the tailings protection area. Again, the channel configuration will allow for the transport or flushing of the small quantities of sediment delivered to the channel.

The majority of the south area discharges through the Industrial Pond and associated surge pond area. The permanent pool area in the reclaimed Industrial Pond was assumed to be full in the flood analysis. Therefore, this volume is not necessary to preserve PMF capacity. Approximately 15 feet of sediment accumulation in the Industrial pond, followed by 4 feet of accumulation in the breech drainage channel would be necessary to reduce the channel to a 1 foot flow depth. Any sediment which does accumulate in the channel will be subject to flushing during more severe events.

The north drainage area has a series of four staged surge ponds, and all of the drainage area passes through at least one of the surge ponds. The use of this volume of temporary storage should nearly eliminate sediment delivery to the lowest surge pond in subbasin N-13. The surge ponds in subbasins N-6, N-7 and N-8 have sufficient capacity to absorb a tremendous volume of sediment with no significant detrimental effects. The general land slope of contributing areas to these ponds is very mild, and the sediment delivery to the upland ponds will be very small.

5.3.8 End Protection and Rock Toe Design

The scour depths discussed in Section 5.3.6 were used to determine the geometry and rock sizing in end protection structures. The length and slope of the end protection structures were designed to provide a stable channel bottom under PMF conditions if excessive scour does occur.

Under assumed uniform flow conditions, the Stephenson method was used to determine the stable slope of the end protection structure (see Table 5-9 and Figure 10-4). Manning's n was held constant at 0.035. The stable slope and specified scour depth then dictated the length of the end protection structure. It should be noted that the end protection structures are designated on relevant exhibits (e.g. Exhibit 10-2) by location only. The majority of the end protection structure will be covered by general fill and, therefore, scale of these structures on the exhibits is of little value. The end protection structure for the outlet of subbasin 5-4 will use the intermediate rock and will have dimensions as indicated in Table 5-9.

The design of rock toe protection at the base of rock mulch protected slopes is very similar to the end protection design. The rock mulch will be used and the toe protection will extend to a depth of 2 ft. (see Figure 10-6). Table 5-9 indicates a slope of 0.27 ft/ft will be a stable slope for the rock toe.

5.3.9 Rock Layer Thickness Oversizing

Abt (1988) presents a rock size adjustment based on placement thickness (Figure 4.8) for rock with a D_{50} less than six inches. This figure indicates that no rock sizing adjustment is required for a thickness of 3 times the D_{50}. At a thickness of 2 times the D_{50}, the figure indicates that the rock should be oversized by a factor of 1.2. The rock sizes in Table 5-2 were evaluated to determine if this adjustment was necessary. Of the 49 rock sizes in Table 5-2, only six required rock D_{50}'s exceed 83% (1 divided by the oversizing factor of 1.2) of the target rock D_{50}. When one considers that the rock sizes were determined for the flow at the end of a flow path segment, the portion of rock mulch area that does not already incorporate the oversizing factor is probably in the neighborhood of 1%. With a PMF design condition, further oversizing or overthickening is not necessary, particularly when the affected area is so small and all other design considerations are grossly conservative.

5.3.10 Non-Tailings Channel Design

The drainage system design for the areas adjacent to the tailings was done by methods similar to those used on the tailings. Table 5-10 presents the channel design for the channel cross-sections on north drainage and south drainage areas. For the sections shown, the rock riprap size and channel capacity is more than adequate for the 1000-year storm design flow. Just downstream of control section HCN-1, (a 2:1 side slope V-notch section) there is a transition to small riprap on a mildly sloping low-water crossing. Immediately downstream of this section, the design riprap is the large riprap on a 0.25 ft/ft slope. This riprap is slightly undersized for a 1000-year design storm, but is grossly oversized for a 100-year design storm.

For the south drainage, the channel capacity and rock size for Channel C is more than adequate for a 1000-year storm, and the channel capacity is adequate for a PMF. Likewise, the channel capacity of the Industrial Pond breech channel is large enough to accommodate the PMF with freeboard. The channel rock for the section that conveys the south drainage to the Area 2/8 reservoir will be sized to withstand the 100-year storm.

5.4 Consolidation Analysis

Substantial consolidation of the tailings will occur as the tailings dewatering progresses. There is currently a large volume of water in the tailings facility. Current efforts are directed to eliminating tailings solution. Dewatering wells are in place on ponds 4 and 5 (TW4- and TW5- wells) and are operational. Tailings consolidation to date is expected to be limited to that occurring in sandier areas above the water table, which represents only a small portion of expected settlement.

5.4.1 Settlement Monument Analysis

Settlement monuments have recently been placed on the tailings. The location of the 13 monuments is presented in Exhibit 5-3. Fifteen additional monuments will be installed before January 2001 to provide additional coverage and to replace destroyed monuments. A construction detail for the monuments is shown in Figure 11-1. Progression of consolidation or settlement will be interpreted primarily by monitoring of settlement monuments. Some predictive analysis was conducted and the results of this are discussed later in this section. However, the heterogenous and stratified nature of the tailings, in conjunction with complex

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drainage conditions, makes predictive consolidation modeling a very uncertain process. For this reason, the actual settlement measurements are considered more valuable.

Settlement monitoring will be performed on a monthly basis until water levels in both ponds are approaching the base of the tailings or until the t_{90} has been reached. The t_{90} will be evaluated by plotting the settlement vs. square root of time or by plotting settlement vs. log of time.

5.4.2 Subsidence Calculations

Consolidation tests were conducted on five samples of tailings materials. One of the samples (TW4-1B, 25'-27') was a mixed sand and clay; two of the samples (TW4-2C, 40'-42' and TW4-3C, 42'-43') were fat clays; and the remaining samples (TW4-5B, 5.5'-8' and TW4-1C, 3'-5') were sands. The results of laboratory testing are presented in Appendix C. All samples were taken with a Shelby tube sampler to minimize disturbance. Sample were subjected to various loading conditions ranging from 0.5 to 8.0 ksf.

Results of the laboratory tests show a large variability in the consolidation characteristics. Initial void ratios in the samples ranged from 0.759 to 2.007 (see Table 5-11). Coefficients of compression ranged from 0.039 to 0.673, with averages of 0.065 for the sand tailings and 0.248 for the mixed and clay tailings.

An analysis of predicted settlement was conducted to develop estimates of required fill and to determine the potential magnitude of differential settlement. Differential settlement will have to be corrected, particularly in non-rock protected areas, but this is not expected to require large volumes of fill.

A very simple model of consolidation was used to predict total settlement for Pond 4 and Pond 5. The results of this modeling are presented in Table 5-12. The model of consolidation is based on

Terzaghi's consolidation theory. Total settlement due to consolidation can be estimated using the relationships:

$$\Delta H = \frac{HC_c}{1+e_1}\log\frac{\overline{P}_j}{\overline{P}_i}$$

and

$$\overline{P} = P - U_w$$

where:

ΔH = settlement, ft
H = layer thickness, ft
C_c = compression index
e = void ratio
$\overline{P}$ = effective stress, Ksf
i,j = subscripts indicating initial and final conditions
P = total stress, Ksf
U_w = pore water pressure, Ksf

Depth of tailings for each of the well locations was determined from well logs and a predicted settlement was computed for each location. A composite compression index for the tailings was based on estimates of sand/clay fractions from well logs.

The cover surcharge was assumed to be 3 ft of material at a density of 110 lb/ft^3. A void ratio of 1.0 was used for both materials. Calculations were made on 1 ft increments for simplicity in programming. The maximum predicted settlement on Pond 4 is 1.4 ft, and the maximum predicted settlement on Pond 5 is 1.48 ft.

The magnitude of settlement in many areas produces a greater strain than a clay radon/infiltration barrier can withstand without losing effectiveness. Placement of the final clay barrier will not be started until settlement monitoring indicates that the rate of consolidation has dropped and the t_{90} has been reached. After this point, settlement is not expected to affect the integrity of the clay cap. If any clay radon/infiltration barrier material is placed as an interim cover, it will be tilled and recompacted to eliminate cracks when final cover is placed.

5.5 Water Infiltration

Infiltration rates were estimated using the partially saturated flow model developed by McWhorter and Nelson (1979). The calculated infiltration rates for the maximum time of ponding of water on the tailings during the PMF runoff events were used to estimate the depth of infiltration. Equation 18 of McWhorter and Nelson (1979) was used for these calculations. This equation is equivalent to the Green and Ampt equation. The equation used to calculate the penetration rate of the infiltration was as follows:

$$q = \frac{K_f(H_f + L - H_c)}{L}$$

where:

q = seepage rate, cm/sec
K_f = vertical permeability of material, cm/sec
H_f = depth of ponding, cm
L = penetration distance, cm
H_c = effective capillary drive, cm

Several vertical permeability tests were conducted at a compaction of 95 percent standard proctor on the cover material. This data is presented in Appendix C. A typical permeability from these tests is 2.6E-8 cm/sec and this value was used in these calculations. Table 5-13 presents estimates of the depths of infiltration during the PMF. In order to dampen peak flows from the PMF runoff event, channel control structures will be constructed at three locations that retard runoff on the tailings ponds (see Section 5.2.3). These sites are designated HCT-1 (No.

4 tailings), and HC5-3 and HC5-11 (No. 5 tailings) on Exhibit 10-2. Based on HEC-1 simulations of the PMP runoff event, maximum time that water will be ponded at these sites is presented in Table 5-13. The maximum depth of ponding varies for the different areas of the tailings and are presented in this table. The maximum time of ponding of water over these tailings for the PMF was also used. The maximum time of ponding from the PMF was obtained from the hydrographs in Appendix E for channel control sites. The maximum ponding depths were obtained from the depth of flow at the cross section which is given in the eleventh column in Table 5-4. The depths at the control cross sections are the maximum depth of flow due to ponding. The rating curves for the different control outlets are given in SQ-SE rows in Tables E-1 and E-2 of Appendix E. The infiltration depth was obtained from the penetration rate equation on page 5-44 and the following infiltration depth equation:

$$L=q(t)/n$$

where: the parameters are the same as on the previous page, plus:

t = time of ponding, seconds
n = effective porosity

An effective capillary drive head of -310 cm was estimated to be representative of the compacted clay. This estimate was obtained from Table 1-3 of Harr (1962). The wetting front depth was varied in the calculations until the seepage rate resulted in that particular depth of penetration for the time of ponding. An effective porosity of 0.05 was used to calculate the penetration depth based on the infiltration rate and time of ponding. The estimate of effective porosity (specific yield) for the compacted clay was obtained from Figure 4.2 of Bear (1987) and Table 5.2 of Driscoll (1986). For example, the seepage rate equation for site

HCT-1 produces a rate of 3.1 E-6 cm/sec for an infiltration depth of 3.92 cm, a maximum ponding of 152 cm, and an effective capillary drive of -310 cm. Table 5-13 shows that the penetration rates into the clay confining layer should be relatively small at less than 5 cm. during the PMF. Water will be removed by evapotranspiration after this infiltration occurs. The removal of the drainable portion of water is important relative to continual movement of water downward. An average annual potential evapotranspiration rate for the Shirley Basin is estimated to be 0.057 inches/day from Figure 12.3 of Martner (1986). A rate of one-half of this value was used to estimate the removal rate of water because the compacted clay will be covered by rock mulch or topsoil. The seepage model provided an estimate of the depth of penetration of the wetting front from the PMF. The evapotranspiration rate indicates the number of days for this water to be removed by evapotranspiration. The effective removal time is presented in Table 5-13, based on the evapotranspiration rate of 0.0285 inches of water per day and the removal rate of wetting front of 0.57 inches/day (0.0285/0.05). Therefore, evapotranspiration should be able to remove the water that penetrates the clay layer in a few days after the PMF event.

5.6 WIND EROSION

There will be no potential for wind erosion in the tailings disposal and mill areas where rock mulch will be used as the ground cover. However, in locations where a vegetated cover is planned, wind erosion potential must be addressed. In those areas, vegetative density and variety is expected to be comparable to that in the undisturbed areas after 20 or so years.

SCS has developed a wind erosion equation (WEQ) (SCS, 1982) which was used to predict the amount of soil loss due to wind over a 1,000 year time period. This WEQ is expressed as a function of the following parameters:

I = soil erodibility by wind,
K = soil surface roughness,
C = climatic factor,
L = field width
and V = vegetative cover.

E, soil loss in tons per acre per year, is then determined from a series of charts based on values assigned to the above parameters.

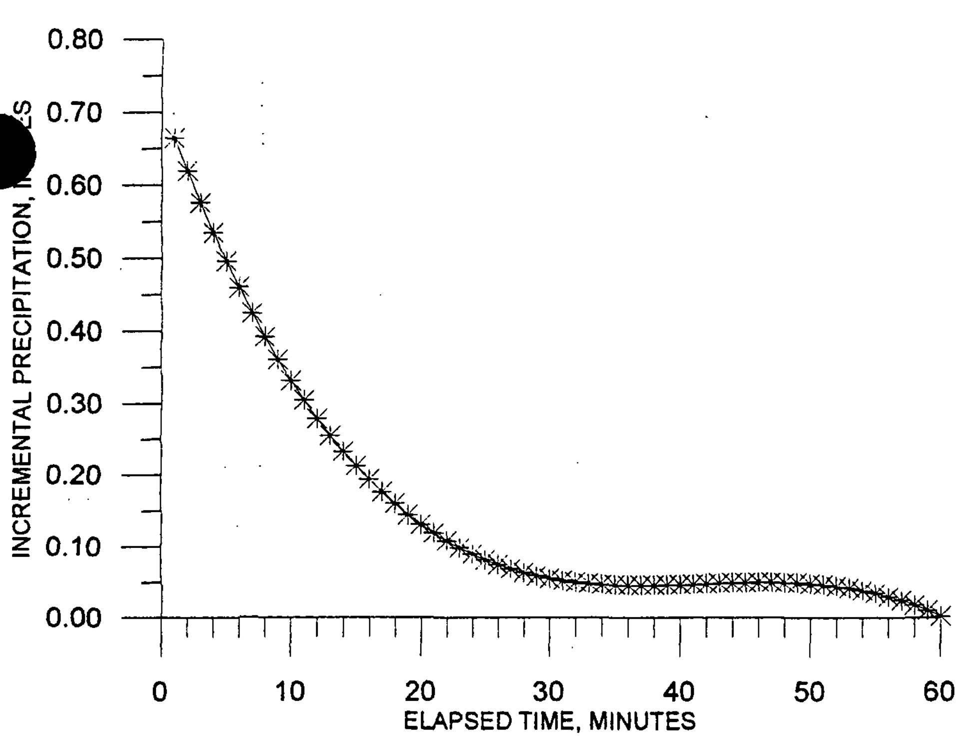
In 1986, SCS personnel from their Casper, Wyoming office estimated the WEQ parameters for Pathfinder's Shirley Basin mine, mill, and tailings disposal site. The parameters, which were given as an example in SCS (1982), were determined by field analysis and are considered by SCS personnel to still be valid (verbal communication, L. Young, September, 1993). The parameters are as follows:

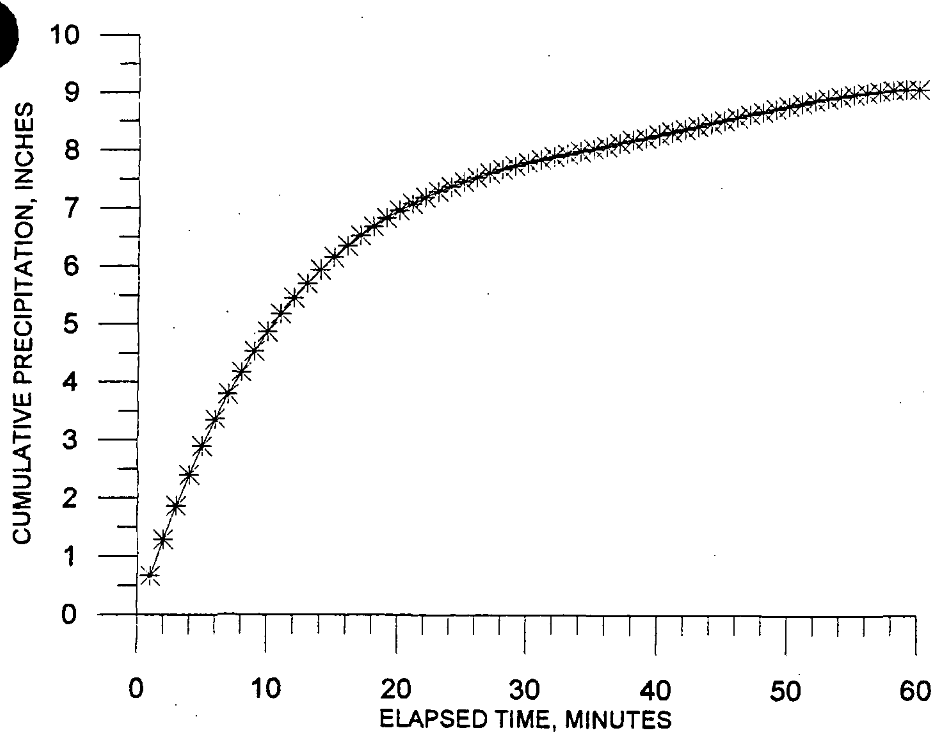
I = 56,
K = 1.0,
C = 100,
and V = 3700 lb/ac flat small grain residue.

The field width factor, L, is the width, in feet, of the unsheltered distance across a strip parallel to the direction of the prevailing erosive wind. In the Shirley Basin, the prevailing erosive wind is from the south southwest. The maximum width of the vegetative cover on Pathfinder's tailings after reclamation, measured in the south southwest direction is approximately 2,800 ft. This value was used in the WEQ.

In the tables given in SCS (1982), the maximum value of V for the other WEQ parameters given above is 2000 lb/ac. E, annual soil loss, based on 2000 lb/ac, is estimated from SCS' tables to be 0.9 tons/ac. Assuming the unit weight of soil is 105 lb/ft^3, annual soil loss is 0.00039 ft/yr. Over 1,000 years then, 0.39 ft (4.7

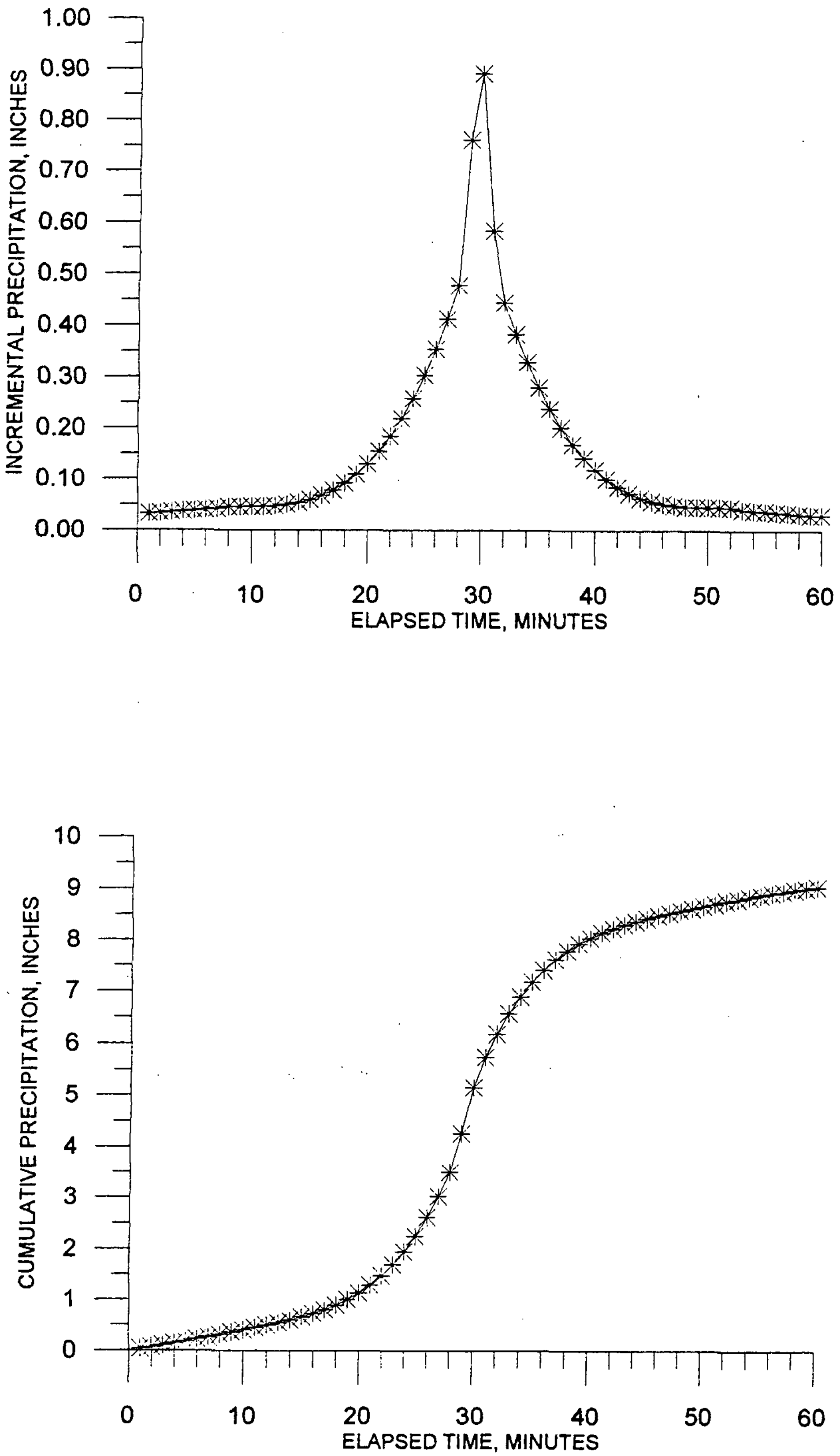
in) of cover material is predicted to be lost to wind erosion. This estimate is considered to be conservative because SCS has estimated a vegetative cover factor of 3700 lb/ac and the above estimate is based on 2000 lb/ac.





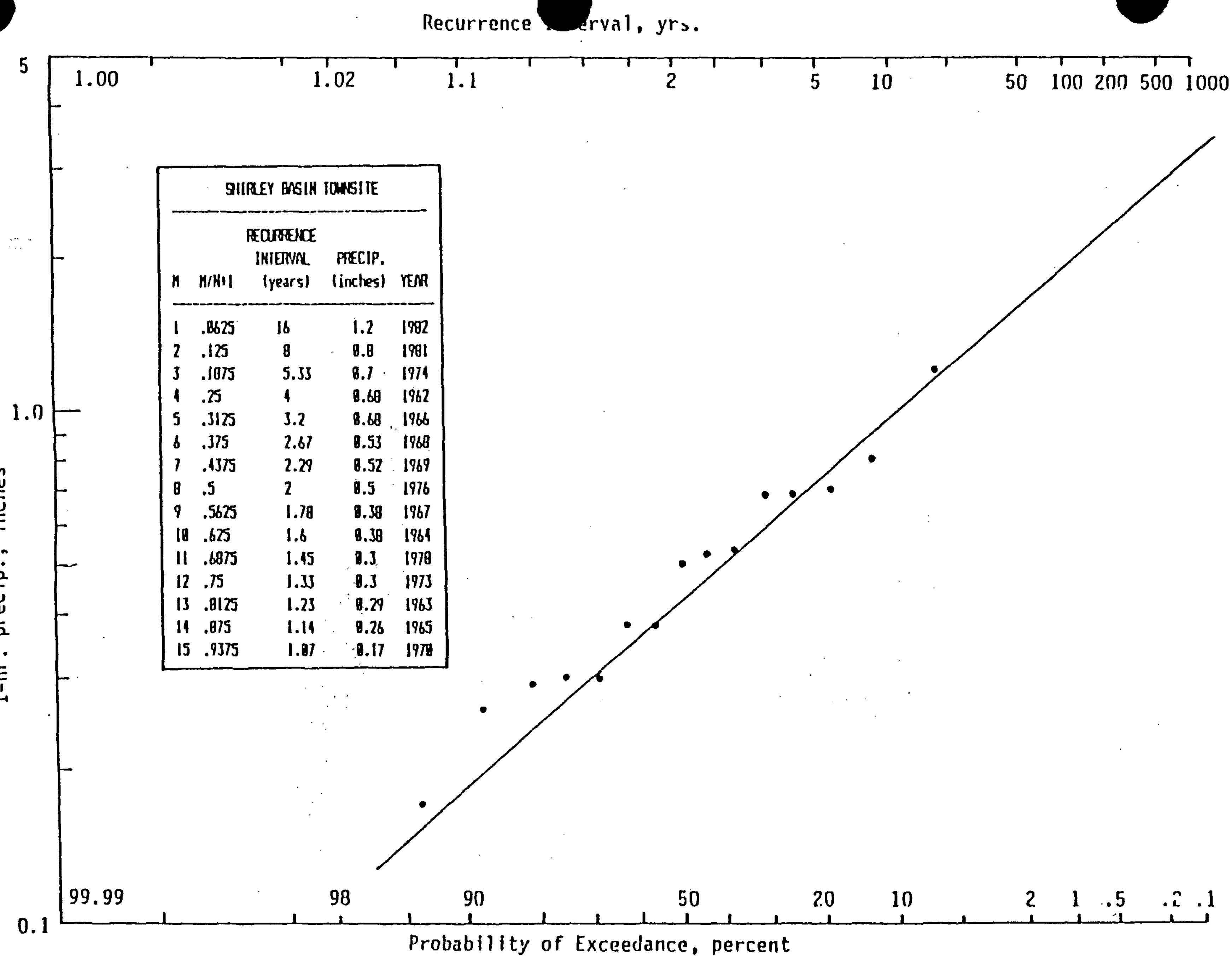
TIME MIN	INCREM. PRECIP.	CUM. PRECIP.
0	0.0000	0.0000
1	0.6647	0.6647
2	0.6192	1.2839
3	0.5759	1.8597
4	0.5348	2.3945
5	0.4958	2.8903
6	0.4590	3.3493
7	0.4242	3.7735
8	0.3914	4.1649
9	0.3605	4.5254
10	0.3315	4.8569
11	0.3043	5.1611
12	0.2788	5.4399
13	0.2551	5.6950
14	0.2330	5.9280
15	0.2124	6.1404
16	0.1934	6.3338
17	0.1759	6.5097
18	0.1598	6.6695
19	0.1450	6.8145
20	0.1315	6.9460
21	0.1193	7.0653
22	0.1083	7.1736
23	0.0940	7.2720
24	0.0895	7.3615
25	0.0817	7.4432
26	0.0748	7.5180
27	0.0689	7.5869
28	0.0637	7.6506
29	0.0594	7.7100
30	0.0558	7.7658
31	0.0528	7.8186
32	0.0505	7.8691
33	0.0487	7.9178
34	0.0474	7.9652
35	0.0466	8.0118
36	0.0461	8.0579
37	0.0460	8.1039
38	0.0462	8.1501
39	0.0465	8.1966
40	0.0470	8.2436
41	0.0477	8.2913
42	0.0483	8.3396
43	0.0490	8.3886
44	0.0496	8.4382
45	0.0500	8.4882
46	0.0503	8.5384
47	0.0503	8.5887
48	0.0500	8.6387
49	0.0494	8.6881
50	0.0483	8.7364
51	0.0468	8.7832
52	0.0448	8.8280
53	0.0421	8.8701
54	0.0388	8.9089
55	0.0349	8.9438
56	0.0301	8.9739
57	0.0246	8.9985
58	0.0182	9.0167
59	0.0108	9.0275
60	0.0025	9.0300

FIGURE 5-1. INCREMENTAL AND CUMULATIVE 1-HR, 1-MI ^{2} PMP PRECIPITATION DISTRIBUTIONS FOR OVERLAND FLOW ANALYSIS.



TIME MIN	INCREM. PRECIP.	CUM. PRECIP.
0	0.0000	0.0000
1	0.0321	0.0321
2	0.0337	0.0658
3	0.0353	0.1011
4	0.0370	0.1381
5	0.0385	0.1766
6	0.0401	0.2167
7	0.0418	0.2585
8	0.0456	0.3041
9	0.0458	0.3499
10	0.0460	0.3959
11	0.0464	0.4423
12	0.0477	0.4900
13	0.0500	0.5400
14	0.0539	0.5939
15	0.0596	0.6535
16	0.0676	0.7211
17	0.0783	0.7994
18	0.0919	0.8913
19	0.1090	1.0003
20	0.1298	1.1301
21	0.1547	1.2848
22	0.1843	1.4691
23	0.2187	1.6878
24	0.2584	1.9462
25	0.3037	2.2499
26	0.3552	2.6051
27	0.4130	3.0181
28	0.4776	3.4957
29	0.7626	4.2583
30	0.8915	5.1498
31	0.5843	5.7341
32	0.4445	6.1786
33	0.3832	6.5618
34	0.3287	6.8905
35	0.2803	7.1708
36	0.2379	7.4087
37	0.2008	7.6095
38	0.1689	7.7784
39	0.1418	7.9202
40	0.1188	8.0390
41	0.1000	8.1390
42	0.0847	8.2237
43	0.0726	8.2963
44	0.0634	8.3597
45	0.0565	8.4162
46	0.0517	8.4679
47	0.0487	8.5166
48	0.0469	8.5635
49	0.0461	8.6096
50	0.0459	8.6555
51	0.0457	8.7012
52	0.0455	8.7467
53	0.0409	8.7876
54	0.0393	8.8269
55	0.0378	8.8647
56	0.0361	8.9008
57	0.0345	8.9353
58	0.0329	8.9682
59	0.0031	8.9995
60	0.0305	9.0300

FIGURE 5-2. INCREMENTAL AND CUMULATIVE 1-HR, 1-MI^2 PMP PRECIPITATION DISTRIBUTIONS FOR HEC-1 ANALYSIS.



SHIRLEY BASIN TOWNSITE

M	M/N+1	RECURRENCE INTERVAL (years)	PRECIP. (inches)	YEAR
1	.0625	16	1.2	1982
2	.125	8	0.8	1981
3	.1875	5.33	0.7	1974
4	.25	4	0.60	1962
5	.3125	3.2	0.60	1966
6	.375	2.67	0.53	1968
7	.4375	2.29	0.52	1969
8	.5	2	0.5	1976
9	.5625	1.78	0.38	1967
10	.625	1.6	0.38	1964
11	.6875	1.45	0.3	1970
12	.75	1.33	0.3	1973
13	.8125	1.23	0.29	1963
14	.875	1.14	0.26	1965
15	.9375	1.07	0.17	1970

FIGURE 5-3. ONE-HOUR DURATION PRECIPITATION VERSUS RECURRENCE INTERVAL FOR SHIRLEY BASIN TOWNSITE.

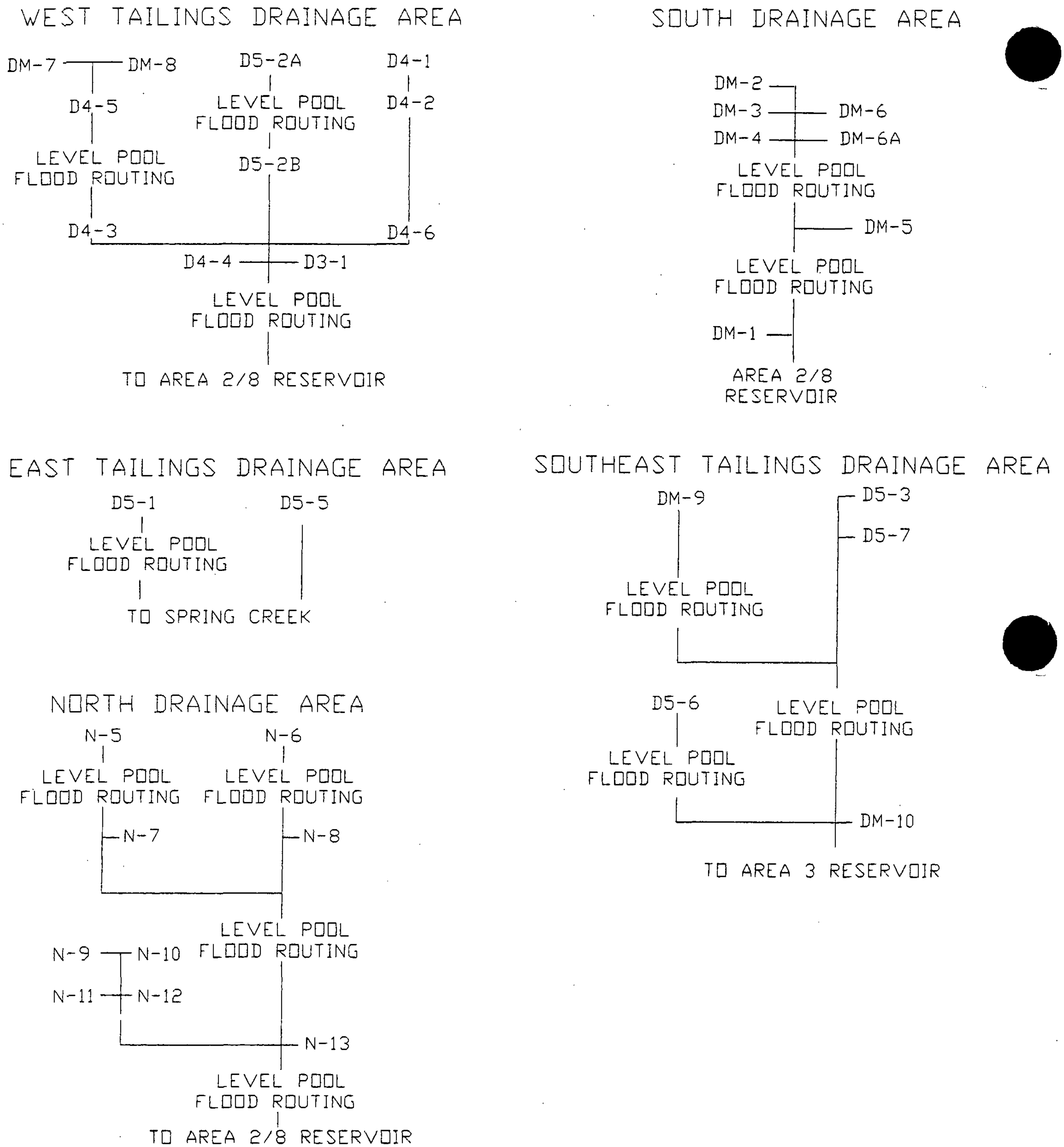


FIGURE 5-4. DRAINAGE SYSTEM SCHEMATIC

TABLE 5-1. BASIN CHARACTERISTICS FOR TAILINGS AREA SUBBASINS.

BASIN	Area (acre)	Area (mi^2)	Hydrologic High Elev. (ft-msl)	Hydrologic High Elev. (ft-msl)	Basin Relief (ft)	Basin Length (ft)	Basin Slope (ft/ft)	Kirpich's tc (hour)	Kirpich's tL (hour)	SCS Curve Number
DM-1	10.76	0.017	7165	7110	55	800	0.069	0.063	0.0376	91
DM-2	27.40	0.043	7182	7128	54	3090	0.017	0.301	0.1805	91
DM-3	18.54	0.029	7182	7127	55	2250	0.024	0.207	0.1243	91
DM-4	21.86	0.034	7180	7120	60	1950	0.031	0.170	0.1019	91
DM-5	22.64	0.035	7133	7110	23	1120	0.021	0.129	0.0777	91
DM-6	49.72	0.078	7162	7115	47	1440	0.033	0.131	0.0788	91
DM-6A	6.67	0.010	7137	7119	18	980	0.018	0.122	0.0731	91
DM-7	7.67	0.012	7138	7125	13	480	0.027	0.061	0.0364	91
DM-7(Overland)			7140	7138	2	650	0.003	0.177	0.1061	
DM-8	4.44	0.007	7139	7125	14	850	0.016	0.114	0.0684	91
DM-8(Overland)			7140	7139	1	320	0.003	0.102	0.0611	
DM-9	29.13	0.046	7140	7110	30	1270	0.024	0.135	0.0811	91
DM-10	9.47	0.015	7148	7093	55	220	0.250	0.014	0.0085	91
DM-10(Low Slope)			7093	7065	28	1000	0.028	0.105	0.0632	91
D3-1	46.41	0.073	7105	7083	22	1020	0.022	0.118	0.0709	89
D3-1(overland)			7121	7105	16	800	0.020	0.101	0.0605	89
D4-1	24.83	0.039	7115	7108	7	1780	0.004	0.349	0.2096	91
D4-1(Overland)			7116	7115	1	350	0.003	0.113	0.0678	
D4-2	24.83	0.039	7108	7083	25	1460	0.017	0.170	0.1021	85
D4-3(Path 1)	29.05	0.045	7114	7083	31	1300	0.024	0.137	0.0822	86
D4-3(Overland)			7120	7114	6	500	0.012	0.086	0.0513	
D4-3(Path 2)	29.05	0.045	7115	7083	32	1300	0.025	0.135	0.0812	86
D4-3(Overland)			7116	7115	1	550	0.002	0.190	0.1142	
D4-4	27.98	0.044	7124	7075	49	980	0.050	0.083	0.0497	91
D4-5	24.31	0.038	7125	7114	11	1350	0.008	0.213	0.1280	87
D4-6	32.34	0.051	7114	7083	31	920	0.034	0.092	0.0552	91
D4-6(Overland)			7116	7114	2	280	0.007	0.067	0.0401	
D5-1	87.30	0.136	7110	7093	17	3480	0.005	0.539	0.323	85
D5-2A	16.42	0.026	7109	7100	9	1000	0.009	0.163	0.098	91
D5-2B	4.87	0.008	7100	7083	17	770	0.022	0.094	0.057	87
D5-3	28.20	0.044	7110.5	7100	10.5	2240	0.005	0.390	0.234	91
D5-4	33.22	0.052	7110.5	7050	60.5	3900	0.016	0.377	0.226	87
D5-5	6.70	0.010	7108.5	7080	28.5	890	0.032	0.091	0.055	87
D5-6	7.19	0.011	7105	7065	40	1080	0.037	0.100	0.060	87
D5-7	6.55	0.010	7111	7105	6	810	0.007	0.149	0.090	87
N-5	23.19	0.036	7290	7280	10	2120	0.005	0.373	0.2236	91
N-6	29.85	0.047	7285	7250	35	1680	0.021	0.176	0.1055	91
N-7	13.21	0.021	7290	7268	22	1520	0.014	0.187	0.1124	91
N-8	38.36	0.060	7250	7235	15	2920	0.005	0.461	0.2769	91
N-9	23.91	0.037	7170	7140	30	1530	0.020	0.168	0.1005	91
N-10	1.64	0.003	7278	7234	44	540	0.081	0.043	0.0260	91
N-11	8.57	0.013	7137	7114	23	570	0.040	0.059	0.0356	91
N-12	11.60	0.018	7155	7114	41	2030	0.020	0.206	0.1235	91
N-13	8.05	0.013	—	—	0	—	—	—	0.0000	100
N-14	24.55	0.038	7236	7110	126	2840	0.044	0.197	0.1182	91

(Revised 05/20/96)

TABLE 5-2. OVERLAND FLOW PATH CHARACTERISTICS AND ROCK MULCH DESIGN.

Path Name	Length (feet)	Relief (feet)	Slope (ft/ft)	tc (min)	Discharge (cfs/ft)	Rock D50 (in)
O3-1A	110	21.5	0.195	0.546	0.076	0.708
*O3-2A	390	5	0.013	4.132	0.256	0.252
O3-2B	170	6	0.035	1.169	0.389	0.804
O3-2C	280	9	0.032	1.653	0.584	0.972
O3-2D	90	5	0.056	0.409	0.646	1.752
O3-2E	90	3	0.033	0.391	0.709	1.128
*O3-3A	470	12	0.026	3.659	0.314	
O3-3B	140	4	0.029	0.809	0.424	0.720
O3-3C	190	10	0.053	0.955	0.556	1.500
O3-3D	100	3	0.030	0.436	0.626	0.960
**O4-3A	400	1.1	0.003	7.621	0.233	
O4-3B	100	5.9	0.059	0.754	0.348	1.224
O4-3C	120	5	0.042	0.756	0.431	1.020
O4-3D	260	15	0.058	1.351	0.612	1.740
O4-3E	90	5	0.056	0.372	0.674	1.800
O4-3F	150	1	0.007	0.663	0.779	0.300
O4-4A	270	4	0.015	2.945	0.185	0.228
O4-4B	100	5	0.050	0.684	0.257	0.852
O4-4C	150	5	0.033	0.922	0.361	0.720
O4-4D	90	5	0.056	0.454	0.424	1.320
O4-4E	90	5	0.050	0.469	0.494	1.320
O4-4F	120	1.5	0.013	0.566	0.577	0.420
*O4-5A	520	17	0.033	3.596	0.348	0.708
*O4-5B	70	9	0.129	0.301	0.410	1.392
*O4-7A	120	7	0.058	0.930	0.083	
*O4-7B	150	1	0.007	1.144	0.188	
O4-7C	200	3	0.015	1.410	0.327	0.336
O4-7D	230	3	0.013	1.511	0.487	0.384
O4-8A	240	1	0.004	4.383	0.156	@
O4-8B	200	5	0.025	1.781	0.306	0.504
O4-8C	240	6	0.025	1.684	0.473	0.672
**O5-1A	90	1	0.011	1.412	0.063	
O5-1B	110	24	0.218	0.515	0.139	1.356
O5-1C	90	15	0.167	0.341	0.202	1.200
**O5-2A	170	1.1	0.006	2.837	0.117	
O5-2B	310	58	0.187	1.225	0.334	1.776
*O5-3A	360	1.3	0.004	6.328	0.219	
O5-3B	50	0.2	0.004	0.613	0.285	@

TABLE 5-2. OVERLAND FLOW PATH CHARACTERISTICS AND ROCK MULCH DESIGN (continued).

Path Name	Length (feet)	Relief (feet)	Slope (ft/ft)	tc (min)	Discharge (cfs/ft)	Rock D50 (in)
**O5-5A	180	1	0.006	3.144	0.122	
O5-5B	150	11	0.073	0.978	0.229	1.140
**O5-6A	90	0.5	0.006	1.843	0.063	
O5-6B	140	11	0.079	0.918	0.160	0.972
**O5-7A	290	0.5	0.002	7.121	0.172	
O5-7B	220	15	0.068	1.380	0.355	1.416
O5-7C	100	0.5	0.005	0.548	0.424	0.192
**O5-8A	90	1	0.011	1.412	0.063	
O5-8B	80	15	0.188	0.424	0.118	0.900
O5-8C	80	5	0.063	0.382	0.174	0.828
**O5-9A	60	1.5	0.025	0.756	0.042	
O5-9B	120	4.5	0.038	0.987	0.125	0.408
O5-9C	260	10	0.038	1.653	0.306	0.744
O5-9D	190	3	0.016	1.077	0.438	0.420
O5-10A	420	13	0.031	3.116	0.286	0.588
**O5-11A	50	0.7	0.014	0.821	0.035	
**O5-11B	300	1.1	0.004	4.523	0.227	
O5-11C	30	3	0.100	0.217	0.264	0.816
O5-11D	140	5	0.036	0.977	0.361	0.792
O5-11E	360	5	0.014	2.481	0.612	0.468
**O5-12A	110	0.5	0.005	2.324	0.076	
O5-12B	40	3	0.075	0.342	0.104	0.696
O5-12C	190	5	0.026	1.468	0.236	0.444
O5-12D	550	5	0.009	4.193	0.583	0.312
O5-14A	300	67	0.223	1.124	0.209	1.596
**OM-1A	450	1.4	0.003	7.958	0.259	
OM-1B	130	0.5	0.004	1.686	0.403	0.180
OM-1C	160	9	0.056	1.094	0.514	1.500
*OM-1D	70	3	0.043	0.383	0.563	
*OM-2A	100	0.4	0.004	2.269	0.070	
OM-2B	270	14	0.052	1.798	0.257	0.888
*OM-2C	240	15	0.063	1.192	0.424	

* FLOW PATH SEGMENT ON NON-TAILINGS AREA
** NON-ROCK AREA
@ LOW SLOPE - ROCK SIZING PROGRAM WILL NOT CONVERGE
(SPECIFIED ROCK MULCH IS OVERSIZED FOR THIS SEGMENT)

TABLE 5-3. OVERLAND FLOW PATH CHARACTERISTICS AND ALLOWABLE SLOPE LENGTH

Path Name	Length (feet)	Relief (feet)	Slope (ft/ft)	tc (min)	Discharge (cfs/ft)	Max. Slope Length (ft)
*O3-2A	390	5	0.013	4.132	0.288	81
*O3-3A	470	12	0.026	3.659	0.353	36
O4-1A	500	1.5	0.003	8.752	0.314	516
O4-2A	360	1.1	0.003	6.748	0.243	471
O4-3A	400	1.1	0.003	7.621	0.262	549
*O4-5A	520	17	0.033	3.596	0.391	27
*O4-5B	70	9	0.129	0.301	0.461	1
*O4-7A	120	7	0.058	0.930	0.094	13
O5-1A	90	1	0.011	1.412	0.070	90
O5-2A	170	1.1	0.006	2.837	0.131	171
O5-3A	360	1.3	0.004	6.328	0.246	382
O5-4A	550	1.5	0.003	9.771	0.334	597
O5-5A	180	1	0.006	3.144	0.138	207
O5-6A	90	0.5	0.006	1.843	0.070	202
O5-7A	290	0.5	0.002	7.121	0.193	930
O5-8A	90	1	0.011	1.412	0.070	90
O5-11A	50	0.7	0.014	0.821	0.039	69
O5-11B	300	1.1	0.004	4.523	0.255	302
O5-12A	110	0.5	0.005	2.324	0.086	255
O5-13A	150	1	0.007	2.547	0.117	164
OM-1A	440	1.4	0.003	7.958	0.291	481
OM-2A	100	0.4	0.004	2.269	0.078	296

* FLOW PATH ON NON-TAILINGS AREA

TABLE 5-4. CHANNEL CONVEYANCE AND INITIAL ROCK SIZING FOR PMF.

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Bottom Slope (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)
	Manning's Equation Channel Conveyance											
HC4-1	7108.6	20	4 : 1	0.008		399	7.4	53.8	0.024	1.94	0.162	0.4
HC4-2	7106.7	40	4 : 1	0.014		399	7.1	56.4	0.027	1.25	0.214	0.4
HC4-3	7089	50	4 : 1	0.033		581	8.4	69.5	0.036	1.26	0.529	0.6
HC4-4	7103	20	4 : 1	0.009		270	6.8	39.6	0.024	1.52	0.148	0.15
HC4-5	7100.1	0	2 : 1	0.006		36	5.2	6.9	0.02	1.86	0.067	0.6
HC4-6	7084	50	6.4 : 1	0.035		170	5.7	29.9	0.032	0.56	0.258	0.6
HC4-7	7081	0	2 : 1					PONDED				0.15
HC4-8	7081	40	4 : 1					PONDED				
HC4-9	7126.4	20	4 : 1	0.039	0.022	180	7.4	24.3	0.036	1.01	0.469	0.4
HC4-10	7127.8	20	4 : 1	0.02		110	5.9	18.6	0.028	0.8	0.192	0.4
HC4-11	7114.8	20	4 : 1	0		289		PONDED				0.4
HC4-12	7108.8	36	4 : 1	0.005		797	7.7	103.9	0.021	2.3	0.127	0.4
HC4-13	7085.8	50	4 : 1	0.05		1300	11.1	116.8	0.044	2.01	1.246	1.2
HCT-1	7081	0	2 : 1	0.006		620	9.3	66.7	0.023	5.78	0.209	1.2
HCT-2	7079.4	40	4 : 1	0.007		620	7.3	84.4	0.023	1.79	0.146	1.2
HCT-3	6971.4	40	4 : 1	0.131		620	11.6	53.6	0.049	1.2	0.988	1.2
HC5-1	7097	60	10 : 1	0.001		1149		PONDED				0.15
HC5-2	7094.5	40	4 : 1	0.004		1149		PONDED				0.15
HC5-3	7093	0	2 : 1	0.006		180	7.2	24.9	0.022	3.53	0.128	1.2
HC5-4	7088.9	25	4 : 1	0.105		180	8.7	20.6	0.042	0.74	0.479	0.6
HC5-5	7077.5	30	4 : 1	0.026		229	6.9	33	0.031	0.97	0.312	0.6
HC5-6	7101.5	25	4 : 1	0.003		501	6.7	75	0.018	2.21	0.07	0.4
HC5-7	7107	20	4 : 1	0.007		173	5.9	29.5	0.021	1.19	0.094	0.4
HC5-8	7102.5	20	4 : 1	0.003		173	5.2	33	0.016	1.31	0.043	0.4
HC5-9	7097	20	4 : 1	0.013		583	8.7	67.1	0.028	2.3	0.304	0.4
HC5-10	7110.1	1	2 : 1	0.016		243	8.9	27.4	0.03	3.46	0.363	1.2
HC5-11	7095	0	2 : 1	0.013	0.002	706	10.7	66.3	0.03	5.76	0.455	0.4
HC5-12	7071.3	30	4 : 1	0.025		751	9.6	78.2	0.034	2.05	0.575	0.6
HC5-13	7065	0	2 : 1	0.002		121	2.3	52.3	0.05	5.11	0.062	0.6
HC5-14	7062.5	30	4 : 1	0.012		843	9	93.8	0.028	2.38	0.308	0.6

TABLE 5-5. CHANNEL CONVEYANCE CHARACTERISTICS FOR PMF WITH STEPHENSON ROCK SIZING.

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)	Alternate (por = 0.45) Riprap D50 (ft)
	Manning's Equation Channel Conveyance											
HC4-1	7108.6	20	4 : 1	0.008	399	7.4	53.8	0.024	1.94	0.092	0.4	0.12
HC4-2	7106.7	40	4 : 1	0.014	399	7.1	56.4	0.027	1.25	0.104	0.4	0.14
HC4-3	7089	50	4 : 1	0.033	581	8.4	69.5	0.036	1.26	0.233	0.6	0.30
HC4-4	7103	20	4 : 1	0.009	270	6.8	39.6	0.024	1.52	0.081	0.15	0.11
HC4-5	7100.1	0	2 : 1	0.006	36	5.2	6.9	0.02	1.86	0.056	0.6	0.07
HC4-6	7084	50	6.4 : 1	0.035	170	5.7	29.9	0.032	0.56	0.110	0.6	0.14
HC4-7	7081	0	2 : 1				PONDED				0.15	
HC4-8	7081	40	4 : 1				PONDED					
HC4-9	7126.4	20	4 : 1	0.039	180	7.4	24.3	0.036	1.01	0.212	0.4	0.28
HC4-10	7127.8	20	4 : 1	0.02	110	5.9	18.6	0.028	0.8	0.091	0.4	0.12
HC4-11	7114.8	20	4 : 1	0	289		PONDED				0.4	
HC4-12	7108.8	36	4 : 1	0.005	797	7.7	103.9	0.021	2.3	0.073	0.4	0.10
HC4-13	7085.8	50	4 : 1	0.05	1300	11.1	116.8	0.044	2.01	0.542	0.6	0.71
HCT-1	7081	0	2 : 1	0.006	620	9.3	66.7	0.023	5.78	0.177	1.2	0.23
HCT-2	7079.4	40	4 : 1	0.007	620	7.3	84.4	0.023	1.79	0.078	1.2	0.10
HCT-3	6971.4	40	4 : 1	0.131	620	11.6	53.6	0.049	1.2	0.943	1.2	1.23
HC5-1	7097	60	10 : 1	0.001	1149		PONDED				0.15	
HC5-2	7094.5	40	4 : 1	0.004	1149		PONDED				0.15	
HC5-3	7093	0	2 : 1	0.006	180	7.2	24.9	0.022	3.53	0.107	1.2	0.14
HC5-4	7088.9	25	4 : 1	0.105	180	8.5	21.2	0.044	0.76	0.479	0.6	0.60
HC5-5	7077.5	30	4 : 1	0.026	229	7.2	31.8	0.034	0.94	0.143	0.6	0.19
HC5-6	7101.5	25	4 : 1	0.003	501	6.7	75	0.018	2.21	0.044	0.4	0.06
HC5-7	7107	20	4 : 1	0.007	173	5.9	29.5	0.021	1.19	0.051	0.4	0.07
HC5-8	7102.5	20	4 : 1	0.003	173	5.2	33	0.016	1.31	0.026	0.4	0.03
HC5-9	7097	20	4 : 1	0.013	583	8.7	67.1	0.028	2.3	0.169	0.4	0.22
HC5-10	7110.1	1	2 : 1	0.016	243	8.9	27.4	0.03	3.46	0.265	1.2	0.35
HC5-11	7095	0	2 : 1	0.013	706	10.7	66.3	0.03	5.76	0.357	0.4	0.46
HC5-12	7071.3	30	4 : 1	0.025	751	9.6	78.2	0.034	2.05	0.281	0.6	0.37
HC5-13	7065	0	2 : 1	0.002	121	2.3	52.3	0.05	5.11	0.027	0.6	0.04
HC5-14	7062.5	30	4 : 1	0.012	843	9	93.8	0.028	2.38	0.166	0.6	0.22

TABLE 5-5. CHANNEL CONVEYANCE CHARACTERISTICS FOR PMF WITH STEPHENSON ROCK SIZING (continued).

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)	Alternate (por = 0.45) Riprap D50 (ft)
					Flow Based on HEC-2 Channel Conveyance							
					Channel A							
HC4-9(90)	7126.4	20	4 : 1	0.039	180	7.5	24	0.035	1	0.213	0.4	0.277
A- 200	7128.8	20	4 : 1	0.031	170	6.8	25	0.035	1.03	0.168	0.4	0.219
A- 220	7129.4	20	4 : 1	0.021	165	6	27.6	0.035	1.13	0.120	0.4	0.156
A- 240	7130	20	4 : 1	0.058	160	8.3	19.4	0.035	0.83	0.281	0.4	0.366
A- 260	7131.2	20	4 : 1	0.052	153	7.9	19.5	0.035	0.84	0.250	0.4	0.325
A- 280	7132.4	20	4 : 1	0.08	147	8.9	16.5	0.035	0.72	0.355	0.4	0.462
A- 400	7135.2	20	4 : 1	0.012	120	4.4	27.4	0.035	1.12	0.062	0.4	0.081
A- 500	7135.9	20	4 : 1	0.005	110	3.2	34.5	0.035	1.36	0.029	0.4	0.037
A- 600	7136.5	20	4 : 1	0.006	100	3.3	30.6	0.035	1.23	0.032	0.4	0.041
A- 700	7137.1	20	4 : 1	0.005	90	3	29.7	0.035	1.2	0.025	0.4	0.033
A- 800	7137.7	20	4 : 1	0.005	80	2.9	27.6	0.035	1.13	0.024	0.4	0.031
					Channel D							
D- 150	7083.5	50	4 : 1	0.025	1325	10.3	128.6	0.035	2.19	0.308	1.2	0.401
D- 200	7085	50	4 : 1	0.052	1300	13	100.2	0.035	1.76	0.570	1.2	0.742
HC4-13(215)	7085.8	50	4 : 1	0.05	1300	12.8	101.3	0.035	1.77	0.548	1.2	0.713
D- 220	7086.1	50	4 : 1	0.05	1297	12.8	101.3	0.035	1.77	0.548	1.2	0.713
D- 240	7087.1	50	4 : 1	0.05	1285	12.8	100.8	0.035	1.77	0.548	1.2	0.713
D- 260	7088.1	50	4 : 1	0.048	1274	12.6	101.1	0.035	1.77	0.524	1.2	0.682
D- 280	7089.2	50	4 : 1	0.045	1262	12.3	103	0.035	1.8	0.494	1.2	0.643
D- 300	7090.2	50	4 : 1	0.038	1250	11.6	108	0.035	1.88	0.425	1.2	0.553
D- 320	7091	50	4 : 1	0.038	1240	11.5	107.7	0.035	1.87	0.421	1.2	0.548
D- 340	7091.8	50	4 : 1	0.037	1230	11.4	107.5	0.035	1.87	0.409	1.2	0.533
D- 360	7092.5	50	4 : 1	0.037	1220	11.4	107.1	0.035	1.86	0.408	0.6	0.531
D- 380	7093.3	50	4 : 1	0.035	1210	11.2	108.4	0.035	1.88	0.388	0.6	0.504
D- 400	7094.1	50	4 : 1	0.031	1200	10.7	112.5	0.035	1.95	0.349	0.6	0.454
D- 420	7094.7	50	4 : 1	0.031	1190	10.7	111.6	0.035	1.93	0.346	0.6	0.451
D- 440	7095.4	50	4 : 1	0.031	1180	10.6	111.2	0.035	1.93	0.344	0.6	0.448
D- 460	7096	50	4 : 1	0.031	1170	10.6	110.4	0.035	1.91	0.342	0.6	0.445
D- 480	7096.7	50	4 : 1	0.031	1160	10.5	110.1	0.035	1.91	0.340	0.6	0.442
D- 500	7097.3	50	4 : 1	0.031	1150	10.5	109.4	0.035	1.9	0.338	0.6	0.441
D- 520	7097.9	50	4 : 1	0.031	1140	10.5	108.5	0.035	1.89	0.337	0.6	0.439
D- 540	7098.6	50	4 : 1	0.031	1130	10.4	108.4	0.035	1.88	0.334	0.6	0.435
D- 560	7099.2	50	4 : 1	0.031	1120	10.4	107.7	0.035	1.87	0.333	0.6	0.433
D- 580	7099.9	50	4 : 1	0.03	1110	10.3	108	0.035	1.88	0.323	0.6	0.420
D- 600	7100.5	50	4 : 1	0.028	1100	10	110.1	0.035	1.91	0.303	0.6	0.394
D- 700	7102.9	50	4 : 1	0	1000			———LOW SLOPE———			0.6	
D- 800	7103.5	50	4 : 1	0.001	950			———LOW SLOPE———			0.4	
D- 900	7104.2	50	4 : 1	0.001	900			———LOW SLOPE———			0.4	
D- 1000	7105.1	50	4 : 1	0.001	875			———LOW SLOPE———			0.4	
D- 1100	7106.1	50	4 : 1	0.001	850			———LOW SLOPE———			0.4	
D- 1200	7107	50	4 : 1	0.001	797			———LOW SLOPE———			0.4	
D- 1220	7107.2	48	4 : 1	0.001	797			———LOW SLOPE———			0.4	
D- 1240	7107.3	46	4 : 1	0.001	797	2.9	277.2	0.035	4.37	0.017	0.4	0.022
D- 1260	7107.5	44	4 : 1	0.001	797	3.1	256.8	0.035	4.22	0.017	0.4	0.022
D- 1280	7107.6	42	4 : 1	0.001	797	3.3	240.7	0.035	4.12	0.017	0.4	0.023
D- 1300	7107.8	40	4 : 1	0.002	797	3.7	217.7	0.035	3.91	0.031	0.4	0.041
D- 1320	7108	39	4 : 1	0.002	797	4	198.3	0.035	3.69	0.032	0.4	0.041
D- 1340	7108.3	38	4 : 1	0.003	797	4.4	181.7	0.035	3.49	0.045	0.4	0.058
D- 1360	7108.5	37	4 : 1	0.004	797	4.8	164.3	0.035	3.28	0.057	0.4	0.074
HC4-12(1380)	7108.8	36	4 : 1	0.005	797	5.4	147.4	0.035	3.06	0.070	0.4	0.091
D- 1400	7109	35	4 : 1	0.007	797	6	132.6	0.035	2.86	0.093	0.4	0.121
D- 1420	7109.3	34	4 : 1	0.01	797	6.9	115.6	0.035	2.62	0.128	0.4	0.167
D- 1440	7109.5	32	4 : 1	0.013	797	7.7	103.2	0.035	2.45	0.162	0.4	0.211
D- 1480	7110.1	30	4 : 1	0.018	797	8.6	92.1	0.035	2.35	0.220	0.4	0.286
D- 1500	7110.4	29	4 : 1	0.016	797	8.4	94.5	0.035	2.46	0.203	0.4	0.264
D- 1520	7110.6	27	4 : 1	0.015	797	8.3	96.1	0.035	2.57	0.197	0.4	0.257
D- 1540	7110.9	26	4 : 1	0.018	797	8.8	90.1	0.035	2.51	0.233	0.4	0.304
D- 1560	7111.2	25	4 : 1	0.015	797	8.4	95	0.035	2.69	0.205	0.4	0.267
D- 1580	7111.4	23	4 : 1	0.018	797	9	88.4	0.035	2.62	0.244	0.4	0.317
D- 1620	7111.9	22	4 : 1	0.011	797	7.5	105.8	0.035	3.11	0.164	0.4	0.213
D- 1640	7112.1	21	4 : 1	0.011	797	7.6	104.5	0.035	3.11	0.165	0.4	0.215
D- 1660	7112.3	21	4 : 1	0.011	797	7.6	104.3	0.035	3.13	0.166	0.4	0.216
D- 1680	7112.5	20	4 : 1	0.011	797	7.7	104.2	0.035	3.15	0.168	0.4	0.219

TABLE 5-5. CHANNEL CONVEYANCE CHARACTERISTICS FOR PMF WITH STEPHENSON ROCK SIZING (continued).

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)	Alternate (por = 0.45) Riprap D50 (ft)
D- 1700	7112.7	20	4 : 1	0.011	797	7.7	103.3	0.035	3.16	0.168	0.4	0.219
D- 1800	7113.6	20	4 : 1	0.009	797	7	114.1	0.035	3.4	0.141	0.4	0.184
D- 1850	7114	20	4 : 1	0.008	797	6.9	116.1	0.035	3.44	0.129	0.4	0.167
D- 1900	7114.1	20	4 : 1	0.004	819	5.1	160.4	0.035	4.31	0.071	0.4	0.092
D- 2000	7114.3	20	4 : 1	0.002	863	4.2	208.2	0.035	5.14	0.041	0.4	0.053
D- 2100	7114.4	20	4 : 1	0.001	720	3.2	222.6	0.035	5.37	0.020	0.4	0.027
D- 2200	7114.5	20	4 : 1	0.001	576			LOW SLOPE			0.4	
D- 2300	7114.7	20	4 : 1	0.001	433			LOW SLOPE			0.4	
HC4-11(2400)	7114.8	20	4 : 1	0.001	289			LOW SLOPE			0.4	
D- 2500	7114.9	20	4 : 1	0.001	289			LOW SLOPE			0.4	
D- 2600	7115.8	20	4 : 1	0.001	289			LOW SLOPE			0.4	
D- 2700	7116.6	20	4 : 1	0.003	289	3.5	82.1	0.035	2.68	0.032	0.4	0.042
D- 2900	7118.7	20	4 : 1	0.014	289	6.2	46.5	0.035	1.73	0.118	0.4	0.154
D- 3000	7121.2	20	4 : 1	0.016	289	6.5	44.6	0.035	1.67	0.132	0.4	0.172
D- 3100	7123	20	4 : 1	0.026	289	7.7	37.7	0.035	1.46	0.200	0.4	0.260
D- 3110	7123.3	20	4 : 1	0.026	277	7.6	36.7	0.035	1.43	0.196	0.4	0.255
D- 3130	7124	20	4 : 1	0.025	253	7.2	35	0.035	1.37	0.178	0.4	0.231
D- 3150	7124.6	20	4 : 1	0.025	229	7.1	32.5	0.035	1.29	0.169	0.4	0.220
D- 3170	7125.2	20	4 : 1	0.026	206	6.8	30.1	0.035	1.21	0.162	0.4	0.211
D- 3190	7125.9	20	4 : 1	0.024	182	6.4	28.2	0.035	1.15	0.141	0.4	0.184
D- 3210	7126.5	20	4 : 1	0.024	158	6.1	25.8	0.035	1.06	0.130	0.4	0.169
D- 3230	7127.2	20	4 : 1	0.025	134	5.9	22.8	0.035	0.96	0.123	0.4	0.160
HC4-10(3250)	7127.8	20	4 : 1	0.02	110	5.1	21.4	0.035	0.91	0.090	0.4	0.117
D- 3400	7130.8	20	4 : 1	0.035	110	6.1	17.9	0.035	0.78	0.144	0.4	0.187
D- 3420	7131.5	20	4 : 1	0.035	110	6.2	17.9	0.035	0.77	0.144	0.4	0.188
D- 3440	7132.2	20	4 : 1	0.034	110	6.1	18.1	0.035	0.78	0.140	0.4	0.183
D- 3460	7132.9	20	4 : 1	0.036	110	6.2	17.8	0.035	0.77	0.147	0.4	0.192
D- 3480	7133.6	20	4 : 1	0.034	110	6.1	18	0.035	0.78	0.140	0.4	0.183
D- 3500	7134.3	20	4 : 1	0.036	110	6.2	17.7	0.035	0.77	0.147	0.4	0.192
D- 3520	7135	20	4 : 1	0.032	110	6	18.4	0.035	0.8	0.134	0.4	0.175
D- 3540	7135.7	20	4 : 1	0.038	110	6.3	17.4	0.035	0.76	0.155	0.4	0.201
D- 3560	7136.4	20	4 : 1	0.029	110	5.8	19.2	0.035	0.82	0.123	0.4	0.160
D- 3580	7137.1	20	4 : 1	0.046	110	6.7	16.4	0.035	0.72	0.182	0.4	0.237
					Channel H							
H- 50	6963.7	40	4 : 1	0.01	620	6.2	99.8	0.035	2.07	0.102	0	0.133
H- 100	6963.8	40	4 : 1	0.005	620	4.8	129.1	0.035	2.57	0.057	1.2	0.075
H- 157	6964.1	40	4 : 1	0.005	620	4.9	126.4	0.035	2.52	0.058	1.2	0.075
H- 165	6965.1	40	4 : 1	0.131	620	14.3	43.3	0.035	0.99	0.954	1.2	1.241
H- 175	6966.4	40	4 : 1	0.133	620	14.4	43	0.035	0.98	0.966	1.2	1.257
H- 183	6967.5	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 193	6968.8	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 203	6970.1	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
HCT-3(213)	6971.4	40	4 : 1	0.131	620	14.4	43.2	0.035	0.98	0.951	1.2	1.239
H- 223	6972.7	40	4 : 1	0.132	620	14.4	43.1	0.035	0.98	0.959	1.2	1.248
H- 233	6974	40	4 : 1	0.142	620	14.7	42.1	0.035	0.96	1.031	1.2	1.342
H- 240	6975	40	4 : 1	0.141	620	14.7	42.2	0.035	0.96	1.024	1.2	1.333
H- 260	6977.8	40	4 : 1	0.142	620	14.7	42.2	0.035	0.96	1.031	1.2	1.342
H- 280	6980.7	40	4 : 1	0.139	620	14.6	42.4	0.035	0.97	1.012	1.2	1.317
H- 300	6983.5	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 320	6986.1	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 340	6988.7	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 360	6991.3	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 380	6993.9	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 400	6996.5	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 420	6999.1	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 440	7001.7	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 460	7004.3	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 480	7006.9	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 500	7009.5	40	4 : 1	0.132	620	14.4	43.1	0.035	0.98	0.959	1.2	1.248
H- 520	7012.1	40	4 : 1	0.133	620	14.4	43	0.035	0.98	0.966	1.2	1.257
H- 540	7014.8	40	4 : 1	0.132	620	14.4	43.1	0.035	0.98	0.959	1.2	1.248
H- 560	7017.5	40	4 : 1	0.132	620	14.4	43.1	0.035	0.98	0.959	1.2	1.248
H- 580	7020.1	40	4 : 1	0.133	620	14.4	43	0.035	0.98	0.966	1.2	1.257
H- 600	7022.8	40	4 : 1	0.132	620	14.4	43.1	0.035	0.98	0.959	1.2	1.248
H- 620	7025.4	40	4 : 1	0.132	620	14.4	43.1	0.035	0.98	0.959	1.2	1.248

TABLE 5-5. CHANNEL CONVEYANCE CHARACTERISTICS FOR PMF WITH STEPHENSON ROCK SIZING (continued).

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)	Alternate (por = 0.45) Riprap D50 (ft)
H- 640	7028	40	4 : 1	0.133	620	14.4	43.1	0.035	0.98	0.966	1.2	1.257
H- 660	7030.7	40	4 : 1	0.132	620	14.4	43.1	0.035	0.98	0.959	1.2	1.248
H- 680	7033.4	40	4 : 1	0.132	620	14.4	43.1	0.035	0.98	0.959	1.2	1.248
H- 700	7036	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 720	7038.6	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 740	7041.2	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 760	7043.8	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 780	7046.4	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 800	7049	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 820	7051.6	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 840	7054.2	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 860	7056.8	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 880	7059.4	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 900	7062	40	4 : 1	0.135	620	14.5	42.8	0.035	0.98	0.985	1.2	1.282
H- 920	7064.7	40	4 : 1	0.135	620	14.5	42.8	0.035	0.98	0.985	1.2	1.282
H- 940	7067.4	40	4 : 1	0.135	620	14.5	42.8	0.035	0.98	0.985	1.2	1.282
H- 960	7070.1	40	4 : 1	0.134	620	14.4	42.9	0.035	0.98	0.973	1.2	1.267
H- 980	7072.8	40	4 : 1	0.13	620	14.3	43.3	0.035	0.99	0.946	1.2	1.232
H- 1000	7075.5	40	4 : 1	0.109	620	13.5	45.9	0.035	1.04	0.794	1.2	1.034
H- 1010	7077	40	4 : 1	0.069	620	11.7	53.2	0.035	1.19	0.522	1.2	0.680
H- 1030	7078.5	40	4 : 1	0.026	620	8.5	72.9	0.035	1.57	0.224	1.2	0.292
HCT-2(1100)	7079.4	40	4 : 1	0.007	620	5.5	112.9	0.035	2.3	0.076	1.2	0.099
H- 1200	7079.6	40	4 : 1	0.004	620	4.4	141.4	0.035	2.77	0.048	1.2	0.062
H- 1220	7079.7	39	4 : 1	0.004	620	4.6	135.6	0.035	2.73	0.049	1.2	0.064
H- 1240	7079.8	38	4 : 1	0.004	620	4.8	130.5	0.035	2.7	0.050	1.2	0.065
H- 1260	7079.9	36	4 : 1	0.005	620	5	125.1	0.035	2.66	0.060	1.2	0.079
H- 1280	7080	35	4 : 1	0.005	620	5.1	121	0.035	2.65	0.061	1.2	0.080
H- 1282	7080	35	3.9 : 1	0.006	620	5.3	115.9	0.035	2.6	0.071	1.2	0.093
H- 1285	7080.1	34	3.9 : 1	0.007	620	5.7	109.5	0.035	2.51	0.083	1.2	0.108
H- 1288	7080.2	33	3.8 : 1	0.008	620	6.1	102.4	0.035	2.43	0.094	1.2	0.122
H- 1291	7080.2	32	3.7 : 1	0.01	620	6.5	95.7	0.035	2.34	0.114	1.2	0.148
H- 1294	7080.3	32	3.7 : 1	0.023	620	8.7	71.3	0.035	1.86	0.231	1.2	0.301
H- 1297	7080.3	31	3.6 : 1	0.021	620	8.4	73.3	0.035	1.95	0.216	1.2	0.282
H- 1300	7080.4	30	3.5 : 1	0.0195	620	8.25	73.3	0.035	2.03	0.207	1.2	0.269
H- 1303	7080.4	29	3.5 : 1	0.018	620	8.1	76.2	0.035	2.08	0.195	1.2	0.254
H- 1306	7080.4	29	3.4 : 1	0.018	620	8.2	75.7	0.035	2.12	0.199	1.2	0.259
H- 1309	7080.4	28	3.4 : 1	0.019	620	8.5	73.1	0.035	2.1	0.211	1.2	0.275
H- 1312	7080.5	27	3.3 : 1	0.019	620	8.5	72.8	0.035	2.14	0.214	1.2	0.279
H- 1315	7080.5	26	3.3 : 1	0.019	620	8.5	72.9	0.035	2.18	0.217	1.2	0.282
H- 1318	7080.5	26	3.3 : 1	0.016	620	8	77.2	0.035	2.33	0.190	1.2	0.247
H- 1321	7080.5	25	3.2 : 1	0.015	620	8	77.2	0.035	2.38	0.183	1.2	0.238
H- 1324	7080.5	24	3.2 : 1	0.016	620	8.3	74.6	0.035	2.36	0.196	1.2	0.255
H- 1327	7080.5	23	3.2 : 1	0.017	620	8.5	72.9	0.035	2.36	0.209	1.2	0.272
H- 1330	7080.5	23	3.1 : 1	0.019	620	8.8	70.7	0.035	2.37	0.235	1.2	0.305
H- 1333	7080.5	22	3.1 : 1	0.016	620	8.4	73.8	0.035	2.5	0.205	1.2	0.267
H- 1336	7080.5	21	3.1 : 1	0.025	620	9.8	63.3	0.035	2.26	0.305	1.2	0.396
H- 1339	7080.6	20	3 : 1	0.026	620	10	61.8	0.035	2.28	0.321	1.2	0.417
H- 1342	7080.6	20	3 : 1	0.028	620	10.4	59.8	0.035	2.27	0.348	1.2	0.454
H- 1345	7080.6	19	2.9 : 1	0.031	620	10.8	57.3	0.035	2.26	0.387	1.2	0.504
H- 1348	7080.6	18	2.9 : 1	0.031	620	10.9	56.8	0.035	2.3	0.394	1.2	0.513
H- 1351	7080.6	17	2.9 : 1	0.034	620	11.3	54.7	0.035	2.29	0.434	1.2	0.565
H- 1354	7080.6	17	2.8 : 1	0.034	620	11.6	53.7	0.035	2.33	0.447	1.2	0.582
H- 1357	7080.6	16	2.8 : 1	0.036	620	11.8	52.6	0.035	2.35	0.477	1.2	0.620
H- 1360	7080.6	15	2.8 : 1	0.039	620	12.2	51	0.035	2.36	0.522	1.2	0.680
H- 1363	7080.7	14	2.7 : 1	0.039	620	12.3	50.4	0.035	2.42	0.534	1.2	0.695
H- 1366	7080.7	14	2.7 : 1	0.041	620	12.7	48.9	0.035	2.43	0.570	1.2	0.742
H- 1369	7080.7	13	2.6 : 1	0.042	620	12.9	48.1	0.035	2.5	0.599	1.2	0.780
H- 1372	7080.7	12	2.6 : 1	0.043	620	13.1	47.2	0.035	2.54	0.624	1.2	0.812
H- 1375	7080.7	11	2.6 : 1	0.044	620	13.3	46.6	0.035	2.59	0.651	1.2	0.847
H- 1378	7080.7	11	2.5 : 1	0.045	620	13.5	45.9	0.035	2.67	0.683	1.2	0.890
H- 1381	7080.7	10	2.5 : 1	0.045	620	13.6	45.5	0.035	2.74	0.699	1.2	0.909
H- 1384	7080.8	9	2.5 : 1	0.045	620	13.7	45.2	0.035	2.82	0.716	1.2	0.932
H- 1387	7080.8	8	2.4 : 1	0.045	620	13.9	44.8	0.035	2.92	0.740	1.2	0.963
H- 1390	7080.8	8	2.4 : 1	0.045	620	13.9	44.6	0.035	3.02	0.756	1.2	0.985
H- 1393	7080.8	7	2.3 : 1	0.043	620	13.9	44.5	0.035	3.16	0.750	1.2	0.977
H- 1396	7080.8	6	2.3 : 1	0.043	620	13.9	44.7	0.035	3.29	0.771	1.2	1.004

TABLE 5-5. CHANNEL CONVEYANCE CHARACTERISTICS FOR PMF WITH STEPHENSON ROCK SIZING (continued).

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)	Alternate (por = 0.45) Riprap D50 (ft)
H- 1399	7080.8	5	2.3 : 1	0.041	620	13.7	45.1	0.035	3.43	0.754	1.2	0.982
H- 1402	7080.8	5	2.2 : 1	0.039	620	13.7	45.4	0.035	3.63	0.752	1.2	0.978
H- 1405	7080.8	4	2.2 : 1	0.037	620	13.4	46.2	0.035	3.8	0.731	1.2	0.952
H- 1408	7080.9	3	2.2 : 1	0.035	620	13.1	47.4	0.035	4.01	0.713	1.2	0.928
H- 1411	7080.9	2	2.1 : 1	0.032	620	12.8	48.5	0.035	4.29	0.682	1.2	0.888
H- 1414	7080.9	2	2.1 : 1	0.028	620	12.2	50.7	0.035	4.57	0.618	1.2	0.804
H- 1417	7080.9	1	2 : 1	0.023	620	11.5	54	0.035	5	0.538	1.2	0.700
HCT-1(1470)	7081	0	2 : 1	0.006	620	6.9	89.7	0.035	6.7	0.160	1.2	0.208
H- 1490	7081	0	2 : 1	0.005	620	6.3	98.2	0.035	7.01	0.135	1.2	0.175
H- 1500	7081	5	2 : 1	0.002	620	4.2	147.9	0.035	7.44	0.052	1.2	0.068
H- 1501	7081	5	2 : 1	0.002	620	4.1	151.5	0.035	7.46	0.051	1.2	0.067
H- 1504	7081	6	2.1 : 1	0.001	620	3.7	166.2	0.035	7.5	0.028	1.2	0.037
H- 1507	7081	7	2.1 : 1	0.001	620	3.5	178.1	0.035	7.61	0.027	1.2	0.036
H- 1510	7081	9	2.2 : 1	0.001	620	3.3	187	0.035	7.49	0.026	1.2	0.034
H- 1513	7081	10	2.3 : 1	0.001	620				PONDED		1.2	
H- 1516	7081	11	2.3 : 1	0.001	620				PONDED		1.2	
H- 1519	7081	12	2.4 : 1	0.001	620				PONDED		1.2	
H- 1522	7081	13	2.4 : 1	0.001	620				PONDED		1.2	
H- 1525	7081	14	2.5 : 1	0.001	620				PONDED		1.2	
H- 1528	7081	15	2.6 : 1	0.001	620				PONDED		1.2	
H- 1531	7081	16	2.6 : 1	0.001	620				PONDED		1.2	
H- 1534	7081	17	2.7 : 1	0.001	620				PONDED		1.2	
H- 1537	7081	18	2.7 : 1	0.001	620				PONDED		1.2	
H- 1540	7081	19	2.8 : 1	0.001	620				PONDED		1.2	
H- 1543	7081	20	2.9 : 1	0.001	620				PONDED		1.2	
H- 1546	7081	21	2.9 : 1	0.001	620				PONDED		1.2	
H- 1549	7081	22	3 : 1	0.001	620				PONDED		1.2	
H- 1552	7081	23	3 : 1	0.001	620				PONDED		1.2	
H- 1555	7081.1	24	3.1 : 1	0.001	620				PONDED		1.2	
H- 1558	7081.1	25	3.2 : 1	0.001	620				PONDED		1.2	
H- 1561	7081.1	26	3.2 : 1	0.001	620				PONDED		1.2	
H- 1564	7081.1	27	3.3 : 1	0.001	620				PONDED		1.2	
H- 1567	7081.1	28	3.3 : 1	0.001	620				PONDED		1.2	
H- 1570	7081.1	30	3.4 : 1	0.001	620				PONDED		1.2	
H- 1573	7081.1	31	3.5 : 1	0.001	620				PONDED		1.2	
H- 1576	7081.1	32	3.5 : 1	0.001	620				PONDED		1.2	
H- 1579	7081.1	33	3.6 : 1	0.001	620				PONDED		1.2	
H- 1582	7081.1	34	3.6 : 1	0.001	620				PONDED			
H- 1585	7081.1	35	3.7 : 1	0.001	620				PONDED			
H- 1588	7081.1	36	3.8 : 1	0.001	620				PONDED			
H- 1591	7081.1	37	3.8 : 1	0.001	620				PONDED			
H- 1594	7081.1	38	3.9 : 1	0.001	620				PONDED			
H- 1597	7081.1	39	3.9 : 1	0.001	620				PONDED			
H- 1600	7081.1	40	4 : 1	0.001	620				PONDED			
H- 1700	7081.2	40	4 : 1	0.001	620				PONDED			
					Channel I							
I- 1450	7081	50	4 : 1	0.007	581	5.1	113.2	0.035	1.96	0.000	0.15	0.085
I- 1490	7081.3	50	4 : 1	0.007	581	5.2	112.2	0.035	1.94	0.065	0.15	0.085
I- 1590	7082.1	50	4 : 1	0.008	581	5.3	108.9	0.035	1.89	0.065	0.15	0.094
I- 1630	7082.4	50	4 : 1	0.008	581	5.3	109.3	0.035	1.9	0.072	0.15	0.095
I- 1730	7083.2	50	4 : 1	0.008	581	5.3	109.8	0.035	1.9	0.073	0.15	0.095
I- 1770	7083.8	50	4 : 1	0.015	581	6.6	87.8	0.035	1.56	0.073	0.15	0.158
I- 1870	7085.3	50	4 : 1	0.033	581	8.5	68.6	0.035	1.25	0.121	0.6	0.305
I- 1890	7086	50	4 : 1	0.033	581	8.4	68.8	0.035	1.25	0.234	0.6	0.302
I- 1910	7086.6	50	4 : 1	0.032	581	8.4	69.2	0.035	1.26	0.232	0.6	0.296
I- 1930	7087.3	50	4 : 1	0.034	581	8.6	68	0.035	1.24	0.228	0.6	0.313
I- 1940	7087.6	50	4 : 1	0.034	581	8.5	68.2	0.035	1.24	0.240	0.6	0.311
I- 1960	7088.3	50	4 : 1	0.034	581	8.5	68.3	0.035	1.24	0.239	0.6	0.311
HC4-3(1980)	7089	50	4 : 1	0.033	581	8.4	68.8	0.035	1.25	0.239	0.6	0.302
I- 1995	7089.5	50	4 : 1	0.032	581	8.4	69.2	0.035	1.26	0.232	0.6	0.296
I- 2015	7090.1	50	4 : 1	0.031	581	8.3	70.2	0.035	1.27	0.228	0.6	0.288
I- 2035	7090.8	50	4 : 1	0.033	581	8.5	68.6	0.035	1.25	0.221	0.6	0.305
I- 2055	7091.5	50	4 : 1	0.031	581	8.3	70.1	0.035	1.27	0.234	0.6	0.288
I- 2075	7092.1	50	4 : 1	0.034	581	8.5	68	0.035	1.24	0.221	0.6	0.311
I- 2090	7092.6	50	4 : 1	0.033	581	8.4	68.9	0.035	1.25	0.239	0.6	0.302

TABLE 5-5. CHANNEL CONVEYANCE CHARACTERISTICS FOR PMF WITH STEPHENSON ROCK SIZING (continued).

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)	Alternate (por = 0.45) Riprap D50 (ft)
I- 2110	7093.3	50	4 : 1	0.034	581	8.5	68.2	0.035	1.24	0.232	0.6	0.311
I- 2130	7094	50	4 : 1	0.033	581	8.4	69	0.035	1.26	0.239	0.6	0.304
I- 2150	7094.6	50	4 : 1	0.035	581	8.6	67.8	0.035	1.23	0.233	0.6	0.319
I- 2170	7095.3	50	4 : 1	0.02	581	7.2	80.3	0.035	1.44	0.245	0.6	0.200
I- 2270	7098	50	4 : 1	0.036	541	8.5	63.7	0.035	1.17	0.153	0.6	0.313
I- 2390	7100.9	49	4 : 1	0.011	496	5.6	88.8	0.035	1.6	0.241	0.4	0.112
I- 2410	7101.2	48	4 : 1	0.012	491	5.8	85.3	0.035	1.57	0.086	0.4	0.122
I- 2430	7101.4	47	4 : 1	0.012	486	5.9	83	0.035	1.55	0.094	0.4	0.122
I- 2450	7101.6	46	4 : 1	0.012	482	5.9	81.9	0.035	1.56	0.094	0.4	0.123
I- 2470	7101.9	46	4 : 1	0.012	477	5.8	81.6	0.035	1.58	0.094	0.4	0.122
I- 2490	7102.1	45	4 : 1	0.012	473	5.9	80.7	0.035	1.59	0.094	0.4	0.124
I- 2510	7102.4	44	4 : 1	0.012	468	5.9	79.7	0.035	1.6	0.095	0.4	0.125
I- 2530	7102.6	43	4 : 1	0.012	464	5.9	78.2	0.035	1.59	0.096	0.4	0.124
I- 2550	7102.8	42	4 : 1	0.013	459	6	76.8	0.035	1.6	0.095	0.4	0.134
I- 2570	7103.1	41	4 : 1	0.012	455	6	76.3	0.035	1.61	0.103	0.4	0.127
I- 2590	7103.3	40	4 : 1	0.012	450	5.9	75.6	0.035	1.63	0.097	0.4	0.126
I- 2614	7103.7	40	4 : 1	0.014	445	6.2	71.9	0.035	1.55	0.097	0.4	0.143
I- 2714	7105.2	40	4 : 1	0.015	422	6.2	67.8	0.035	1.48	0.110	0.4	0.146
HC4-2(2810)	7106.7	40	4 : 1	0.014	399	5.9	67.1	0.035	1.46	0.112	0.4	0.133
I- 2815	7106.7	40	4 : 1	0.012	399	5.7	70.6	0.035	1.53	0.102	0.4	0.118
I- 2830	7106.8	40	4 : 1	0.007	399	4.8	82.9	0.035	1.76	0.091	0.4	0.076
I- 2930	7107.2	40	4 : 1	0.005	399	4.1	96.7	0.035	2.01	0.058	0.4	0.057
I- 3030	7107.6	40	4 : 1	0.004	399	4	98.9	0.035	2.05	0.044	0.4	0.048
I- 3040	7107.6	39	4 : 1	0.004	399	4.1	97.7	0.035	2.06	0.037	0.4	0.049
I- 3060	7107.7	38	4 : 1	0.005	399	4.2	94.7	0.035	2.07	0.037	0.4	0.059
I- 3080	7107.8	36	4 : 1	0.005	399	4.4	91.3	0.035	2.06	0.046	0.4	0.061
I- 3100	7107.9	34	4 : 1	0.005	399	4.5	88.8	0.035	2.08	0.047	0.4	0.062
I- 3120	7108	33	4 : 1	0.006	399	4.6	86.4	0.035	2.1	0.048	0.4	0.073
I- 3140	7108	31	4 : 1	0.006	399	4.7	84.6	0.035	2.13	0.056	0.4	0.075
I- 3160	7108.1	30	4 : 1	0.006	399	4.8	82.3	0.035	2.15	0.058	0.4	0.077
I- 3180	7108.2	28	4 : 1	0.006	399	4.9	80.7	0.035	2.19	0.059	0.4	0.079
I- 3200	7108.3	26	4 : 1	0.007	399	5.1	78.7	0.035	2.23	0.060	0.4	0.092
I- 3220	7108.4	25	4 : 1	0.007	399	5.2	77.1	0.035	2.28	0.071	0.4	0.095
I- 3240	7108.4	23	4 : 1	0.007	399	5.3	76	0.035	2.34	0.073	0.4	0.098
I- 3260	7108.5	22	4 : 1	0.007	399	5.4	74.2	0.035	2.38	0.075	0.4	0.100
HC4-1(3280)	7108.6	20	4 : 1	0.008	399	5.5	72.1	0.035	2.43	0.077	0.4	0.114
I- 3290	7108.8	21	4 : 1	0.016	399	7.1	56.5	0.035	1.94	0.088	0.4	0.202
I- 3310	7109.3	24	4 : 1	0.016	399	7	57.1	0.035	1.81	0.155	0.4	0.191
I- 3330	7109.7	27	4 : 1	0.017	399	6.9	57.6	0.035	1.7	0.147	0.4	0.190
I- 3360	7110.3	29	4 : 1	0.01	399	5.7	69.8	0.035	1.89	0.146	0.4	0.118
I- 3380	7110.4	28	4 : 1	0.009	399	5.5	72.3	0.035	2.01	0.091	0.4	0.110
I- 3400	7110.5	27	4 : 1	0.009	399	5.5	72.6	0.035	2.07	0.085	0.4	0.113
I- 3420	7110.6	25	4 : 1	0.009	399	5.6	71.7	0.035	2.12	0.087	0.4	0.116
I- 3440	7110.7	24	4 : 1	0.009	399	5.6	71.1	0.035	2.17	0.089	0.4	0.118
I- 3460	7110.9	23	4 : 1	0.009	399	5.8	69.4	0.035	2.2	0.090	0.4	0.122
I- 3480	7111	21	4 : 1	0.009	399	5.8	68.6	0.035	2.26	0.093	0.4	0.124
I- 3500	7111.1	20	4 : 1	0.009	399	5.9	67.7	0.035	2.32	0.095	0.4	0.127
					Channel M							
M- 200	7082.5	50	8 : 1	0.005	170	2.8	59.6	0.035	1.02	0.000	0.6	0.028
M- 270	7083	50	8 : 1	0.007	170	3.2	53.3	0.035	0.93	0.022	0.6	0.038
HC4-6(295)	7084	50	6.4 : 1	0.035	170	5.4	31.8	0.035	0.59	0.029	0.6	0.143
M- 395	7088	50	8 : 1	0.046	170	5.8	29.5	0.035	0.54	0.110	0.6	0.178
M- 495	7094.1	50	8 : 1	0.09	150	6.8	22	0.035	0.41	0.137	0.6	0.295
M- 605	7099.9	50	8 : 1	0.001	36	1	36	0.035	0.65	0.226	0.6	0.003
M- 612	7099.9	43	7.1 : 1	0.002	36	1.2	31	0.035	0.65	0.002	0.6	0.006
M- 618	7099.9	36	5.1 : 1	0.002	36	1.4	25.5	0.035	0.65	0.004	0.6	0.006
M- 625	7100	30	7.4 : 1	0.003	36	1.6	22	0.035	0.64	0.005	0.6	0.010
M- 633	7100	20	4 : 1	0.008	36	2.6	13.9	0.035	0.62	0.007	0.6	0.028
M- 641	7100	10	4 : 1	0.079	36	6.5	5.5	0.035	0.47	0.021	0.6	0.279
M- 645	7100	5	4 : 1	0.083	36	7.4	4.8	0.035	0.64	0.214	0.6	0.390
M- 650	7100	0	4 : 1	0.023	36	4.9	7.4	0.035	1.36	0.300	0.6	0.166
M- 670	7100	0	2.5 : 1	0.023	36	5.3	6.8	0.035	1.64	0.128	0.6	0.199
M- 680	7100.1	0	2 : 1	0.02	36	5.2	6.9	0.035	1.85	0.153	0.6	0.190
HC4-5(705)	7100.1	0	2 : 1	0.008	36	3.3	10.8	0.035	2.33	0.146	0.6	0.063
M- 730	7100.2	0	2 : 1	0.005	36	3.1	11.8	0.035	2.43	0.048	0.6	0.054

TABLE 5-5. CHANNEL CONVEYANCE CHARACTERISTICS FOR PMF WITH STEPHENSON ROCK SIZING (continued).

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)	Alternate (por = 0.45) Riprap D50 (ft)
M- 755	7100.2	25	4 : 1	0.001	36	——SURGE POND——					0.6	
					Channel N							
N- 100	7076.2	30	4 : 1	0.042	229	7.6	30.2	0.035	0.9	0.225	–	0.277
N- 110	7076.6	30	4 : 1	0.048	229	7.9	28.9	0.035	0.86	0.252	–	0.309
HC5-5(130)	7077.5	30	4 : 1	0.026	229	6.5	35.5	0.035	1.04	0.149	0.6	0.186
N- 140	7078.3	30	4 : 1	0.024	229	6.3	36.2	0.035	1.06	0.141	0.6	0.172
N- 190	7079	30	4 : 1	0.025	229	6.4	35.7	0.035	1.04	0.146	0.6	0.178
N- 200	7079.3	30	4 : 1	0.019	213	5.7	37.4	0.035	1.09	0.11	0.6	0.136
N- 220	7080	30	4 : 1	0.055	180	7.6	23.7	0.035	0.72	0.242	0.6	0.300
N- 230	7080.5	28	4 : 1	0.055	180	7.7	23.4	0.035	0.75	0.248	0.6	0.311
N- 240	7081	27	4 : 1	0.054	180	7.8	23.1	0.035	0.78	0.254	0.6	0.317
N- 250	7081.5	25	4 : 1	0.045	180	7.4	24.2	0.035	0.85	0.225	0.6	0.278
N- 270	7082.4	25	4 : 1	0.046	180	7.5	24	0.035	0.85	0.229	0.6	0.285
N- 290	7083.3	25	4 : 1	0.044	180	7.4	24.3	0.035	0.86	0.221	0.6	0.275
N- 310	7084.2	25	4 : 1	0.046	180	7.5	23.9	0.035	0.84	0.231	0.6	0.283
N- 330	7085.1	25	4 : 1	0.038	180	7.1	25.5	0.035	0.89	0.196	0.6	0.242
N- 350	7086	25	4 : 1	0.083	180	9.1	19.8	0.035	0.71	0.385	0.6	0.480
N- 365	7087.2	25	4 : 1	0.077	180	8.9	20.3	0.035	0.73	0.361	0.6	0.451
HC5-4(385)	7088.9	25	4 : 1	0.105	180	9.9	18.3	0.035	0.66	0.483	0.6	0.600
N- 395	7090	25	4 : 1	0.092	180	9.4	19.1	0.035	0.69	0.426	0.6	0.528
N- 400	7090.2	20	4 : 1	0.109	180	10.6	17	0.035	0.74	0.573	0.6	0.702
N- 402	7090.4	19	3.9 : 1	0.11	180	10.8	16.7	0.035	0.76	0.594	1.2	0.729
N- 404	7090.5	18	3.8 : 1	0.109	180	10.9	16.5	0.035	0.79	0.613	1.2	0.747
N- 406	7090.7	17	3.7 : 1	0.107	180	11	16.3	0.035	0.82	0.623	1.2	0.757
N- 408	7090.8	16	3.6 : 1	0.105	180	11.1	16.2	0.035	0.85	0.633	1.2	0.766
N- 410	7091	15	3.5 : 1	0.099	180	11.1	16.2	0.035	0.9	0.622	1.2	0.753
N- 412	7091.1	14	3.4 : 1	0.102	180	11.4	15.8	0.035	0.92	0.668	1.2	0.800
N- 414	7091.2	13	3.3 : 1	0.104	180	11.7	15.4	0.035	0.95	0.715	1.2	0.847
N- 416	7091.3	12	3.2 : 1	0.106	180	12	15	0.035	0.99	0.761	1.2	0.901
N- 418	7091.4	11	3.1 : 1	0.107	180	12.3	14.7	0.035	1.03	0.803	1.2	0.949
N- 420	7091.5	10	3 : 1	0.105	180	12.4	14.5	0.035	1.09	0.837	1.2	0.974
N- 430	7092	5	3 : 1	0.092	180	12.7	14.1	0.035	1.49	1.003	1.2	1.078
N- 440	7092.5	0	3 : 1	0.065	180	11.4	15.7	0.035	2.29	1.051	1.2	0.981
N- 445	7092.8	0	2.5 : 1	0.047	180	10.5	17.2	0.035	2.62	0.826	1.2	0.770
HC5-3(475)	7093	0	2 : 1	0.006	180	5.2	34.9	0.035	4.18	0.145	1.2	0.126
N- 500	7093.1	0	2 : 1	0.005	180	4.8	37.4	0.035	4.32	0.122	1.2	0.106
N- 503	7093.1	3	2.2 : 1	0.002	180	3	59.4	0.035	4.58	0.034	1.2	0.039
N- 508	7093.1	8	2.6 : 1	0.001	180		——LOW SLOPE——				1.2	
N- 513	7093.1	13	3 : 1	0.001	180		——LOW SLOPE——				1.2	
N- 515	7093.1	17	3.2 : 1	0.001	180		——LOW SLOPE——				0.15	
N- 520	7093.1	29	3.6 : 1	0.001	180		——LOW SLOPE——				0.15	
N- 525	7093.2	40	4 : 1	0.001	180		——LOW SLOPE——				0.15	
N- 600	7094	40	4 : 1	0.001	450		——LOW SLOPE——				0.15	
N- 680	7094.1	40	4 : 1	0.001	650	3.2	202.1	0.035	3.69	0.023	0.15	0.021
N- 780	7094.3	40	4 : 1	0.003	899	4.6	194.4	0.035	3.58	0.052	0.15	0.061
HC5-2(880)	7094.5	40	4 : 1	0.005	1149	5.8	198.6	0.035	3.64	0.086	0.15	0.107
N- 885	7094.5	40	4.1 : 1	0.004	1149	5.7	202.6	0.035	3.66	0.083	0.15	0.089
N- 890	7094.5	41	4.2 : 1	0.004	1149	5.5	208.7	0.035	3.71	0.077	0.15	0.088
N- 895	7094.5	41	4.3 : 1	0.004	1149	5.4	211.4	0.035	3.72	0.075	0.15	0.087
N- 900	7094.6	41	4.4 : 1	0.004	1149	5.3	216.3	0.035	3.74	0.072	0.15	0.086
N- 920	7094.6	43	4.8 : 1	0.003	1149	5	231.2	0.035	3.81	0.062	0.15	0.067
N- 940	7094.7	44	5.1 : 1	0.003	1149	4.7	245.3	0.035	3.86	0.055	0.15	0.065
N- 960	7094.8	45	5.5 : 1	0.003	1149	4.4	258.9	0.035	3.9	0.049	0.15	0.063
N- 980	7094.8	46	5.9 : 1	0.002	1149	4.3	270.4	0.035	3.9	0.045	0.15	0.045
N- 1000	7094.9	48	6.3 : 1	0.002	1149	4.1	282.9	0.035	3.92	0.041	0.15	0.044
N- 1020	7094.9	49	6.6 : 1	0.002	1149	4	290.8	0.035	3.9	0.039	0.15	0.043
N- 1040	7095	50	7 : 1	0.002	1149	3.8	305.3	0.035	3.94	0.035	0.15	0.042
N- 1060	7095.1	51	7.4 : 1	0.002	1149	3.7	315.1	0.035	3.93	0.033	0.15	0.041
N- 1080	7095.1	53	7.8 : 1	0.002	1149	3.6	319	0.035	3.86	0.032	0.15	0.040
N- 1100	7095.2	54	8.1 : 1	0.002	1149	3.5	328.5	0.035	3.87	0.03	0.15	0.039
N- 1120	7095.3	55	8.5 : 1	0.002	1149	3.4	339.5	0.035	3.87	0.028	0.15	0.038
N- 1140	7095.3	56	8.9 : 1	0.002	1149	3.3	343.2	0.035	3.81	0.028	0.15	0.037
N- 1160	7095.4	58	9.3 : 1	0.002	1149	3.2	354.8	0.035	3.82	0.026	0.15	0.036
N- 1180	7095.4	59	9.6 : 1	0.002	1149	3.2	357.6	0.035	3.77	0.026	0.15	0.036
N- 1200	7095.5	60	10 : 1	0.001	1149	3.1	370.1	0.035	3.78	0.024	0.15	0.021

TABLE 5-5. CHANNEL CONVEYANCE CHARACTERISTICS FOR PMF WITH STEPHENSON ROCK SIZING (continued).

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)	Alternate (por = 0.45) Riprap D50 (ft)
N- 1300	7095.7	60	10 : 1	0.002	1149	3.2	361.2	0.035	3.72	0.025	0.15	0.036
N- 1400	7095.8	60	10 : 1	0.002	1149	3.2	361.2	0.035	3.72	0.025	0.15	0.036
N- 1500	7096	60	10 : 1	0.002	1149	3.2	361.2	0.035	3.72	0.025	0.15	0.036
N- 1600	7096.2	60	10 : 1	0.002	1149	3.3	352.9	0.035	3.66	0.027	0.15	0.036
N- 1950	7096.7	60	10 : 1	0.002	1149	3.2	361.2	0.035	3.72	0.025	0.15	0.036
N- 2150	7096.9	60	10 : 1	0.001	1149	3.1	370.1	0.035	3.78	0.024	0.15	0.021
HC5-1(2250)	7097	60	10 : 1	0.001	1149	3	380.1	0.035	3.86	0.022	0.15	0.020
N- 2300	7097.1	60	10 : 1	0.001	1149	3	380.1	0.035	3.86	0.022	0.15	0.020
N- 2400	7097.2	60	10 : 1	0.001	1149	3	380.1	0.035	3.86	0.022	0.15	0.020
N- 2500	7097.3	60	10 : 1	0.001	1149	3	380.1	0.035	3.86	0.022	0.15	0.020
N- 2600	7097.5	60	10 : 1	0.001	1149	3	380.1	0.035	3.86	0.022	0.15	0.020
N- 2700	7097.6	60	10 : 1	0.001	1149	3	380.1	0.035	3.86	0.022	0.15	0.020
N- 2800	7097.7	60	10 : 1	0.001	1149	3	380.1	0.035	3.86	0.022	0.15	0.020
N- 2900	7097.9	60	10 : 1	0.001	1149	3	380.1	0.035	3.86	0.022	0.15	0.020
N- 3000	7098	60	10 : 1	0.001	1149	3	380.1	0.035	3.86	0.022	0.15	0.020
					Channel O							
HC5-9(55)	7097	20	4 : 1	0.013	583	7.3	79.5	0.035	2.61	0.000	0.4	0.212
O- 150	7098.7	20	4 : 1	0.012	583	7.3	79.9	0.035	2.62	0.163	0.4	0.200
O- 250	7100	20	4 : 1	0.014	583	7.6	76.5	0.035	2.54	0.153	0.4	0.227
O- 310	7100.4	20	4 : 1	0.006	583	5.7	102.1	0.035	3.14	0.175	0.4	0.111
O- 410	7101	20	4 : 1	0.006	583	5.7	102.1	0.035	3.14	0.085	0.4	0.111
O- 411	7101	21	5.3 : 1	0.004	575	4.4	131.2	0.035	3.41	0.085	0.4	0.072
O- 414	7101	22	5.3 : 1	0.003	550	4	138.5	0.035	3.44	0.055	0.4	0.054
O- 417	7101	24	5.2 : 1	0.002	526	3.6	146.3	0.035	3.51	0.041	0.4	0.037
O- 420	7101	25	3.9 : 1	0.002	501	3.7	134.9	0.035	3.49	0.029	0.4	0.038
O- 460	7101.3	25	3.9 : 1	0.003	501	3.9	127.1	0.035	3.34	0.029	0.4	0.052
O- 465	7101.3	25	3.9 : 1	0.003	501	3.9	127.1	0.035	3.34	0.040	0.4	0.052
O- 470	7101.3	25	3.9 : 1	0.003	501	4	125.4	0.035	3.31	0.040	0.4	0.053
O- 475	7101.3	25	3.9 : 1	0.003	501	4	125.4	0.035	3.31	0.040	0.4	0.053
O- 480	7101.4	25	3.9 : 1	0.003	501	4.1	123.8	0.035	3.28	0.040	0.4	0.053
O- 485	7101.4	25	3.9 : 1	0.003	501	4.1	123.8	0.035	3.28	0.041	0.4	0.053
O- 490	7101.4	25	4 : 1	0.003	501	4.1	122.8	0.035	3.24	0.041	0.4	0.053
O- 495	7101.4	25	4 : 1	0.003	501	4.1	122.8	0.035	3.24	0.040	0.4	0.053
O- 500	7101.5	25	4 : 1	0.003	501	4.1	121.3	0.035	3.21	0.040	0.4	0.052
O- 505	7101.5	25	4 : 1	0.003	501	4.1	121.3	0.035	3.21	0.040	0.4	0.052
HC5-6(510)	7101.5	25	4 : 1	0.003	501	4.1	121.3	0.035	3.21	0.040	0.4	0.052
O- 610	7102	25	4 : 1	0.004	501	4.6	109.6	0.035	2.97	0.040	0.4	0.067
O- 620	7102	25	4 : 1	0.004	501	4.6	109.6	0.035	2.97	0.052	0.4	0.067
O- 720	7102.5	25	4 : 1	0.004	501	4.7	105.9	0.035	2.9	0.052	0.4	0.067
O- 820	7103	25	4 : 1	0.005	501	4.8	104.3	0.035	2.86	0.052	0.4	0.080
O- 830	7103	25	4 : 1	0.005	501	4.8	104.3	0.035	2.86	0.062	0.4	0.080
O- 930	7103.5	25	4 : 1	0.005	501	4.9	102.8	0.035	2.83	0.062	0.4	0.081
O- 1030	7104	25	4 : 1	0.005	501	4.9	102.8	0.035	2.83	0.062	0.4	0.081
O- 1130	7104.5	25	4 : 1	0.005	501	4.9	102.8	0.035	2.83	0.062	0.4	0.081
O- 1230	7105	25	4 : 1	0.005	501	4.9	102	0.035	2.81	0.062	0.4	0.081
					Channel P							
P- 10	7101.3	20	4 : 1	0.005	446	4.9	90.4	0.035	2.87	0.000	0.4	0.082
P- 30	7102	20	4 : 1	0.001	173	2.2	79.5	0.035	2.61	0.063	0.4	0.013
HC5-8(50)	7102.5	20	4 : 1	0.003	173	3	58.7	0.035	2.07	0.010	0.4	0.032
P- 70	7103	20	4 : 1	0.007	173	4.2	41.2	0.035	1.57	0.024	0.4	0.064
P- 110	7104	20	4 : 1	0.022	173	6.1	28.4	0.035	1.15	0.049	0.4	0.166
P- 200	7105.5	20	4 : 1	0.01	173	4.7	36.7	0.035	1.43	0.128	0.4	0.086
P- 240	7106	20	4 : 1	0.013	173	5.1	33.8	0.035	1.33	0.066	0.4	0.107
P- 300	7106.5	20	4 : 1	0.007	173	4.3	40.7	0.035	1.55	0.082	0.4	0.065
HC5-7(370)	7107	20	4 : 1	0.007	173	4.2	41.4	0.035	1.58	0.050	0.4	0.064
P- 450	7107.5	20	4 : 1	0.006	173	4	43.2	0.035	1.63	0.050	0.4	0.056
P- 540	7108	20	4 : 1	0.006	173	3.8	45	0.035	1.68	0.043	0.15	0.056
P- 600	7108.5	20	4 : 1	0.008	173	4.3	40.3	0.035	1.54	0.043	0.15	0.072
P- 670	7109	20	4 : 1	0.007	173	4.2	41.2	0.035	1.57	0.055	0.15	0.064
P- 760	7109.5	20	4 : 1	0.006	173	3.8	45.3	0.035	1.69	0.049	0.15	0.056
P- 840	7110	20	4 : 1	0.006	173	4	43.7	0.035	1.64	0.043	0.15	0.057

TABLE 5-5. CHANNEL CONVEYANCE CHARACTERISTICS FOR PMF WITH STEPHENSON ROCK SIZING (continued).

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)	Alternate (por = 0.45) Riprap D50 (ft)
					Channel Q							
Q- 100	7060.9	30	4 : 1	0.011	843	7.3	114.9	0.035	2.79	0.163	0.6	0.194
Q- 130	7061.3	30	4 : 1	0.012	843	7.6	111	0.035	2.72	0.177	0.6	0.210
Q- 220	7062.4	30	4 : 1	0.012	843	7.7	109.7	0.035	2.69	0.182	0.6	0.211
HC5-14(230)	7062.5	30	4 : 1	0.024	843	9.7	86.9	0.035	2.23	0.318	0.6	0.378
Q- 250	7063	30	4 : 1	0.021	843	9.3	91.2	0.035	2.32	0.283	0.6	0.338
Q- 260	7063.2	30	4 : 1	0.02	833	9.1	92	0.035	2.34	0.27	0.6	0.323
Q- 270	7063.5	30	4 : 1	0.015	823	8.2	100.2	0.035	2.5	0.214	0.6	0.250
Q- 280	7063.7	30	4 : 1	0.022	813	9.3	87.8	0.035	2.25	0.286	0.6	0.344
Q- 290	7064	30	4 : 1	0.021	803	9.1	88	0.035	2.26	0.276	0.6	0.328
Q- 300	7064.2	30	4 : 1	0.02	792	8.9	88.5	0.035	2.27	0.264	0.6	0.311
Q- 310	7064.5	30	4 : 1	0.015	782	8.1	96.7	0.035	2.43	0.207	0.6	0.243
Q- 320	7064.7	30	4 : 1	0.021	772	9.1	84.9	0.035	2.19	0.276	0.6	0.321
Q- 330	7065	30	4 : 1	0.029	761	10.1	75.5	0.035	1.99	0.355	0.6	0.419
Q- 340	7065.2	30	4 : 1	0.046	751	11.7	64.2	0.035	1.74	0.517	0.6	0.619
Q- 360	7066.1	30	4 : 1	0.045	751	11.6	64.5	0.035	1.74	0.511	0.6	0.604
Q- 380	7067	30	4 : 1	0.045	751	11.6	64.8	0.035	1.75	0.506	0.6	0.607
Q- 400	7068	30	4 : 1	0.043	751	11.4	65.7	0.035	1.77	0.488	0.6	0.582
Q- 420	7068.9	30	4 : 1	0.039	751	11.1	67.9	0.035	1.82	0.448	0.6	0.537
Q- 440	7069.8	30	4 : 1	0.025	751	9.5	78.8	0.035	2.06	0.311	0.6	0.365
HC5-12(500)	7071.3	30	4 : 1	0.025	751	9.5	79.2	0.035	2.07	0.307	0.6	0.366
Q- 540	7072.3	30	4 : 1	0.025	751	9.6	78.4	0.035	2.05	0.314	0.6	0.366
Q- 590	7073.6	30	4 : 1	0.024	751	9.4	80	0.035	2.09	0.299	0.6	0.354
Q- 690	7076.1	30	4 : 1	0.026	751	9.7	77.6	0.035	2.04	0.322	0.6	0.380
Q- 790	7078.6	30	4 : 1	0.023	751	9.3	81.1	0.035	2.11	0.289	0.6	0.342
Q- 870	7080.6	30	4 : 1	0.027	751	9.8	76.5	0.035	2.01	0.334	0.6	0.390
Q- 970	7083.1	30	4 : 1	0.021	751	8.9	84.1	0.035	2.17	0.265	0.6	0.314
Q- 980	7083.4	30	4 : 1	0.016	747	8.2	91.3	0.035	2.32	0.215	0.6	0.250
Q- 1080	7085.9	30	4 : 1	0.093	706	14.5	48.7	0.035	1.37	0.93	1.2	1.125
Q- 1095	7087.3	30	4 : 1	0.093	706	14.5	48.8	0.035	1.37	0.925	1.2	1.125
Q- 1115	7089.2	30	4 : 1	0.092	706	14.4	48.9	0.035	1.38	0.919	1.2	1.114
Q- 1135	7091	30	4 : 1	0.089	706	14.3	49.5	0.035	1.39	0.89	1.2	1.081
Q- 1155	7092.9	30	4 : 1	0.079	706	13.8	51.3	0.035	1.44	0.803	1.2	0.971
Q- 1175	7094.8	30	4 : 1	0.053	706	12	58.8	0.035	1.61	0.559	1.2	0.674
Q- 1180	7094.8	30	4 : 1	0.009	706	6.4	109.7	0.035	2.69	0.122	1.2	0.148
Q- 1195	7094.9	10	4 : 1	0.046	706	13	54.3	0.035	2.64	0.813	1.2	0.877
Q- 1215	7094.9	0	4 : 1	0.033	706	11.8	59.7	0.035	3.86	0.864	1.2	0.804
Q- 1220	7094.9	0	3.7 : 1	0.03	706	11.6	60.8	0.035	4.05	0.818	1.2	0.759
Q- 1230	7095	0	3 : 1	0.015	706	9.4	75.5	0.035	5.02	0.47	1.2	0.436
Q- 1240	7095	0	2.8 : 1	0.02	706	10.4	67.6	0.035	4.91	0.616	1.2	0.578
Q- 1270	7095	0	2.5 : 1	0.018	706	10.3	68.7	0.035	5.24	0.59	1.2	0.551
Q- 1275	7095	0	2.4 : 1	0.022	706	11.2	63.2	0.035	5.13	0.726	1.2	0.675
Q- 1285	7095	0	2.2 : 1	0.02	706	11.1	63.8	0.035	5.39	0.711	1.2	0.642
HC5-11(1295)	7095	0	2 : 1	0.012	706	9.3	75.8	0.035	6.16	0.469	1.2	0.415
Q- 1320	7095	0	2 : 1	0.007	706	7.4	95.5	0.035	6.91	0.267	1.2	0.252
Q- 1325	7095	6	2.4 : 1	0.001	706	3.8	187.4	0.035	7.68	0.044	0.4	0.038
Q- 1330	7095	12	2.8 : 1	0.001	706		——PONDING——				0.4	
Q- 1335	7095	18	3.2 : 1	0.001	706		——PONDING——				0.4	
Q- 1340	7095	24	3.6 : 1	0.001	706		——PONDING——				0.4	
Q- 1345	7095	30	4 : 1	0.001	706		——PONDING——				0.4	
Q- 1348	7095.3	30	4 : 1	0.001	700		——PONDING——				0.4	
Q- 1352	7095.8	30	4 : 1	0.001	650		——PONDING——				0.4	
Q- 1356	7096.3	30	4 : 1	0.001	600		——PONDING——				0.4	
Q- 1360	7096.7	30	4 : 1	0.001	550		——PONDING——				0.4	
Q- 1364	7097.2	30	4 : 1	0.001	500		——PONDING——				0.4	
Q- 1368	7097.6	30	4 : 1	0.001	450		——PONDING——				0.4	
Q- 1372	7098.1	30	4 : 1	0.001	400		——PONDING——				0.4	
Q- 1376	7098.5	30	4 : 1	0.08	480	12.1	39.6	0.035	1.15	0.635	1.2	0.774
Q- 1380	7099	30	4 : 1	0.078	460	11.8	39	0.035	1.13	0.597	1.2	0.736
Q- 1384	7099.5	30	4 : 1	0.074	440	11.4	38.4	0.035	1.12	0.558	1.2	0.682
Q- 1388	7099.9	30	4 : 1	0.07	420	11	38.1	0.035	1.11	0.511	1.2	0.631
Q- 1392	7100.4	30	4 : 1	0.063	400	10.5	38.2	0.035	1.11	0.452	1.2	0.558
Q- 1396	7100.9	30	4 : 1	0.101	300	11.1	27.1	0.035	0.82	0.58	1.2	0.721
Q- 1400	7101.3	30	4 : 1	0.103	290	11	26.4	0.035	0.8	0.574	1.2	0.718
Q- 1404	7101.8	30	4 : 1	0.106	280	10.9	25.6	0.035	0.77	0.575	1.2	0.715
Q- 1408	7102.2	30	4 : 1	0.112	270	11	24.6	0.035	0.75	0.591	1.2	0.744

TABLE 5-5. CHANNEL CONVEYANCE CHARACTERISTICS FOR PMF WITH STEPHENSON ROCK SIZING (continued).

Cross Section	Bottom Elevation (Ft+MSL)	Bottom Width (ft)	Side Slope (H : V)	Energy Gradient (ft/ft)	Discharge (cfs)	Velocity (fps)	Flow Area (sq. ft.)	Manning's n	Depth (ft)	Riprap D50 (ft)	Target Rock D50 (ft)	Alternate (por = 0.45) Riprap D50 (ft)
Q- 1412	7102.7	30	4 : 1	0.122	260	11.2	23.3	0.035	0.71	0.63	1.2	0.788
Q- 1416	7103.1	30	4 : 1	0.146	250	11.6	21.5	0.035	0.66	0.732	1.2	0.918
Q- 1420	7103.6	30	4 : 1	0.2	243	12.7	19.1	0.035	0.59	1.008	1.2	1.267
Q- 1427	7105	30	4 : 1	0.19	243	12.5	19.4	0.035	0.6	0.953	1.2	1.197
Q- 1434	7106.5	30	4 : 1	0.159	243	11.9	20.5	0.035	0.63	0.789	1.2	0.988
Q- 1444	7108.1	30	4 : 1	0.144	243	11.5	21.2	0.035	0.65	0.709	1.2	0.891
Q- 1454	7109.8	30	4 : 1	0.047	243	8	30.3	0.035	0.9	0.255	1.2	0.315
Q- 1455	7109.8	29	4 : 1	0.053	243	8.4	28.9	0.035	0.88	0.29	1.2	0.355
Q- 1475	7109.9	10	4 : 1	0.072	243	11.4	21.3	0.035	1.38	0.676	1.2	0.766
Q- 1485	7110	0	4 : 1	0.03	243	8.7	27.9	0.035	2.64	0.502	1.2	0.471
Q- 1490	7110	0	3.6 : 1	0.027	243	8.6	28.2	0.035	2.8	0.483	1.2	0.446
Q- 1499	7110	0	3 : 1	0.017	243	7.5	32.2	0.035	3.28	0.342	1.2	0.312
Q- 1500	7110	0	3 : 1	0.016	243	7.4	33	0.035	3.32	0.322	1.2	0.297
Q- 1510	7110	0	2.7 : 1	0.019	243	7.9	30.7	0.035	3.37	0.383	1.2	0.359
Q- 1530	7110.1	0	2.2 : 1	0.022	243	8.7	27.9	0.035	3.56	0.491	1.2	0.447
HC5-10(1543)	7110.1	1	2.2 : 1	0.004	243	4.7	51.8	0.035	4.59	0.101	1.2	0.091
Q- 1548	7110.1	3	2.4 : 1	0.002	243	3.4	70.9	0.035	4.81	0.044	0.4	0.044
Q- 1553	7110.1	5	2.7 : 1	0.001	243	2.7	89.1	0.035	4.88	0.024	0.4	0.022
Q- 1558	7110.1	7	2.9 : 1	0.001	243		——PONDING——				0.4	
Q- 1563	7110.1	9	3.2 : 1	0.001	243		——PONDING——				0.4	
Q- 1568	7110.1	11	3.5 : 1	0.001	243		——PONDING——				0.4	
Q- 1573	7110.1	13	3.7 : 1	0.001	243		——PONDING——					
Q- 1578	7110.1	15	4 : 1	0.001	243		——PONDING——					
Q- 1590	7110.2	30	4 : 1	0.001	243		——PONDING——					

TABLE 5-6. CHANNEL CONVEYANCE CHARACTERISTICS BASED ON HEC-2 MODEL SIMULATION.

Channel Cross Section Name	Channel Station (ft)	Channel Base Elev. (ft+msl)	Channel Base Width (ft)	Channel Side Slope	Bottom Slope (ft/ft)	HEC-2 Energy Gradient (ft/ft)	Discharge (cfs)	HEC-2 Velocity (fps)	Area (ft^2)	Flow Depth (ft)	Top Width (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Calc-ulated Average Shear (lb/ft^2)	Equivalent Slope For Average Shear (ft/ft)	Channel Bend Radius (ft)	Channel Bend Stress Ratio	Maximum Shear (lb/ft^2)	Calc-ulated Slope For Rock Sizing (ft/ft)	Average Unit Discharge (cfs/ft)	Maximum Unit Discharge (cfs/ft)	Average Unit Discharge Stephenson Rock D50 (ft)	Maximum Unit Discharge Stephenson Rock D50 (ft)	Rock Type+	Target Riprap D50 (ft)
												CHANNEL A													
HC4-9	90	7126.4	20	4	0.022	0.039	180	7.5	24	1	28	28.25	0.85	1.104	0.0208	NONE	1.000	1.157	0.022	6.43	7.50	0.12	0.13	SML	0.40
	200	7128.8	20	4	0.026	0.031	170	6.8	25	1.03	28.24	28.49	0.87	1.359	0.0250	NONE	1.000	1.410	0.026	6.02	7.00	0.13	0.15	SML	0.40
	220	7129.4	20	4	0.030	0.021	165	6	27.6	1.13	29.04	29.32	0.95	1.838	0.0312	NONE	1.000	1.769	0.030	5.68	6.78	0.14	0.16	SML	0.40
	240	7130	20	4	0.045	0.058	160	8.3	19.4	0.83	26.64	26.84	0.72	2.151	0.0478	NONE	1.000	2.151	0.048	6.01	6.89	0.22	0.24	SML	0.40
	260	7131.2	20	4	0.060	0.052	153	7.9	19.5	0.84	26.72	26.93	0.73	2.731	0.0601	NONE	1.000	2.728	0.060	5.73	6.64	0.26	0.28	SML	0.40
	280	7132.4	20	4	0.042	0.080	147	8.9	16.5	0.72	25.76	25.94	0.64	1.502	0.0379	NONE	1.000	1.651	0.042	5.71	6.41	0.19	0.20	SML	0.40
	400	7135.2	20	4	0.015	0.012	120	4.4	27.4	1.12	28.96	29.24	0.94	0.877	0.0150	NONE	1.000	0.888	0.015	4.14	4.93	0.07	0.07	SML	0.40
	500	7135.9	20	4	0.006	0.005	110	3.2	34.5	1.36	30.88	31.21	1.11	0.453	0.0065	NONE	1.000	0.450	0.006	3.56	4.35	0.03	0.04	SML	0.40
	600	7136.5	20	4	0.006	0.006	100	3.3	30.6	1.23	29.84	30.14	1.02	0.323	0.0051	NONE	1.000	0.381	0.006	3.35	4.06	0.03	0.03	SML	0.40
	700	7137.1	20	4	0.006	0.005	90	3	29.7	1.2	29.6	29.90	1.00	0.331	0.0053	NONE	1.000	0.373	0.006	3.04	3.60	0.03	0.03	SML	0.40
	800	7137.7	20	4	0.006	0.005	80	2.9	27.6	1.13	29.04	29.32	0.95	0.306	0.0052	NONE	1.000	0.354	0.006	2.75	3.28	0.02	0.03	SML	0.40
												CHANNEL D													
	150	7083.5	50	4	0.030	0.025	1325	10.3	128.6	2.19	67.52	68.06	1.89	4.344	0.0368	NONE	1.000	3.540	0.030	19.62	22.56	0.33	0.36	LRG	1.20
	200	7085	50	4	0.042	0.052	1300	13	100.2	1.76	64.08	64.51	1.56	4.705	0.0485	NONE	1.000	5.049	0.052	20.29	22.88	0.53	0.57	LRG	1.20
HC4-13	215	7085.6	50	4	0.057	0.050	1300	12.8	101.3	1.77	64.16	64.60	1.56	5.238	0.0537	NONE	1.000	5.631	0.057	20.26	22.66	0.57	0.61	LRG	1.20
	220	7086.1	50	4	0.055	0.050	1297	12.8	101.3	1.77	64.16	64.60	1.56	5.374	0.0551	NONE	1.000	5.368	0.055	20.22	22.66	0.55	0.59	LRG	1.20
	240	7087.1	50	4	0.050	0.050	1285	12.8	100.8	1.77	64.16	64.60	1.56	4.691	0.0481	NONE	1.000	4.880	0.050	20.03	22.66	0.50	0.55	LRG	1.20
	260	7088.1	50	4	0.053	0.048	1274	12.6	101.1	1.77	64.16	64.60	1.56	4.769	0.0489	NONE	1.000	5.124	0.053	19.86	22.30	0.52	0.57	LRG	1.20
	280	7089.2	50	4	0.053	0.045	1262	12.3	103	1.8	64.4	64.84	1.59	4.633	0.0468	NONE	1.000	5.202	0.053	19.60	22.14	0.52	0.56	LRG	1.20
	300	7090.2	50	4	0.045	0.038	1250	11.6	108	1.68	65.04	65.50	1.65	4.149	0.0403	NONE	1.000	4.636	0.045	19.22	21.81	0.45	0.49	LRG	1.20
	320	7091	50	4	0.040	0.038	1240	11.5	107.7	1.67	64.96	65.42	1.64	3.918	0.0382	NONE	1.000	4.101	0.040	19.09	21.51	0.41	0.44	LRG	1.20
	340	7091.8	50	4	0.038	0.037	1230	11.4	107.5	1.67	64.96	65.42	1.64	3.736	0.0364	NONE	1.000	3.845	0.038	18.93	21.32	0.38	0.41	LRG	1.20
	360	7092.5	50	4	0.038	0.037	1220	11.4	107.1	1.66	64.88	65.34	1.64	3.698	0.0362	NONE	1.000	3.826	0.038	18.80	21.20	0.38	0.41	INT	0.60
	380	7093.3	50	4	0.040	0.035	1210	11.2	108.4	1.68	65.04	65.50	1.65	3.807	0.0370	NONE	1.000	4.121	0.040	18.60	21.06	0.40	0.43	INT	0.60
	400	7094.1	50	4	0.035	0.031	1200	10.7	112.5	1.95	65.6	66.08	1.71	3.460	0.0325	NONE	1.000	3.725	0.035	18.29	20.87	0.35	0.39	INT	0.60
	420	7094.7	50	4	0.032	0.031	1190	10.7	111.6	1.93	65.44	65.92	1.69	3.302	0.0313	NONE	1.000	3.427	0.032	18.18	20.65	0.33	0.36	INT	0.60
	440	7095.4	50	4	0.032	0.031	1180	10.6	111.2	1.93	65.44	65.92	1.69	3.290	0.0312	NONE	1.000	3.427	0.032	18.03	20.46	0.33	0.36	INT	0.60
	460	7096	50	4	0.033	0.031	1170	10.6	110.4	1.91	65.28	65.75	1.67	3.275	0.0313	NONE	1.000	3.396	0.033	17.92	20.25	0.33	0.36	INT	0.60
	480	7096.7	50	4	0.032	0.031	1160	10.5	110.1	1.91	65.28	65.75	1.67	3.293	0.0315	NONE	1.000	3.396	0.032	17.77	20.06	0.33	0.35	INT	0.60
	500	7097.3	50	4	0.030	0.031	1150	10.5	109.4	1.9	65.2	65.67	1.67	3.065	0.0295	NONE	1.000	3.224	0.031	17.64	19.95	0.31	0.34	INT	0.60
	520	7097.9	50	4	0.033	0.031	1140	10.5	108.5	1.69	65.12	65.59	1.66	3.227	0.0312	NONE	1.000	3.364	0.033	17.51	19.85	0.32	0.35	INT	0.60
	540	7098.6	50	4	0.033	0.031	1130	10.4	108.4	1.88	65.04	65.50	1.65	3.229	0.0313	NONE	1.000	3.348	0.033	17.37	19.55	0.32	0.35	INT	0.60
	560	7099.2	50	4	0.032	0.031	1120	10.4	107.7	1.87	64.96	65.42	1.64	3.263	0.0318	NONE	1.000	3.332	0.032	17.24	19.45	0.32	0.35	INT	0.60
	580	7099.9	50	4	0.032	0.030	1110	10.3	108	1.88	65.04	65.50	1.65	3.155	0.0306	NONE	1.000	3.348	0.032	17.07	19.36	0.32	0.34	INT	0.60
	600	7100.5	50	4	0.027	0.028	1100	10	110.1	1.91	65.28	65.75	1.67	-0.858	-0.0082	NONE	1.000	2.821	0.027	16.85	19.10	0.27	0.29	INT	0.60
	700	7102.9	50	4	0.015	0.000	1000	LOW SLOPE- ROCK SIZING METHODS FAIL							–	800	1.000	–	–	–	–	–	–	INT	0.60
	800	7103.5	50	4	0.007	0.001	950	LOW SLOPE- ROCK SIZING METHODS FAIL							–	700	1.000	–	–	–	–	–	–	SML	0.40
	900	7104.2	50	4	0.008	0.001	900	LOW SLOPE- ROCK SIZING METHODS FAIL							–	500	1.000	–	–	–	–	–	–	SML	0.40
	1000	7105.1	50	4	0.009	0.001	875	LOW SLOPE- ROCK SIZING METHODS FAIL							–	500	1.000	–	–	–	–	–	–	SML	0.40
	1100	7106.1	50	4	0.009	0.001	850	LOW SLOPE- ROCK SIZING METHODS FAIL							–	500	1.000	–	–	–	–	–	–	SML	0.40
	1200	7107	50	4	0.010	0.001	797	LOW SLOPE- ROCK SIZING METHODS FAIL							–	500	1.000	–	–	–	–	–	–	SML	0.40
	1220	7107.2	48	4	0.007	0.001	797	LOW SLOPE- ROCK SIZING METHODS FAIL							--	500	1.000	–	–	–	–	–	–	SML	0.40
	1240	7107.3	46	4	0.007	0.001	797	2.9	277.2	4.37	80.96	82.04	3.38	19.230	0.0911	500	1.247	1.974	0.009	9.84	12.67	0.08	0.10	SML	0.40
	1260	7107.5	44	4	0.008	0.001	797	3.1	256.8	4.22	77.76	78.80	3.26	0.403	0.0020	500	1.223	1.865	0.009	10.25	13.08	0.08	0.10	SML	0.40
	1280	7107.6	42	4	0.007	0.001	797	3.3	240.7	4.12	74.96	75.97	3.17	0.197	0.0010	500	1.200	1.781	0.009	10.63	13.60	0.08	0.10	SML	0.40
	1300	7107.8	40	4	0.010	0.002	797	3.7	217.7	3.91	71.28	72.24	3.01	0.154	0.0008	500	1.170	2.199	0.012	11.18	14.47	0.11	0.12	SML	0.40
	1320	7108	39	4	0.013	0.002	797	4	198.3	3.69	68.52	69.43	2.86	0.658	0.0037	500	1.148	2.558	0.014	11.63	14.76	0.13	0.15	SML	0.40
	1340	7108.3	38	4	0.013	0.003	797	4.4	181.7	3.49	65.92	66.78	2.72	0.751	0.0044	500	1.126	2.384	0.014	12.09	15.36	0.13	0.15	SML	0.40
	1360	7108.5	37	4	0.013	0.004	797	4.8	164.3	3.28	63.24	64.05	2.57	0.758	0.0047	500	1.102	2.207	0.014	12.60	15.74	0.13	0.15	SML	0.40
HC4-12	1380	7108.8	36	4	0.013	0.005	797	5.4	147.4	3.06	60.48	61.23	2.41	0.899	0.0060	500	1.078	2.027	0.013	13.18	16.52	0.13	0.15	SML	0.40
	1400	7109	35	4	0.013	0.007	797	6	132.6	2.86	57.88	58.58	2.27	1.008	0.0071	500	1.055	1.865	0.013	13.77	17.16	0.13	0.15	SML	0.40
	1420	7109.3	34	4	0.013	0.010	797	6.9	115.6	2.62	54.96	55.61	2.10	1.227	0.0094	500	1.028	1.680	0.013	14.50	18.08	0.13	0.16	SML	0.40
	1440	7109.5	32	4	0.013	0.013	797	7.7	103.2	2.45	51.6	52.20	1.96	1.666	0.0136	500	0.996	1.585	0.013	15.45	18.87	0.14	0.16	SML	0.40
	1480	7110.1	30	4	0.015	0.018	797	8.6	92.1	2.35	48.8	49.38	1.88	2.060	0.0176	500	1.000	2.106	0.018	16.33	20.21	0.19	0.22	SML	0.40
	1500	7110.4	29	4	0.013	0.016	797	8.4	94.5	2.46	48.68	49.29	1.94	1.973	0.0163	500	1.000	1.936	0.016	16.37	20.66	0.17	0.20	SML	0.40
	1520	7110.6	27	4	0.013	0.015	797	8.3	96.1	2.57	47.56	48.19	1.99	1.959	0.0158	500	1.000	1.861	0.015	16.76	21.33	0.17	0.20	SML	0.40
	1540	7110.9	26	4	0.015	0.018	797	8.8	90.1	2.51	46.08	46.70	1.94	2.242	0.0185	600	1.000	2.176	0.018	17.30	22.09	0.20	0.23	SML	0.40
	1560	7111.2	25	4	0.013	0.015	797	8.4	95	2.69	46.52	47.18	2.04	2.038	0.0160	700	1.000	1.908	0.015	17.13	22.60	0.17	0.20	SML	0.40
	1580	7111.4	23	4	0.011	0.018	797	9	88.4	2.62	43.96	44.61	1.97	1.900	0.0155	800	1.000	2.209	0.018	18.13	23.58	0.20	0.24	SML	0.40
	1620	7111.9	22	4	0.011	0.011	797	7.5	105.8	3.11	46.88	47.65	2.25	2.104	0.0150	900	1.000	1.578	0.011	17.00	23.33	0.13	0.17	SML	0.40
	1640	7112.1	21	4	0.010	0.011	797	7.6	104.5	3.11	45.88	46.65	2.23	1.528	0.0110	NONE	1.000	1.530	0.011	17.37	23.64	0.13	0.16	SML	0.40
	1660	7112.3	21	4	0.010	0.011	797	7.6	104.3	3.13	46.04	46.81	2.24	1.590	0.0114	NONE	1.000	1.538	0.011	17.31	23.79	0.13	0.17	SML	0.40
	1680	7112.5	20	4	0.010	0.011	797	7.7	104.2	3.15	45.2	45.98	2.23	1.579	0.0113	NONE	1.000	1.533	0.011	17.63	24.26	0.14	0.17	SML	0.40
	1700	7112.7	20	4	0.010	0.011	797	7.7	103.3	3.16	45.28	46.06	2.24	1.485	0.0106	NONE	1.000	1.537	0.011	17.60	24.33	0.14	0.17	SML	0.40
	1800	7113.6	20	4	0.008	0.009	797	7	114.1	3.4	47.2	48.04	2.38	1.411	0.0095	NONE	1.000	1.336	0.009	16.89	23.80	0.11	0.14	SML	0.40
	1850	7114	20	4	0.005	0.008	797	6.9	116.1	3.44	47.52	48.37	2.40	1.764	0.0118	NONE	1.000	1.199	0.008	16.77	23.74	0.10	0.13	SML	0.40

TABLE 5-6. CHANNEL CONVEYANCE CHARACTERISTICS BASED ON HEC-2 MODEL SIMULATION (CONTINUED).

Channel Cross Section Name	Channel Station (ft)	Channel Base Elev. (ft+msl)	Channel Base Width (ft)	Channel Side Slope	Bottom Slope (ft/ft)	HEC-2 Energy Gradient (ft/ft)	Discharge (cfs)	HEC-2 Velocity (fps)	Area (ft^2)	Flow Depth (ft)	Top Width (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Calculated Average Shear (lb/ft^2)	Equivalent Slope For Average Shear (ft/ft)	Channel Bend Radius (ft)	Channel Bend Stress Ratio	Maximum Shear (lb/ft^2)	Calculated Slope For Rock Sizing (ft/ft)	Average Unit Discharge (cfs/ft)	Maximum Unit Discharge (cfs/ft)	Average Unit Discharge Stephenson Rock D50 (ft)	Maximum Unit Discharge Stephenson Rock D50 (ft)	Rock Type+	Target Riprap D50 (ft)
CHANNEL D																									
	1900	7114.1	20	4	0.002	0.004	819	5.1	160.4	4.31	54.48	55.54	2.89	2.048	0.0114	NONE	1.000	0.721	0.004	15.03	21.98	0.06	0.07	SML	0.40
	2000	7114.3	20	4	0.001	0.002	863	4.2	208.2	5.14	61.12	62.39	3.34	1.216	0.0058	NONE	1.000	0.417	0.002	14.12	21.59	0.03	0.04	SML	0.40
	2100	7114.4	20	4	0.001	0.001	720	3.2	222.6	5.37	62.96	64.28	3.47	-4.192	-0.0194	NONE	1.000	0.218	0.001	11.44	17.18	0.02	0.02	SML	0.40
	2200	7114.5	20	4	0.002	0.001	576	——— LOW SLOPE- ROCK SIZING METHODS FAIL ———							–	NONE	1.000	0.000	–	–	–	–	–	SML	0.40
	2300	7114.7	20	4	0.001	0.001	433	——— LOW SLOPE- ROCK SIZING METHODS FAIL ———							–	NONE	1.000	0.000	–	–	–	–	–	SML	0.40
HC4-11	2400	7114.8	20	4	0.001	0.001	289	——— LOW SLOPE- ROCK SIZING METHODS FAIL ———							–	NONE	1.000	–	–	–	–	–	–	SML	0.40
	2500	7114.9	20	4	0.005	0.001	289	——— LOW SLOPE- ROCK SIZING METHODS FAIL ———							–	NONE	1.000	0.000	–	–	–	–	–	SML	0.40
	2600	7115.8	20	4	0.009	0.001	289	——— LOW SLOPE- ROCK SIZING METHODS FAIL ———							–	NONE	1.000	0.000	–	–	–	–	–	SML	0.40
	2700	7116.6	20	4	0.012	0.003	289	3.5	82.1	2.68	41.44	42.10	1.96	2.099	0.0172	NONE	1.000	1.434	0.012	6.97	9.38	0.08	0.09	SML	0.40
	2900	7119.7	20	4	0.015	0.014	289	6.2	46.5	1.73	33.84	34.27	1.36	1.099	0.0130	NONE	1.000	1.293	0.015	8.54	10.73	0.11	0.13	SML	0.40
	3000	7121.2	20	4	0.016	0.016	289	6.5	44.6	1.67	33.36	33.77	1.32	1.350	0.0164	NONE	1.000	1.358	0.016	8.66	10.86	0.12	0.14	SML	0.40
	3100	7123	20	4	0.024	0.026	289	7.7	37.7	1.46	31.68	32.04	1.18	1.739	0.0237	800	1.000	1.910	0.026	9.12	11.24	0.17	0.20	SML	0.40
	3110	7123.3	20	4	0.032	0.026	277	7.6	36.7	1.43	31.44	31.79	1.16	1.894	0.0262	600	1.000	2.346	0.032	8.81	10.87	0.20	0.23	SML	0.40
	3130	7124	20	4	0.033	0.025	253	7.2	35	1.37	30.96	31.30	1.12	1.863	0.0268	400	1.000	2.262	0.033	8.17	9.86	0.19	0.22	SML	0.40
	3150	7124.6	20	4	0.030	0.025	229	7.1	32.5	1.29	30.32	30.64	1.06	1.600	0.0242	350	1.000	1.983	0.030	7.55	9.18	0.17	0.20	SML	0.40
	3170	7125.2	20	4	0.032	0.026	206	6.8	30.1	1.21	29.68	29.98	1.00	1.620	0.0259	300	1.000	2.033	0.032	6.94	8.23	0.17	0.19	SML	0.40
	3190	7125.9	20	4	0.032	0.024	182	6.4	28.2	1.15	29.2	29.48	0.96	1.539	0.0257	270	1.019	1.984	0.033	6.23	7.38	0.16	0.18	SML	0.40
	3210	7126.5	20	4	0.033	0.024	158	6.1	25.8	1.06	28.48	28.74	0.89	1.442	0.0258	250	1.046	1.897	0.034	5.55	6.47	0.16	0.17	SML	0.40
	3230	7127.2	20	4	0.032	0.025	134	5.9	22.8	0.96	27.68	27.92	0.82	1.261	0.0246	250	1.032	1.715	0.034	4.84	5.66	0.14	0.16	SML	0.40
HC4-10	3250	7127.8	20	4	0.025	0.020	110	5.1	21.4	0.91	27.28	27.50	0.78	1.171	0.0240	270	1.000	1.220	0.025	4.03	4.64	0.10	0.11	SML	0.40
	3400	7130.8	20	4	0.028	0.035	110	6.1	17.9	0.78	26.24	26.43	0.68	1.171	0.0275	300	1.000	1.171	0.028	4.19	4.76	0.11	0.12	SML	0.40
	3420	7131.5	20	4	0.035	0.035	110	6.2	17.9	0.77	26.16	26.35	0.67	1.483	0.0352	350	1.000	1.473	0.035	4.20	4.77	0.13	0.14	SML	0.40
	3440	7132.2	20	4	0.035	0.034	110	6.1	18.1	0.78	26.24	26.43	0.68	1.495	0.0351	400	1.000	1.490	0.035	4.19	4.78	0.13	0.14	SML	0.40
	3460	7132.9	20	4	0.035	0.036	110	6.2	17.8	0.77	26.16	26.35	0.67	1.474	0.0350	500	1.000	1.515	0.036	4.20	4.77	0.14	0.15	SML	0.40
	3480	7133.6	20	4	0.035	0.034	110	6.1	18	0.78	26.24	26.43	0.68	1.486	0.0349	600	1.000	1.490	0.035	4.19	4.76	0.13	0.14	SML	0.40
	3500	7134.3	20	4	0.035	0.036	110	6.2	17.7	0.77	26.16	26.35	0.67	1.470	0.0349	600	1.000	1.515	0.036	4.20	4.77	0.14	0.15	SML	0.40
	3520	7135	20	4	0.035	0.032	110	6	18.4	0.8	26.4	26.60	0.70	1.517	0.0348	600	1.000	1.524	0.035	4.17	4.80	0.13	0.14	SML	0.40
	3540	7135.7	20	4	0.035	0.038	110	6.3	17.4	0.76	26.08	26.27	0.67	1.431	0.0344	600	1.000	1.581	0.038	4.22	4.79	0.14	0.15	SML	0.40
	3560	7136.4	20	4	0.035	0.029	110	5.8	19.2	0.82	26.56	26.76	0.71	1.593	0.0358	600	1.000	1.558	0.035	4.14	4.76	0.13	0.14	SML	0.40
	3580	7137.1	20	4	0.035	0.046	110	6.7	16.4	0.72	25.76	25.94	0.64	1.504	0.0379	600	1.000	1.504	0.038	4.27	4.82	0.14	0.16	SML	0.40
CHANNEL H																									
	50	6963.7	40	4	0.002	0.010	620	6.2	99.8	1.92	55.36	55.83	1.64	0.817	0.0080	NONE	1.000	0.817	0.008	11.20	11.90	0.08	0.08		
	100	6963.8	40	4	0.004	0.005	620	4.8	129.1	2.43	59.44	60.04	2.01	-0.638	-0.0051	NONE	1.000	0.456	0.004	10.43	11.66	0.04	0.04	LRG	1.20
	157	6964.1	40	4	0.065	0.005	620	4.9	126.4	0.93	47.44	47.67	0.85	12.417	0.2333	NONE	1.000	3.467	0.065	13.07	4.56	0.48	0.24	LRG	1.20
	165	6965.1	40	4	0.127	0.131	620	14.3	43.3	0.92	47.36	47.59	0.84	19.442	0.3690	NONE	1.000	6.903	0.131	13.09	13.16	0.91	0.91	LRG	1.20
	175	6966.4	40	4	0.134	0.133	620	14.4	43.0	0.92	47.36	47.59	0.84	7.475	0.1419	NONE	1.000	7.048	0.134	13.09	13.25	0.92	0.93	LRG	1.20
	183	6967.5	40	4	0.134	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.398	0.1404	NONE	1.000	7.048	0.134	13.09	13.16	0.92	0.93	LRG	1.20
	193	6968.8	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	203	6970.1	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.436	0.1411	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
HCT-3	213	6971.4	40	4	0.130	0.131	620	14.4	43.2	0.92	47.36	47.59	0.84	7.419	0.1408	NONE	1.000	6.903	0.131	13.09	13.25	0.91	0.91	LRG	1.20
	223	6972.7	40	4	0.130	0.132	620	14.4	43.1	0.92	47.36	47.59	0.84	7.583	0.1439	NONE	1.000	6.956	0.132	13.09	13.25	0.91	0.92	LRG	1.20
	233	6974	40	4	0.136	0.142	620	14.7	42.1	0.9	47.2	47.42	0.83	7.840	0.1518	NONE	1.000	7.332	0.142	13.14	13.23	0.98	0.99	LRG	1.20
	240	6975	40	4	0.141	0.141	620	14.7	42.2	0.9	47.2	47.42	0.83	7.776	0.1506	NONE	1.000	7.303	0.141	13.14	13.23	0.98	0.98	LRG	1.20
	260	6977.8	40	4	0.143	0.142	620	14.7	42.2	0.9	47.2	47.42	0.83	7.775	0.1506	NONE	1.000	7.358	0.143	13.14	13.23	0.99	0.99	LRG	1.20
	280	6980.7	40	4	0.143	0.139	620	14.6	42.4	0.9	47.2	47.42	0.83	7.663	0.1484	NONE	1.000	7.358	0.143	13.14	13.14	0.99	0.99	LRG	1.20
	300	6983.5	40	4	0.135	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.448	0.1413	NONE	1.000	7.114	0.135	13.09	13.16	0.93	0.94	LRG	1.20
	320	6986.1	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	340	6988.7	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	360	6991.3	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	380	6993.9	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	400	6996.5	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	420	6999.1	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	440	7001.7	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	460	7004.3	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	480	7006.9	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.378	0.1400	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	500	7009.5	40	4	0.130	0.132	620	14.4	43.1	0.92	47.36	47.59	0.84	7.344	0.1394	NONE	1.000	6.956	0.132	13.09	13.25	0.91	0.92	LRG	1.20
	520	7012.1	40	4	0.132	0.133	620	14.4	43.0	0.92	47.36	47.59	0.84	7.406	0.1406	NONE	1.000	7.008	0.133	13.09	13.25	0.92	0.93	LRG	1.20
	540	7014.8	40	4	0.135	0.132	620	14.4	43.1	0.92	47.36	47.59	0.84	7.561	0.1435	NONE	1.000	7.114	0.135	13.09	13.25	0.93	0.94	LRG	1.20
	560	7017.5	40	4	0.133	0.132	620	14.4	43.1	0.92	47.36	47.59	0.84	7.424	0.1409	NONE	1.000	6.982	0.133	13.09	13.25	0.92	0.92	LRG	1.20
	580	7020.1	40	4	0.132	0.133	620	14.4	43.0	0.92	47.36	47.59	0.84	7.406	0.1406	NONE	1.000	7.008	0.133	13.09	13.25	0.92	0.93	LRG	1.20
	600	7022.8	40	4	0.132	0.132	620	14.4	43.1	0.92	47.36	47.59	0.84	7.424	0.1409	NONE	1.000	6.982	0.132	13.09	13.25	0.92	0.92	LRG	1.20
	620	7025.4	40	4	0.130	0.132	620	14.4	43.1	0.92	47.36	47.59	0.84	7.266	0.1383	NONE	1.000	6.956	0.132	13.09	13.25	0.91	0.92	LRG	1.20
	640	7028	40	4	0.133	0.133	620	14.4	43.1	0.92	47.36	47.59	0.84	7.424	0.1409	NONE	1.000	7.008	0.133	13.09	13.25	0.92	0.93	LRG	1.20
	660	7030.7	40	4	0.135	0.132	620	14.4	43.1	0.92	47.36	47.59	0.84	7.561	0.1435	NONE	1.000	7.114	0.135	13.09	13.25	0.93	0.94	LRG	1.20
	680	7033.4	40	4	0.132	0.132	620	14.4	43.1	0.92	47.36	47.59	0.84	7.365	0.1398	NONE	1.000	6.982	0.132	13.09	13.25	0.92	0.92	LRG	1.20
	700	7036	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.261	0.1378	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.80	LRG	1.20

TABLE 5-6. CHANNEL CONVEYANCE CHARACTERISTICS BASED ON HEC-2 MODEL SIMULATION (CONTINUED).

Channel Cross Section Name	Channel Station (ft)	Channel Base Elev. (ft+msl)	Channel Base Width (ft)	Channel Side Slope	Bottom Slope (ft/ft)	HEC-2 Energy Gradient (ft/ft)	Discharge (cfs)	HEC-2 Velocity (fps)	Area (ft^2)	Flow Depth (ft)	Top Width (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Calculated Average Shear (lb/ft^2)	Equivalent Slope For Average Shear (ft/ft)	Channel Bend Radius (ft)	Channel Bend Stress Ratio	Maximum Shear (lb/ft^2)	Calculated Slope For Rock Sizing (ft/ft)	Average Unit Discharge (cfs/ft)	Maximum Unit Discharge (cfs/ft)	Average Unit Discharge Stephenson Rock D50 (ft)	Maximum Unit Discharge Stephenson Rock D50 (ft)	Rock Type+	Target Riprap D50 (ft)
CHANNEL H																									
	720	7038.6	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	740	7041.2	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	760	7043.8	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	780	7046.4	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	800	7049	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	820	7051.6	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	840	7054.2	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.320	0.1389	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	860	7056.8	40	4	0.130	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.333	0.1392	NONE	1.000	6.850	0.130	13.09	13.16	0.90	0.90	LRG	1.20
	880	7059.4	40	4	0.130	0.130	620	14.3	43.3	0.93	47.44	47.67	0.85	7.410	0.1392	NONE	1.000	6.919	0.130	13.07	13.30	0.90	0.91	LRG	1.20
	900	7062	40	4	0.133	0.135	620	14.5	42.8	0.91	47.28	47.50	0.84	7.475	0.1433	NONE	1.000	7.042	0.135	13.11	13.20	0.93	0.94	LRG	1.20
	920	7064.7	40	4	0.135	0.135	620	14.5	42.8	0.91	47.28	47.50	0.84	7.522	0.1442	NONE	1.000	7.042	0.135	13.11	13.20	0.93	0.94	LRG	1.20
	940	7067.4	40	4	0.135	0.135	620	14.5	42.8	0.91	47.28	47.50	0.84	7.463	0.1431	NONE	1.000	7.042	0.135	13.11	13.20	0.93	0.94	LRG	1.20
	960	7070.1	40	4	0.135	0.134	620	14.4	42.9	0.91	47.28	47.50	0.84	7.436	0.1425	NONE	1.000	7.042	0.135	13.11	13.10	0.93	0.93	LRG	1.20
	980	7072.8	40	4	0.135	0.130	620	14.3	43.3	0.92	47.36	47.59	0.84	7.139	0.1355	NONE	1.000	7.114	0.135	13.09	13.16	0.93	0.94	LRG	1.20
	1000	7075.5	40	4	0.143	0.109	620	13.5	45.9	0.96	47.68	47.92	0.88	6.772	0.1236	NONE	1.000	7.810	0.143	13.00	12.96	0.98	0.98	LRG	1.20
	1010	7077	40	4	0.113	0.069	620	11.7	53.2	1.1	48.8	49.07	1.00	4.961	0.0799	NONE	1.000	6.987	0.113	12.70	12.87	0.77	0.77	LRG	1.20
	1030	7078.5	40	4	0.044	0.026	620	8.5	72.9	1.47	51.76	52.12	1.29	3.414	0.0423	NONE	1.000	3.547	0.044	11.98	12.50	0.32	0.33	LRG	1.20
HCT-2	1100	7079.4	40	4	0.007	0.007	620	5.5	112.9	2.15	57.2	57.73	1.81	1.225	0.0108	NONE	1.000	0.839	0.007	10.84	11.83	0.07	0.08	LRG	1.20
	1200	7079.6	40	4	0.004	0.004	620	4.4	141.4	2.62	60.96	61.61	2.15	0.815	0.0061	NONE	1.000	0.536	0.004	10.17	11.53	0.04	0.05	LRG	1.20
	1220	7079.7	39	4	0.005	0.004	620	4.6	135.6	2.56	59.48	60.11	2.10	0.639	0.0049	NONE	1.000	0.654	0.005	10.42	11.78	0.05	0.06	LRG	1.20
	1240	7079.8	38	4	0.005	0.004	620	4.8	130.5	2.55	58.4	59.03	2.08	0.728	0.0056	NONE	1.000	0.650	0.005	10.62	12.24	0.05	0.06	LRG	1.20
	1260	7079.9	36	4	0.005	0.005	620	5	125.1	2.52	56.16	56.78	2.05	0.658	0.0052	NONE	1.000	0.638	0.005	11.04	12.60	0.05	0.06	LRG	1.20
	1280	7080	35	4	0.003	0.005	620	5.1	121.0	2.5	55	55.62	2.02	0.123	0.0010	NONE	1.000	0.316	0.003	11.27	12.75	0.03	0.03	LRG	1.20
	1282	7080	35	3.9	0.017	0.006	620	5.3	115.9	2.44	54.03	54.65	1.99	0.913	0.0074	NONE	1.000	2.067	0.017	11.47	12.93	0.14	0.15	LRG	1.20
	1285	7080.1	34	3.9	0.033	0.007	620	5.7	109.5	2.36	52.41	53.00	1.92	3.585	0.0299	NONE	1.000	4.001	0.033	11.83	13.45	0.25	0.28	LRG	1.20
	1288	7080.2	33	3.8	0.017	0.008	620	6.1	102.4	2.28	50.33	50.92	1.87	1.401	0.0120	NONE	1.000	1.940	0.017	12.32	13.91	0.15	0.16	LRG	1.20
	1291	7080.2	32	3.7	0.017	0.010	620	6.5	95.7	2.19	48.21	48.79	1.80	7.365	0.0656	NONE	1.000	1.872	0.017	12.86	14.24	0.15	0.16	LRG	1.20
	1294	7080.3	32	3.7	0.017	0.023	620	8.7	71.3	2.09	47.47	48.02	1.73	1.826	0.0169	NONE	1.000	1.826	0.017	13.06	18.18	0.16	0.20	LRG	1.20
	1297	7080.3	31	3.6	0.008	0.021	620	8.4	73.3	1.83	44.18	44.67	1.54	-1.127	-0.0117	NONE	1.000	0.801	0.008	14.03	15.37	0.09	0.10	LRG	1.20
	1303	7080.4	29	3.5	0.008	0.018	620	8.1	76.2	2.05	43.35	43.92	1.69	1.859	0.0176	NONE	1.000	1.896	0.018	14.30	16.61	0.17	0.19	LRG	1.20
	1306	7080.4	29	3.4	0.000	0.018	620	8.2	75.7	1.96	42.33	42.89	1.63	0.541	0.0053	NONE	1.000	0.541	0.005	14.65	16.07	0.07	0.07	LRG	1.20
	1309	7080.4	28	3.4	0.017	0.019	620	8.5	73.1	1.99	41.53	42.11	1.64	4.543	0.0443	NONE	1.000	1.948	0.019	14.93	16.92	0.19	0.20	LRG	1.20
	1312	7080.5	27	3.3	0.017	0.019	620	8.5	72.8	2.05	40.53	41.14	1.68	3.586	0.0342	NONE	1.000	1.995	0.019	15.30	17.43	0.19	0.21	LRG	1.20
	1315	7080.5	26	3.3	0.000	0.019	620	8.5	72.9	2.09	39.79	40.41	1.70	-1.344	-0.0127	NONE	1.000	0.000	0.000	15.58	17.77	0.00	0.00	LRG	1.20
	1318	7080.5	26	3.3	0.000	0.016	620	8	77.2	2.09	39.79	40.41	1.70	-1.337	-0.0126	NONE	1.000	0.000	0.000	15.58	16.72	0.00	0.00	LRG	1.20
	1321	7080.5	25	3.2	0.000	0.015	620	8	77.2	2.13	38.63	39.28	1.73	2.514	0.0234	NONE	1.000	1.615	0.015	16.05	17.04	0.16	0.17	LRG	1.20
	1324	7080.5	24	3.2	0.000	0.016	620	8.3	74.6	2.16	37.82	38.48	1.74	5.047	0.0466	NONE	1.000	1.732	0.016	16.39	17.93	0.17	0.18	LRG	1.20
	1327	7080.5	23	3.2	0.000	0.017	620	8.5	72.9	2.29	37.66	38.35	1.81	5.463	0.0483	NONE	1.000	1.921	0.017	16.46	19.47	0.18	0.20	LRG	1.20
	1330	7080.5	23	3.1	0.000	0.019	620	8.8	70.7	2.34	37.51	38.24	1.85	-0.992	-0.0088	NONE	1.000	0.000	0.000	16.53	20.59	0.00	0.00	LRG	1.20
	1333	7080.5	22	3.1	0.000	0.016	620	8.4	73.8	2.26	36.01	36.72	1.79	3.640	0.0327	NONE	1.000	1.782	0.016	17.22	18.98	0.18	0.19	LRG	1.20
	1336	7080.5	21	3.1	0.017	0.025	620	9.8	63.3	2.3	35.26	35.98	1.80	12.528	0.1117	NONE	1.000	2.805	0.025	17.58	22.54	0.26	0.31	LRG	1.20
	1339	7080.6	20	3	0.017	0.026	620	10	61.8	2.45	34.7	35.50	1.89	2.409	0.0205	NONE	1.000	2.409	0.020	17.87	24.50	0.22	0.28	LRG	1.20
	1342	7080.6	20	3	0.000	0.028	620	10.4	59.8	2.19	33.14	33.85	1.72	-1.348	-0.0126	NONE	1.000	0.000	0.000	18.71	22.78	0.00	0.00	LRG	1.20
	1345	7080.6	19	2.9	0.000	0.031	620	10.8	57.3	2.17	31.59	32.31	1.70	2.659	0.0251	NONE	1.000	2.659	0.025	19.63	23.44	0.28	0.32	LRG	1.20
	1348	7080.6	18	2.9	0.000	0.031	620	10.9	56.8	2.2	30.76	31.50	1.70	2.696	0.0254	NONE	1.000	2.696	0.025	20.16	23.98	0.29	0.32	LRG	1.20
	1351	7080.6	17	2.9	0.000	0.034	620	11.3	54.7	2.18	29.64	30.37	1.67	3.981	0.0381	NONE	1.000	3.551	0.034	20.91	24.63	0.38	0.42	LRG	1.20
	1354	7080.6	17	2.8	0.000	0.034	620	11.6	53.7	2.22	29.43	30.20	1.71	3.678	0.0345	NONE	1.000	3.621	0.034	21.07	25.75	0.38	0.43	LRG	1.20
	1357	7080.6	16	2.8	0.000	0.036	620	11.8	52.6	2.24	28.54	29.32	1.70	3.551	0.0334	NONE	1.000	3.822	0.036	21.72	26.43	0.40	0.46	LRG	1.20
	1360	7080.6	15	2.8	0.017	0.039	620	12.2	51.0	2.24	27.54	28.32	1.68	5.660	0.0539	NONE	1.000	4.095	0.039	22.51	27.33	0.44	0.50	LRG	1.20
	1363	7080.7	14	2.7	0.017	0.039	620	12.3	50.4	2.3	26.42	27.24	1.71	5.970	0.0561	NONE	1.000	4.152	0.039	23.47	28.29	0.46	0.52	LRG	1.20
	1366	7080.7	14	2.7	0.000	0.041	620	12.7	48.9	2.31	26.47	27.30	1.71	4.617	0.0432	NONE	1.000	4.381	0.041	23.42	29.34	0.47	0.55	LRG	1.20
	1369	7080.7	13	2.6	0.000	0.042	620	12.9	48.1	2.37	25.32	26.20	1.73	3.930	0.0363	NONE	1.000	4.542	0.042	24.48	30.57	0.50	0.58	LRG	1.20
	1372	7080.7	12	2.6	0.000	0.043	620	13.1	47.2	2.4	24.48	25.37	1.73	3.791	0.0352	NONE	1.000	3.791	0.035	25.33	31.44	0.44	0.51	LRG	1.20
	1375	7080.7	11	2.6	0.000	0.044	620	13.3	46.6	2.45	23.74	24.65	1.73	4.719	0.0438	NONE	1.000	4.740	0.044	26.12	32.59	0.54	0.63	LRG	1.20
	1378	7080.7	11	2.5	0.000	0.045	620	13.5	45.9	2.53	23.65	24.62	1.78	4.374	0.0394	NONE	1.000	4.998	0.045	26.22	34.16	0.55	0.66	LRG	1.20
	1381	7080.7	10	2.5	0.017	0.045	620	13.6	45.5	2.59	22.95	23.95	1.78	5.776	0.0519	NONE	1.000	5.003	0.045	27.02	35.22	0.56	0.67	LRG	1.20
	1384	7080.8	9	2.5	0.017	0.045	620	13.7	45.2	2.67	22.35	23.38	1.79	6.981	0.0625	NONE	1.000	5.027	0.045	27.74	36.58	0.57	0.69	LRG	1.20
	1387	7080.8	8	2.4	0.000	0.045	620	13.9	44.8	2.76	21.25	22.35	1.81	4.614	0.0409	NONE	1.000	5.071	0.045	29.18	38.36	0.59	0.71	LRG	1.20
	1390	7080.8	8	2.4	0.000	0.045	620	13.9	44.6	2.85	21.68	22.82	1.85	4.453	0.0385	NONE	1.000	5.204	0.045	28.60	39.62	0.59	0.73	LRG	1.20
	1393	7080.8	7	2.3	0.000	0.043	620	13.9	44.5	2.99	20.75	22.00	1.89	5.092	0.0433	NONE	1.000	5.061	0.043	29.87	41.56	0.58	0.72	LRG	1.20
	1396	7080.8	6	2.3	0.000	0.043	620	13.9	44.7	3.11	20.31	21.60	1.89	3.727	0.0315	NONE	1.000	3.727	0.032	30.53	43.23	0.46	0.57	LRG	1.20
	1399	7080.8	5	2.3	0.000	0.041	620	13.7	45.1	3.24	19.9	21.25	1.90	5.168	0.0438	NONE	1.000	4.857	0.041	31.15	44.39	0.57	0.73	LRG	1.20
	1402	7080.8	5	2.2	0.000	0.039	620	13.7	45.4	3.43	20.09	21.58	1.99	5.717	0.0459	NONE	1.000	4.853	0.039	30.86	46.99	0.55	0.72	LRG	1.20
	1405	7080.8	4	2.2	0.017	0.037	620	13.4	46.2	3.6	19.84	21.40	2.01	6.604	0.0528	NONE	1.000	4.630	0.037	31.25	48.24	0.53	0.71	LRG	1.20
	1408	7080.9	3	2.2	0.017	0.035	620	13.1	47.4	3.8	19.72	21.37	2.02	8.989	0.0713	NONE	1.000	4.413	0.035	31.44	49.78	0.51	0.69	LRG	1.20
	1411	7080.9	2	2.1	0.000	0.032	620	12.8	48.5	4.07	19.09	20.93	2.05	6.761	0.0528	NONE	1.000	4.095	0.032	32.47	52.10	0.48	0.66	LRG	1.20
	1414	7080.9	2	2.1	0.000	0.028	620	12.2	50.7	4.34	20.23	22.19	2.17	9.288	0.0685	NONE	1.000	3.798	0.028	30.65	52.95	0.41	0.60	LRG	1.20
	1417	7080.9	1	2	0.001	0.023	620	11.5	54.0	4.76	20.04	22.29	2.25	3.070	0.0219	NONE	1.000	3.225	0.023	30.94	54.74	0.36	0.52	LRG	1.20

TABLE [illegible]NNEL CONVEYANCE CHARACTERISTICS BASED ON HEC-2 MODEL SIMULATION (CONTINUED).

Channel Cross Section Name	Channel Station (ft)	Channel Base Elev. (ft+msl)	Channel Base Width (ft)	Channel Side Slope	Bottom Slope (ft/ft)	HEC-2 Energy Gradient (ft/ft)	Discharge (cfs)	HEC-2 Velocity (fps)	Area (ft^2)	Flow Depth (ft)	Top Width (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Calculated Average Shear (lb/ft^2)	Equivalent Slope For Average Shear (ft/ft)	Channel Bend Radius (ft)	Channel Bend Stress Ratio	Maximum Shear (lb/ft^2)	Calculated Slope For Rock Sizing (ft/ft)	Average Unit Discharge (cfs/ft)	Maximum Unit Discharge (cfs/ft)	Average Unit Discharge Stephenson Rock D50 (ft)	Maximum Unit Discharge Stephenson Rock D50 (ft)	Rock Type+	Target Riprap D50 (ft)
													CHANNEL H												
HCT-1	1470	7081	0	2	0.001	0.006	620	6.9	89.7	6.44	25.76	28.80	2.88	3.260	0.0181	NONE	1.000	1.078	0.006	24.07	44.44	0.10	0.16	LRG	1.20
	1490	7081	0	2	0.000	0.005	620	6.3	98.2	6.72	26.88	30.05	3.01	2.278	0.0121	NONE	1.000	0.938	0.005	23.07	42.34	0.09	0.13	LRG	1.20
	1500	7081	5	2	0.000	0.002	620	4.2	147.9	7.09	33.36	36.71	3.70	4.121	0.0178	NONE	1.000	0.462	0.002	18.59	29.78	0.04	0.05	LRG	1.20
	1501	7081	5	2	0.000	0.002	620	4.1	151.5	7.1	33.4	36.75	3.71	0.547	0.0024	NONE	1.000	0.463	0.002	18.56	29.11	0.04	0.05	LRG	1.20
	1504	7081	6	2.1	0.000	0.001	620	3.7	166.2	7.14	35.99	39.21	3.82	3.790	0.0159	NONE	1.000	0.239	0.001	17.23	26.42	0.02	0.03	LRG	1.20
	1507	7081	7	2.1	0.000	0.001	620	3.5	178.1	7.24	37.41	40.68	3.95	5.811	0.0236	NONE	1.000	0.247	0.001	16.57	25.34	0.02	0.03	LRG	1.20
	1510	7081	9	2.2	0.000	0.001	620	3.3	187.0	7.31	41.16	44.33	4.14	-242.452	-0.9394	NONE	1.000	0.000	0.000	15.06	24.12	0.00	0.00	LRG	1.20
	1513	7081	10	2.3	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1516	7081	11	2.3	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1519	7081	12	2.4	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1522	7081	13	2.4	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1525	7081	14	2.5	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1528	7081	15	2.6	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1531	7081	16	2.6	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1534	7081	17	2.7	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1537	7081	18	2.7	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1540	7081	19	2.8	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1543	7081	20	2.9	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1546	7081	21	2.9	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1549	7081	22	3	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1552	7081	23	3	0.017	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1555	7081.1	24	3.1	0.017	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1558	7081.1	25	3.2	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1561	7081.1	26	3.2	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1564	7081.1	27	3.3	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1567	7081.1	28	3.3	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1570	7081.1	30	3.4	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1573	7081.1	31	3.5	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1576	7081.1	32	3.5	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1579	7081.1	33	3.6	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.20
	1582	7081.1	34	3.6	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.00
	1585	7081.1	35	3.7	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.00
	1588	7081.1	36	3.8	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.00
	1591	7081.1	37	3.8	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.00
	1594	7081.1	38	3.9	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.00
	1597	7081.1	39	3.9	0.000	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.00
	1600	7081.1	40	4	0.001	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.00
	1700	7081.2	40	4	0.001	0.001	620	LOW SLOPE- ROCK SIZING METHODS FAIL							--	NONE	1.000	--	--	--	--	--	--	LRG	1.00
													CHANNEL I												
	1450	7081	50	4	0.007	0.007	581	5.1	113.2	1.96	65.68	66.16	1.71	0.785	0.0073	NONE	1.000	0.802	0.007	8.85	10.00	0.06	0.07	RM	0.15
	1490	7081.3	50	4	0.008	0.007	581	5.2	112.2	1.94	65.52	66.00	1.70	0.791	0.0075	NONE	1.000	0.821	0.008	8.87	10.09	0.07	0.07	RM	0.15
	1590	7082.1	50	4	0.008	0.008	581	5.3	108.9	1.89	65.12	65.59	1.66	0.784	0.0076	NONE	1.000	0.828	0.008	8.92	10.02	0.07	0.07	RM	0.15
	1630	7082.4	50	4	0.008	0.008	581	5.3	109.3	1.9	65.2	65.67	1.67	0.812	0.0078	NONE	1.000	0.832	0.008	8.91	10.07	0.07	0.07	RM	0.15
	1730	7083.2	50	4	0.011	0.008	581	5.3	109.8	1.9	65.2	65.67	1.67	1.099	0.0106	NONE	1.000	1.196	0.011	8.91	10.07	0.09	0.10	RM	0.15
	1770	7083.8	50	4	0.015	0.015	581	6.6	87.8	1.56	62.48	62.86	1.40	1.269	0.0146	NONE	1.000	1.306	0.015	9.30	10.30	0.11	0.12	RM	0.15
	1870	7085.3	50	4	0.025	0.033	581	8.5	68.6	1.25	60	60.31	1.14	1.835	0.0258	NONE	1.000	1.835	0.026	9.68	10.63	0.18	0.19	INT	0.60
	1890	7086	50	4	0.033	0.033	581	8.4	68.8	1.25	60	60.31	1.14	2.287	0.0322	900	1.000	2.347	0.033	9.68	10.50	0.22	0.23	INT	0.60
	1910	7086.6	50	4	0.032	0.032	581	8.4	69.2	1.26	60.08	60.39	1.15	2.390	0.0334	800	1.000	2.329	0.032	9.67	10.58	0.22	0.23	INT	0.60
	1930	7087.3	50	4	0.033	0.034	581	8.6	68	1.24	59.92	60.23	1.13	2.298	0.0326	700	1.000	2.401	0.034	9.70	10.66	0.23	0.24	INT	0.60
	1940	7087.6	50	4	0.033	0.034	581	8.5	68.2	1.24	59.92	60.23	1.13	2.238	0.0317	600	1.000	2.401	0.034	9.70	10.54	0.23	0.24	INT	0.60
	1960	7088.3	50	4	0.035	0.034	581	8.5	68.3	1.24	59.92	60.23	1.13	2.450	0.0347	600	1.000	2.471	0.035	9.70	10.54	0.23	0.24	INT	0.60
HC4-3	1980	7089	50	4	0.034	0.033	581	8.4	68.8	1.25	60	60.31	1.14	2.423	0.0341	500	1.074	2.610	0.037	9.68	10.50	0.24	0.25	INT	0.60
	1995	7089.5	50	4	0.032	0.032	581	8.4	69.2	1.26	60.08	60.39	1.15	2.255	0.0315	500	1.075	2.464	0.034	9.67	10.58	0.23	0.24	INT	0.60
	2015	7090.1	50	4	0.032	0.031	581	8.3	70.2	1.27	60.16	60.47	1.16	2.378	0.0329	500	1.075	2.523	0.035	9.66	10.54	0.23	0.24	INT	0.60
	2035	7090.8	50	4	0.035	0.033	581	8.5	68.6	1.25	60	60.31	1.14	2.483	0.0349	500	1.074	2.674	0.038	9.68	10.63	0.24	0.26	INT	0.60
	2055	7091.5	50	4	0.033	0.031	581	8.3	70.1	1.27	60.16	60.47	1.16	2.332	0.0323	500	1.075	2.523	0.035	9.66	10.54	0.23	0.24	INT	0.60
	2075	7092.1	50	4	0.032	0.034	581	8.5	68	1.24	59.92	60.23	1.13	2.238	0.0317	500	1.073	2.576	0.036	9.70	10.54	0.24	0.25	INT	0.60
	2090	7092.6	50	4	0.034	0.033	581	8.4	68.9	1.25	60	60.31	1.14	2.434	0.0342	500	1.074	2.610	0.037	9.68	10.50	0.24	0.25	INT	0.60
	2110	7093.3	50	4	0.035	0.034	581	8.5	68.2	1.24	59.92	60.23	1.13	2.489	0.0353	500	1.073	2.652	0.038	9.70	10.54	0.24	0.26	INT	0.60
	2130	7094	50	4	0.033	0.033	581	8.4	69	1.26	60.08	60.39	1.15	2.341	0.0327	500	1.075	2.541	0.035	9.67	10.58	0.23	0.25	INT	0.60
	2150	7094.6	50	4	0.032	0.035	581	8.6	67.8	1.23	59.84	60.14	1.12	2.100	0.0300	500	1.072	2.631	0.038	9.71	10.58	0.25	0.26	INT	0.60
	2170	7095.3	50	4	0.031	0.020	581	7.2	80.3	1.44	61.52	61.87	1.30	2.458	0.0304	500	1.087	2.730	0.034	9.44	10.37	0.22	0.23	INT	0.60
	2270	7098	50	4	0.026	0.036	541	8.5	63.7	1.17	59.36	59.65	1.07	1.642	0.0245	500	1.068	1.829	0.027	9.11	9.95	0.18	0.19	INT	0.60
	2390	7100.9	49	4	0.020	0.011	496	5.6	88.8	1.6	61.8	62.19	1.43	1.713	0.0193	600	1.000	1.742	0.020	8.03	8.96	0.13	0.14	SML	0.40
	2410	7101.2	48	4	0.013	0.012	491	5.8	85.3	1.57	60.56	60.95	1.40	1.087	0.0125	800	1.000	1.091	0.013	8.11	9.11	0.09	0.10	SML	0.40
	2430	7101.4	47	4	0.010	0.012	486	5.9	83	1.55	59.4	59.78	1.38	0.880	0.0102	NONE	1.000	1.033	0.012	8.18	9.15	0.09	0.09	SML	0.40

TABLE 5-6. CHANNEL CONVEYANCE CHARACTERISTICS BASED ON HEC-2 MODEL SIMULATION (CONTINUED).

Channel Cross Section Name	Channel Station (ft)	Channel Base Elev. (ft+msl)	Channel Base Width (ft)	Channel Side Slope	Bottom Slope (ft/ft)	HEC-2 Energy Gradient (ft/ft)	Discharge (cfs)	HEC-2 Velocity (fps)	Area (ft^2)	Flow Depth (ft)	Top Width (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Calculated Average Shear (lb/ft^2)	Equivalent Slope For Average Shear (ft/ft)	Channel Bend Radius (ft)	Channel Bend Stress Ratio	Maximum Shear (lb/ft^2)	Calculated Slope For Rock Sizing (ft/ft)	Average Unit Discharge (cfs/ft)	Maximum Unit Discharge (cfs/ft)	Average Unit Discharge Stephenson Rock D50 (ft)	Maximum Unit Discharge Stephenson Rock D50 (ft)	Rock Type+	Target Riprap D50 (ft)
CHANNEL I																									
	2450	7101.6	46	4	0.013	0.012	482	5.9	81.9	1.56	58.48	58.86	1.38	1.115	0.0129	NONE	1.000	1.080	0.013	8.24	9.20	0.09	0.10	SML	0.40
	2470	7101.9	46	4	0.013	0.012	477	5.8	81.6	1.58	58.64	59.03	1.40	1.144	0.0131	NONE	1.000	1.092	0.013	8.13	9.16	0.09	0.10	SML	0.40
	2490	7102.1	45	4	0.013	0.012	473	5.9	80.7	1.59	57.72	58.11	1.41	1.162	0.0133	NONE	1.000	1.096	0.013	8.19	9.38	0.09	0.10	SML	0.40
	2510	7102.4	44	4	0.013	0.012	468	5.9	79.7	1.6	56.8	57.19	1.41	1.087	0.0124	NONE	1.000	1.100	0.013	8.24	9.44	0.09	0.10	SML	0.40
	2530	7102.6	43	4	0.010	0.012	464	5.9	78.2	1.59	55.72	56.11	1.40	0.905	0.0104	NONE	1.000	1.047	0.012	8.33	9.38	0.09	0.10	SML	0.40
	2550	7102.8	42	4	0.013	0.013	459	6	76.8	1.6	54.8	55.19	1.40	1.165	0.0133	NONE	1.000	1.138	0.013	8.38	9.60	0.09	0.10	SML	0.40
	2570	7103.1	41	4	0.013	0.012	455	6	76.3	1.61	53.88	54.28	1.41	1.127	0.0128	NONE	1.000	1.098	0.013	8.44	9.66	0.09	0.10	SML	0.40
	2590	7103.3	40	4	0.013	0.012	450	5.9	75.6	1.63	53.04	53.44	1.42	1.123	0.0127	NONE	1.000	1.181	0.013	8.48	9.62	0.10	0.11	SML	0.40
	2614	7103.7	40	4	0.016	0.014	445	6.2	71.9	1.55	52.4	52.78	1.36	1.278	0.0151	NONE	1.000	1.340	0.016	8.49	9.61	0.11	0.12	SML	0.40
	2714	7105.2	40	4	0.015	0.015	422	6.2	67.8	1.48	51.84	52.20	1.30	1.182	0.0145	NONE	1.000	1.244	0.015	8.14	9.18	0.11	0.11	SML	0.40
HC4-2	2810	7106.7	40	4	0.008	0.014	399	5.9	67.1	1.46	51.68	52.04	1.29	0.604	0.0075	NONE	1.000	0.627	0.008	7.72	8.61	0.06	0.06	SML	0.40
	2815	7106.7	40	4	0.003	0.012	399	5.7	70.6	1.53	52.24	52.62	1.34	0.854	0.0102	NONE	1.000	1.004	0.012	7.64	8.72	0.08	0.09	SML	0.40
	2830	7106.8	40	4	0.005	0.007	399	4.8	82.9	1.76	54.08	54.51	1.52	0.731	0.0077	NONE	1.000	0.663	0.007	7.38	8.45	0.05	0.06	SML	0.40
	2930	7107.2	40	4	0.004	0.005	399	4.1	96.7	2.01	56.08	56.57	1.71	0.530	0.0050	NONE	1.000	0.533	0.005	7.11	8.24	0.04	0.04	SML	0.40
	3030	7107.6	40	4	0.002	0.004	399	4	98.9	2.05	56.4	56.90	1.74	0.266	0.0025	NONE	1.000	0.266	0.002	7.07	8.20	0.02	0.03	SML	0.40
	3040	7107.6	39	4	0.003	0.004	399	4.1	97.7	2.06	55.48	55.99	1.74	0.423	0.0039	NONE	1.000	0.434	0.004	7.19	8.45	0.03	0.04	SML	0.40
	3060	7107.7	38	4	0.005	0.005	399	4.2	94.7	2.07	54.56	55.07	1.74	0.626	0.0058	NONE	1.000	0.543	0.005	7.31	8.69	0.04	0.05	SML	0.40
	3080	7107.8	36	4	0.005	0.005	399	4.4	91.3	2.06	52.48	52.99	1.72	0.657	0.0061	NONE	1.000	0.537	0.005	7.60	9.06	0.04	0.05	SML	0.40
	3100	7107.9	34	4	0.005	0.005	399	4.5	88.8	2.08	50.64	51.15	1.72	0.712	0.0066	NONE	1.000	0.537	0.005	7.88	9.36	0.04	0.05	SML	0.40
	3120	7108	33	4	0.003	0.006	399	4.6	86.4	2.1	49.8	50.32	1.73	0.467	0.0043	700	1.000	0.467	0.004	8.01	9.66	0.04	0.04	SML	0.40
	3140	7108	31	4	0.003	0.006	399	4.7	84.6	2.13	48.04	48.56	1.73	0.472	0.0044	500	1.000	0.472	0.004	8.31	10.01	0.04	0.04	SML	0.40
	3160	7108.1	30	4	0.005	0.006	399	4.8	82.3	2.15	47.2	47.73	1.74	0.767	0.0071	300	1.230	0.800	0.007	8.45	10.32	0.06	0.07	SML	0.40
	3180	7108.2	28	4	0.005	0.006	399	4.9	80.7	2.19	45.52	46.06	1.75	0.866	0.0079	200	1.479	0.968	0.009	8.77	10.73	0.07	0.08	SML	0.40
	3200	7108.3	26	4	0.005	0.007	399	5.1	78.7	2.23	43.84	44.39	1.75	0.904	0.0083	200	1.451	1.112	0.010	9.10	11.37	0.08	0.10	SML	0.40
	3220	7108.4	25	4	0.003	0.007	399	5.2	77.1	2.28	43.24	43.80	1.78	0.649	0.0059	200	1.441	1.118	0.010	9.23	11.86	0.08	0.10	SML	0.40
	3240	7108.4	23	4	0.003	0.007	399	5.3	76	2.34	41.72	42.30	1.79	0.630	0.0056	300	1.156	0.728	0.007	9.56	12.40	0.06	0.07	SML	0.40
	3260	7108.5	22	4	0.005	0.007	399	5.4	74.2	2.38	41.04	41.63	1.80	0.881	0.0078	300	1.147	0.903	0.008	9.72	12.85	0.07	0.09	SML	0.40
HC4-1	3280	7108.6	20	4	0.012	0.008	399	5.5	72.1	2.43	39.44	40.04	1.80	0.670	0.0060	500	1.000	1.407	0.012	10.12	13.37	0.10	0.12	SML	0.40
	3290	7108.8	21	4	0.022	0.016	399	7.1	56.5	1.94	36.52	37.00	1.51	0.931	0.0099	700	1.000	2.117	0.022	10.93	13.77	0.17	0.20	SML	0.40
	3310	7109.3	24	4	0.023	0.016	399	7	57.1	1.81	38.48	38.93	1.45	1.433	0.0158	900	1.000	2.039	0.023	10.37	12.67	0.17	0.19	SML	0.40
	3330	7109.7	27	4	0.020	0.017	399	6.9	57.6	1.7	40.6	41.02	1.40	1.490	0.0170	NONE	1.000	1.748	0.020	9.83	11.73	0.15	0.17	SML	0.40
	3360	7110.3	29	4	0.012	0.010	399	5.7	69.8	1.89	44.12	44.59	1.55	1.413	0.0146	NONE	1.000	1.209	0.012	9.04	10.77	0.10	0.11	SML	0.40
	3380	7110.4	28	4	0.005	0.009	399	5.5	72.3	2.01	44.08	44.57	1.63	0.888	0.0088	NONE	1.000	0.913	0.009	9.05	11.06	0.07	0.08	SML	0.40
	3400	7110.5	27	4	0.005	0.009	399	5.5	72.6	2.07	43.56	44.07	1.66	0.834	0.0081	NONE	1.000	0.931	0.009	9.16	11.39	0.07	0.09	SML	0.40
	3420	7110.6	25	4	0.005	0.009	399	5.6	71.7	2.12	41.96	42.48	1.67	0.824	0.0079	NONE	1.000	0.938	0.009	9.51	11.87	0.08	0.09	SML	0.40
	3440	7110.7	24	4	0.007	0.009	399	5.6	71.1	2.17	41.36	41.89	1.69	1.078	0.0102	NONE	1.000	0.951	0.009	9.65	12.15	0.08	0.09	SML	0.40
	3460	7110.9	23	4	0.007	0.009	399	5.8	69.4	2.2	40.6	41.14	1.70	1.103	0.0104	NONE	1.000	0.955	0.009	9.83	12.76	0.08	0.09	SML	0.40
	3480	7111	21	4	0.005	0.009	399	5.8	68.6	2.26	39.08	39.64	1.71	0.898	0.0084	NONE	1.000	0.962	0.009	10.21	13.11	0.08	0.10	SML	0.40
	3500	7111.1	20	4	0.005	0.009	399	5.9	67.7	2.32	38.56	39.13	1.74	0.938	0.0087	NONE	1.000	0.975	0.009	10.35	13.69	0.08	0.10	SML	0.40
CHANNEL M																									
	200	7082.5	50	8	0.007	0.005	170	2.8	59.6	1.02	66.32	66.45	0.89	0.355	0.0064	NONE	1.000	0.398	0.007	2.56	2.86	0.03	0.03	INT	0.60
	270	7083	50	8	0.024	0.007	170	3.2	53.3	0.93	64.88	65.00	0.82	1.112	0.0217	NONE	1.000	1.209	0.024	2.62	2.98	0.07	0.08	INT	0.60
HC4-6	295	7084	50	6.4	0.040	0.035	170	5.4	31.8	0.59	57.55	57.64	0.55	1.367	0.0398	NONE	1.000	1.374	0.040	2.95	3.19	0.12	0.12	INT	0.60
	395	7088	50	8	0.051	0.046	170	5.8	29.5	0.54	58.64	58.71	0.50	1.591	0.0510	NONE	1.000	1.574	0.051	2.90	3.13	0.14	0.15	INT	0.60
	495	7094.1	50	8	0.057	0.090	150	6.8	22	0.41	56.56	56.61	0.39	1.282	0.0532	NONE	1.000	1.369	0.057	2.65	2.79	0.15	0.15	INT	0.60
	605	7099.9	50	8	0.026	0.001	36	1	36	0.65	60.4	60.48	0.59	0.997	0.0269	NONE	1.000	0.976	0.026	0.60	0.65	0.03	0.03	INT	0.60
	612	7099.9	43	7.1	0.000	0.002	36	1.2	31	0.65	52.23	52.32	0.59	0.037	0.0010	NONE	1.000	0.037	0.001	0.69	0.78	0.00	0.00	INT	0.60
	618	7099.9	36	5.1	0.007	0.002	36	1.4	25.5	0.65	42.63	42.76	0.60	0.284	0.0076	NONE	1.000	0.266	0.007	0.84	0.91	0.01	0.01	INT	0.60
	625	7100	30	7.4	0.007	0.003	36	1.6	22	0.64	39.47	39.56	0.56	0.302	0.0086	NONE	1.000	0.250	0.007	0.91	1.02	0.01	0.01	INT	0.60
	633	7100	20	4	0.000	0.008	36	2.6	13.9	0.62	24.96	25.11	0.56	0.418	0.0121	NONE	1.000	0.277	0.008	1.44	1.61	0.02	0.02	INT	0.60
	641	7100	10	4	0.000	0.079	36	6.5	5.5	0.47	13.76	13.88	0.40	1.785	0.0711	NONE	1.000	1.984	0.079	2.62	3.06	0.19	0.21	INT	0.60
	645	7100	5	4	0.000	0.083	36	7.4	4.8	0.64	10.12	10.28	0.47	2.628	0.0894	NONE	1.000	2.438	0.083	3.56	4.74	0.25	0.30	INT	0.60
	650	7100	0	4	0.000	0.023	36	4.9	7.4	1.36	10.88	11.21	0.66	1.252	0.0304	NONE	1.000	0.947	0.023	3.31	6.66	0.08	0.13	INT	0.60
	670	7100	0	2.5	0.005	0.023	36	5.3	6.8	1.64	8.2	8.83	0.76	1.047	0.0220	NONE	1.000	1.093	0.023	4.39	8.69	0.10	0.15	INT	0.60
	680	7100.1	0	2	0.005	0.020	36	5.2	6.9	1.85	7.4	8.27	0.83	1.074	0.0208	NONE	1.000	1.033	0.020	4.86	9.62	0.09	0.15	INT	0.60
HC4-5	705	7100.1	0	2	0.002	0.006	36	3.3	10.8	2.33	9.32	10.42	1.04	0.712	0.0110	NONE	1.000	0.390	0.006	3.86	7.69	0.03	0.05	INT	0.60
	730	7100.2	0	2	0.002	0.005	36	3.1	11.8	2.43	9.72	10.87	1.09	-2.414	-0.0356	NONE	1.000	0.136	0.002	3.70	7.53	0.01	0.02	INT	0.60
	755	7100.2	25	4		0.001	36	——SURGE POND——								NONE	1.000	–	–	–	–	–	–	INT	0.60
CHANNEL N																									
	100	7076.2	30	4	0.040	0.042	229	7.6	30.2	0.90	37.2	37.42	0.81	2.135	0.0423	NONE	1.000	2.118	0.042	6.16	6.84	0.20	0.21	INT	0.60
	110	7076.6	30	4	0.042	0.048	229	7.9	28.9	0.86	36.88	37.09	0.78	1.907	0.0394	NONE	1.000	2.056	0.042	6.21	6.79	0.20	0.21	INT	0.60
HC5-5	130	7077.5	30	4	0.062	0.026	229	6.5	35.5	1.04	38.32	38.58	0.92	3.403	0.0592	NONE	1.000	3.592	0.062	5.98	6.76	0.27	0.30	INT	0.60
	140	7078.3	30	4	0.047	0.024	229	6.3	36.2	1.06	38.48	38.74	0.94	2.720	0.0465	NONE	1.000	2.748	0.047	5.95	6.68	0.21	0.23	INT	0.60
	190	7079	30	4	0.022	0.025	229	6.4	35.7	1.04	38.32	38.58	0.92	1.197	0.0208	NONE	1.000	1.264	0.022	5.98	6.66	0.11	0.12	INT	0.60

TABLE 5-6. CHANNEL CONVEYANCE CHARACTERISTICS BASED ON HEC-2 MODEL SIMULATION (CONTINUED).

Channel Cross Section Name	Channel Station (ft)	Channel Base Elev. (ft+msl)	Channel Base Width (ft)	Channel Side Slope	Bottom Slope (ft/ft)	HEC-2 Energy Gradient (ft/ft)	Discharge (cfs)	HEC-2 Velocity (fps)	Area (ft^2)	Flow Depth (ft)	Top Width (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Calculated Average Shear (lb/ft^2)	Equivalent Slope For Average Shear (ft/ft)	Channel Bend Radius (ft)	Channel Bend Stress Ratio	Maximum Shear (lb/ft^2)	Calculated Slope For Rock Sizing (ft/ft)	Average Unit Discharge (cfs/ft)	Maximum Unit Discharge (cfs/ft)	Average Unit Discharge Stephenson Rock D50 (ft)	Maximum Unit Discharge Stephenson Rock D50 (ft)	Rock Type+	Target Riprap D50 (ft)
CHANNEL N																									
	200	7079.3	30	4	0.032	0.019	213	5.7	37.4	1.09	38.72	38.99	0.96	1.742	0.0291	NONE	1.000	1.948	0.032	5.50	6.21	0.15	0.16	INT	0.60
	220	7080	30	4	0.043	0.055	180	7.6	23.7	0.72	35.76	35.94	0.66	1.812	0.0441	NONE	1.000	1.812	0.044	5.03	5.47	0.18	0.19	INT	0.60
	230	7080.5	28	4	0.050	0.055	180	7.7	23.4	0.75	34	34.18	0.68	2.353	0.0555	NONE	1.000	2.334	0.055	5.29	5.78	0.23	0.24	INT	0.60
	240	7081	27	4	0.050	0.054	180	7.8	23.1	0.78	33.24	33.43	0.70	2.233	0.0509	NONE	1.000	2.368	0.054	5.42	6.08	0.23	0.24	INT	0.60
	250	7081.5	25	4	0.047	0.045	180	7.4	24.2	0.85	31.8	32.01	0.75	2.249	0.0478	NONE	1.000	2.235	0.047	5.66	6.29	0.21	0.22	INT	0.60
	270	7082.4	25	4	0.045	0.046	180	7.5	24	0.85	31.8	32.01	0.75	2.115	0.0449	NONE	1.000	2.165	0.046	5.66	6.38	0.20	0.22	INT	0.60
	290	7083.3	25	4	0.045	0.044	180	7.4	24.3	0.86	31.88	32.09	0.76	2.112	0.0444	NONE	1.000	2.140	0.045	5.65	6.36	0.20	0.22	INT	0.60
	310	7084.2	25	4	0.045	0.046	180	7.5	23.9	0.84	31.72	31.93	0.75	2.062	0.0443	NONE	1.000	2.142	0.046	5.67	6.30	0.20	0.22	INT	0.60
	330	7085.1	25	4	0.045	0.038	180	7.1	25.5	0.89	32.12	32.34	0.79	2.446	0.0499	NONE	1.000	2.207	0.045	5.60	6.32	0.20	0.21	INT	0.60
	350	7086	25	4	0.063	0.083	180	9.1	19.8	0.71	30.68	30.85	0.64	2.830	0.0708	NONE	1.000	3.318	0.083	5.87	6.46	0.35	0.37	INT	0.60
	365	7087.2	25	4	0.082	0.077	180	8.9	20.3	0.73	30.84	31.02	0.66	3.533	0.0862	NONE	1.000	3.383	0.082	5.84	6.50	0.34	0.37	INT	0.60
HC5-4	385	7088.9	25	4	0.097	0.105	180	9.9	18.3	0.66	30.28	30.44	0.60	3.763	0.1006	NONE	1.000	3.926	0.105	5.94	6.53	0.43	0.46	INT	0.60
	395	7090	25	4	0.075	0.092	180	9.4	19.1	0.69	30.52	30.69	0.62	3.596	0.0923	NONE	1.000	3.583	0.092	5.90	6.49	0.38	0.41	INT	0.60
	400	7090.2	20	4	0.070	0.109	180	10.6	17	0.74	25.92	26.10	0.65	5.607	0.1381	NONE	1.000	4.427	0.109	6.94	7.84	0.50	0.54	INT	0.60
	402	7090.4	19	3.9	0.075	0.11	180	10.8	16.7	0.76	24.93	25.12	0.66	4.540	0.1095	NONE	1.000	4.581	0.110	7.22	8.21	0.51	0.56	LRG	1.20
	404	7090.5	18	3.8	0.075	0.109	180	10.9	16.5	0.79	24	24.21	0.69	4.453	0.1041	NONE	1.000	4.662	0.109	7.50	8.61	0.52	0.57	LRG	1.20
	406	7090.7	17	3.7	0.075	0.107	180	11	16.3	0.82	23.07	23.29	0.71	4.578	0.1040	NONE	1.000	4.710	0.107	7.80	9.02	0.53	0.58	LRG	1.20
	408	7090.8	16	3.6	0.075	0.105	180	11.1	16.2	0.85	22.12	22.35	0.72	4.629	0.1023	NONE	1.000	4.749	0.105	8.14	9.44	0.53	0.59	LRG	1.20
	410	7091	15	3.5	0.075	0.099	180	11.1	16.2	0.90	21.3	21.55	0.76	5.363	0.1134	NONE	1.000	4.682	0.099	8.45	9.99	0.52	0.58	LRG	1.20
	412	7091.1	14	3.4	0.050	0.102	180	11.4	15.8	0.92	20.26	20.52	0.77	5.156	0.1076	NONE	1.000	4.887	0.102	8.89	10.49	0.55	0.61	LRG	1.20
	414	7091.2	13	3.3	0.050	0.104	180	11.7	15.4	0.95	19.27	19.55	0.78	5.554	0.1135	NONE	1.000	5.088	0.104	9.34	11.12	0.58	0.65	LRG	1.20
	416	7091.3	12	3.2	0.050	0.106	180	12	15	0.99	18.34	18.64	0.81	5.836	0.1161	NONE	1.000	5.329	0.106	9.82	11.88	0.61	0.69	LRG	1.20
	418	7091.4	11	3.1	0.050	0.107	180	12.3	14.7	1.03	17.39	17.71	0.83	5.488	0.1066	NONE	1.000	5.511	0.107	10.35	12.67	0.64	0.73	LRG	1.20
	420	7091.5	10	3	0.050	0.105	180	12.4	14.5	1.09	16.54	16.89	0.86	5.434	0.1017	NONE	1.000	5.610	0.105	10.88	13.52	0.65	0.75	LRG	1.20
	430	7092	5	3	0.050	0.092	180	12.7	14.1	1.49	13.94	14.42	0.98	6.133	0.1005	NONE	1.000	5.616	0.092	12.91	18.92	0.64	0.83	LRG	1.20
	440	7092.5	0	3	0.055	0.065	180	11.4	15.7	2.29	13.74	14.48	1.09	6.793	0.1002	NONE	1.000	4.406	0.065	13.10	26.11	0.48	0.75	LRG	1.20
	445	7092.8	0	2.5	0.033	0.047	180	10.5	17.2	2.62	13.1	14.11	1.22	4.924	0.0649	NONE	1.000	3.567	0.047	13.74	27.51	0.37	0.59	LRG	1.20
HC5-3	475	7093	0	2	0.005	0.006	180	5.2	34.9	4.18	16.72	18.69	1.87	2.954	0.0253	NONE	1.000	0.700	0.006	10.77	21.74	0.06	0.10	LRG	1.20
	500	7093.1	0	2	0.002	0.005	180	4.8	37.4	4.32	17.28	19.32	1.93	1.266	0.0105	NONE	1.000	0.603	0.005	10.42	20.74	0.05	0.08	LRG	1.20
	503	7093.1	3	2.2	0.000	0.002	180	3	59.4	4.58	23.15	25.14	2.38	-63.775	-0.4290	NONE	1.000	0.000	0.000	7.77	13.74	0.00	0.00	LRG	1.20
	508	7093.1	8	2.6	0.000	0.001	180		LOW SLOPE - ROCK SIZING METHODS FAIL							NONE	1.000	–	–	–	–	–	–	LRG	1.20
	513	7093.1	13	3	0.000	0.001	180		LOW SLOPE - ROCK SIZING METHODS FAIL							NONE	1.000	–	–	–	–	–	–	LRG	1.20
	515	7093.1	17	3.2	0.000	0.001	180		LOW SLOPE - ROCK SIZING METHODS FAIL							NONE	1.000	–	–	–	–	–	–	RM	0.15
	520	7093.1	29	3.6	0.010	0.001	180		LOW SLOPE - ROCK SIZING METHODS FAIL							NONE	1.000	–	–	–	–	–	–	RM	0.15
	525	7093.2	40	4	0.015	0.001	180		LOW SLOPE - ROCK SIZING METHODS FAIL							NONE	1.000	–	–	–	–	–	–	RM	0.15
	600	7094	40	4	0.006	0.001	450		LOW SLOPE - ROCK SIZING METHODS FAIL							NONE	1.000	–	–	–	–	–	–	RM	0.15
	680	7094.1	40	4	0.002	0.001	650		PONDING							NONE	1.000	–	–	–	–	–	–	RM	0.15
	780	7094.3	40	4	0.002	0.003	899		PONDING							NONE	1.000	–	–	–	–	–	–	RM	0.15
HC5-2	880	7094.5	40	4	0.001	0.005	1149		PONDING							NONE	1.000	–	–	–	–	–	–	RM	0.15
	885	7094.5	40	4.1	0.000	0.004	1149		PONDING							NONE	1.000	–	–	–	–	–	–	RM	0.15
	890	7094.5	41	4.2	0.000	0.004	1149		PONDING							NONE	1.000	–	–	–	–	–	–	RM	0.15
	895	7094.5	41	4.3	0.010	0.004	1149		PONDING							NONE	1.000	–	–	–	–	–	–	RM	0.15
	900	7094.6	41	4.4	0.010	0.004	1149		PONDING							NONE	1.000	–	–	–	–	–	–	RM	0.15
	920	7094.6	43	4.8	0.003	0.003	1149	5	231.2	3.81	79.58	80.36	2.91	16.136	0.0890	NONE	1.000	0.544	0.003	14.44	19.05	0.04	0.05	RM	0.15
	940	7094.7	44	5.1	0.005	0.003	1149	4.7	245.3	3.86	83.37	84.12	2.92	1.017	0.0056	NONE	1.000	0.912	0.005	13.78	18.14	0.06	0.07	RM	0.15
	960	7094.8	45	5.5	0.002	0.003	1149	4.4	258.9	3.90	87.9	88.60	2.92	0.448	0.0025	NONE	1.000	0.456	0.002	13.07	17.16	0.03	0.04	RM	0.15
	980	7094.8	46	5.9	0.003	0.002	1149	4.3	270.4	3.90	92.02	92.68	2.90	0.411	0.0023	NONE	1.000	0.453	0.003	12.49	16.77	0.03	0.04	RM	0.15
	1000	7094.9	48	6.3	0.003	0.002	1149	4.1	282.9	3.92	97.39	98.01	2.91	0.323	0.0018	NONE	1.000	0.454	0.003	11.80	16.07	0.03	0.04	RM	0.15
	1020	7094.9	49	6.6	0.003	0.002	1149	4	290.8	3.90	100.5	101.07	2.88	0.416	0.0023	NONE	1.000	0.450	0.003	11.44	15.60	0.03	0.04	RM	0.15
	1040	7095	50	7	0.005	0.002	1149	3.8	305.3	3.94	105.2	105.72	2.89	0.919	0.0051	NONE	1.005	0.907	0.005	10.93	14.97	0.05	0.07	RM	0.15
	1060	7095.1	51	7.4	0.003	0.002	1149	3.7	315.1	3.93	109.2	109.69	2.87	0.017	0.0001	NONE	1.024	0.458	0.003	10.53	14.54	0.03	0.04	RM	0.15
	1080	7095.1	53	7.8	0.003	0.002	1149	3.6	319	3.86	113.2	113.71	2.82	0.100	0.0006	NONE	1.043	0.459	0.003	10.15	13.90	0.03	0.04	RM	0.15
	1100	7095.2	54	8.1	0.005	0.002	1149	3.5	328.5	3.87	116.7	117.17	2.82	0.849	0.0048	NONE	1.059	0.931	0.005	9.85	13.55	0.05	0.06	RM	0.15
	1120	7095.3	55	8.5	0.002	0.002	1149	3.4	339.5	3.87	120.8	121.24	2.81	0.108	0.0006	NONE	1.077	0.472	0.003	9.51	13.16	0.03	0.04	RM	0.15
	1140	7095.3	56	8.9	0.003	0.002	1149	3.3	343.2	3.81	123.8	124.24	2.76	0.150	0.0009	NONE	1.091	0.469	0.003	9.28	12.57	0.03	0.04	RM	0.15
	1160	7095.4	58	9.3	0.003	0.002	1149	3.2	354.8	3.82	129.1	129.46	2.76	0.225	0.0013	NONE	1.114	0.479	0.003	8.90	12.22	0.03	0.04	RM	0.15
	1180	7095.4	59	9.6	0.003	0.002	1149	3.2	357.6	3.77	131.4	131.78	2.72	0.222	0.0013	NONE	1.124	0.477	0.003	8.75	12.06	0.03	0.04	RM	0.15
	1200	7095.5	60	10	0.004	0.001	1149	3.1	370.1	3.78	135.6	135.98	2.72	0.524	0.0031	NONE	1.142	0.678	0.004	8.47	11.72	0.04	0.05	RM	0.15
	1300	7095.7	60	10	0.001	0.002	1149	3.2	361.2	3.72	134.4	134.77	2.68	0.206	0.0012	NONE	1.136	0.285	0.002	8.55	11.90	0.02	0.02	RM	0.15
	1400	7095.8	60	10	0.001	0.002	1149	3.2	361.2	3.72	134.4	134.77	2.68	0.251	0.0015	NONE	1.136	0.285	0.002	8.55	11.90	0.02	0.02	RM	0.15
	1500	7096	60	10	0.002	0.002	1149	3.2	361.2	3.72	134.4	134.77	2.68	0.290	0.0017	NONE	1.136	0.381	0.002	8.55	11.90	0.02	0.03	RM	0.15
	1600	7096.2	60	10	0.002	0.002	1149	3.3	352.9	3.66	133.2	133.57	2.65	0.283	0.0017	NONE	1.131	0.374	0.002	8.63	12.08	0.02	0.03	RM	0.15
	1950	7096.7	60	10	0.001	0.002	1149	3.2	361.2	3.72	134.4	134.77	2.68	0.235	0.0014	NONE	1.136	0.267	0.002	8.55	11.90	0.02	0.02	RM	0.15
	2150	7096.9	60	10	0.001	0.001	1149	3.1	370.1	3.78	135.6	135.98	2.72	0.241	0.0014	500	1.614	0.274	0.002	8.47	11.72	0.02	0.02	RM	0.15
HC5-1	2250	7097	60	10	0.002	0.001	1149	3	380.1	3.86	137.2	137.59	2.77	0.342	0.0020	500	1.624	0.420	0.002	8.37	11.58	0.03	0.03	RM	0.15
	2300	7097.1	60	10	0.002	0.001	1149	3	380.1	3.86	137.2	137.59	2.77	0.259	0.0015	500	1.624	0.420	0.002	8.37	11.58	0.03	0.03	RM	0.15
	2400	7097.2	60	10	0.001	0.001	1149	3	380.1	3.86	137.2	137.59	2.77	0.172	0.0010	500	1.624	0.280	0.002	8.37	11.58	0.02	0.02	RM	0.15
	2500	7097.3	60	10	0.001	0.001	1149	3	380.1	3.86	137.2	137.59	2.77	0.259	0.0015	500	1.624	0.420	0.002	8.37	11.58	0.03	0.03	RM	0.15

TABLE 5-8. CHANNEL CONVEYANCE CHARACTERISTICS BASED ON HEC-2 MODEL SIMULATION (CONTINUED).

Channel Cross Section Name	Channel Station (ft)	Channel Base Elev. (ft+msl)	Channel Base Width (ft)	Channel Side Slope	Bottom Slope (ft/ft)	HEC-2 Energy Gradient (ft/ft)	Discharge (cfs)	HEC-2 Velocity (fps)	Area (ft^2)	Flow Depth (ft)	Top Width (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Calculated Average Shear (lb/ft^2)	Equivalent Slope For Average Shear (ft/ft)	Channel Bend Radius (ft)	Channel Bend Stress Ratio	Maximum Shear (lb/ft^2)	Calculated Slope For Rock Sizing (ft/ft)	Average Unit Discharge (cfs/ft)	Maximum Unit Discharge (cfs/ft)	Average Unit Discharge Stephenson Rock D50 (ft)	Maximum Unit Discharge Stephenson Rock D50 (ft)	Rock Type+	Target Riprap D50 (ft)
CHANNEL N																									
	2600	7097.5	60	10	0.002	0.001	1149	3	380.1	3.86	137.2	137.59	2.77	0.259	0.0015	NONE	1.000	0.259	0.002	8.37	11.58	0.02	0.02	RM	0.15
	2700	7097.6	60	10	0.001	0.001	1149	3	380.1	3.86	137.2	137.59	2.77	0.172	0.0010	NONE	1.000	0.173	0.001	8.37	11.58	0.01	0.02	RM	0.15
	2800	7097.7	60	10	0.001	0.001	1149	3	380.1	3.86	137.2	137.59	2.77	0.259	0.0015	NONE	1.000	0.259	0.001	8.37	11.58	0.02	0.02	RM	0.15
	2900	7097.9	60	10	0.001	0.001	1149	3	380.1	3.86	137.2	137.59	2.77	0.259	0.0015	NONE	1.000	0.259	0.001	8.37	11.58	0.02	0.02	RM	0.15
	3000	7098	60	10	0.001	0.001	1149	3	380.1	3.86	137.2	137.59	2.77	0.172	0.0010	NONE	1.148	0.198	0.001	8.37	11.58	0.01	0.02	SML	0.40
CHANNEL O																									
HC5-9	55	7097	20	4	0.018	0.013	583	7.3	79.5	2.61	40.88	41.52	1.91	2.146	0.0180	NONE	1.000	2.137	0.018	14.26	19.05	0.17	0.21	SML	0.40
	150	7098.7	20	4	0.015	0.012	583	7.3	79.9	2.62	40.96	41.61	1.92	1.839	0.0154	NONE	1.000	1.850	0.015	14.23	19.13	0.15	0.19	SML	0.40
	250	7100	20	4	0.010	0.014	583	7.6	76.5	2.54	40.32	40.95	1.87	1.345	0.0115	NONE	1.000	1.345	0.012	14.46	19.30	0.12	0.15	SML	0.40
	310	7100.4	20	4	0.006	0.006	583	5.7	102.1	3.14	45.12	45.89	2.23	1.165	0.0084	250	1.317	1.159	0.008	12.92	17.90	0.09	0.11	SML	0.40
	410	7101	20	4	0.003	0.006	583	5.7	102.1	3.14	45.12	45.89	2.23	0.567	0.0041	250	1.317	0.747	0.005	12.92	17.90	0.06	0.08	SML	0.40
	411	7101	21	5.3	0.000	0.004	575	4.4	131.2	3.41	57.15	57.78	2.31	4.998	0.0347	250	1.482	0.853	0.006	10.06	15.00	0.06	0.07	SML	0.40
	414	7101	22	5.3	0.000	0.003	550	4	138.5	3.44	58.46	59.11	2.34	0.788	0.0054	250	1.499	0.657	0.004	9.41	13.76	0.04	0.06	SML	0.40
	417	7101	24	5.2	0.000	0.002	526	3.6	146.3	3.51	60.5	61.17	2.42	0.671	0.0044	250	1.525	0.461	0.003	8.69	12.64	0.03	0.04	SML	0.40
	420	7101	25	3.9	0.004	0.002	501	3.7	134.9	3.49	52.22	53.10	2.54	0.069	0.0004	250	1.417	0.841	0.005	9.59	12.91	0.05	0.06	SML	0.40
	460	7101.3	25	3.9	0.004	0.003	501	3.9	127.1	3.34	51.05	51.89	2.45	0.120	0.0008	250	1.401	0.802	0.005	9.81	13.03	0.05	0.06	SML	0.40
	465	7101.3	25	3.9	0.000	0.003	501	3.9	127.1	3.34	51.05	51.89	2.45	-0.318	-0.0021	250	1.401	0.000	0.000	9.81	13.03	0.00	0.00	SML	0.40
	470	7101.3	25	3.9	0.000	0.003	501	4	125.4	3.31	50.82	51.65	2.43	-0.316	-0.0021	250	1.398	0.000	0.000	9.86	13.24	0.00	0.00	SML	0.40
	475	7101.3	25	3.9	0.010	0.003	501	4	125.4	3.31	50.82	51.65	2.43	1.201	0.0079	250	1.398	2.119	0.014	9.86	13.24	0.11	0.14	SML	0.40
	480	7101.4	25	3.9	0.010	0.003	501	4.1	123.8	3.28	50.58	51.41	2.41	1.191	0.0079	250	1.394	2.098	0.014	9.90	13.45	0.11	0.14	SML	0.40
	485	7101.4	25	3.9	0.000	0.003	501	4.1	123.8	3.28	50.58	51.41	2.41	-0.600	-0.0040	250	1.394	0.000	0.000	9.90	13.45	0.00	0.00	SML	0.40
	490	7101.4	25	4	0.000	0.003	501	4.1	122.8	3.24	50.92	51.72	2.38	-0.595	-0.0040	250	1.399	0.000	0.000	9.84	13.28	0.00	0.00	SML	0.40
	495	7101.4	25	4	0.010	0.003	501	4.1	122.8	3.24	50.92	51.72	2.38	1.037	0.0070	250	1.399	2.076	0.014	9.84	13.28	0.11	0.14	SML	0.40
	500	7101.5	25	4	0.010	0.003	501	4.1	121.3	3.21	50.68	51.47	2.36	1.028	0.0070	250	1.396	2.055	0.014	9.89	13.16	0.11	0.13	SML	0.40
	505	7101.5	25	4	0.000	0.003	501	4.1	121.3	3.21	50.68	51.47	2.36	0.000	0.0000	250	1.396	0.000	0.000	9.89	13.16	0.00	0.00	SML	0.40
HC5-6	510	7101.5	25	4	0.003	0.003	501	4.1	121.3	3.21	50.68	51.47	2.36	0.104	0.0007	250	1.396	0.514	0.003	9.89	13.16	0.04	0.05	SML	0.40
	610	7102	25	4	0.003	0.004	501	4.6	109.6	2.97	48.76	49.49	2.21	0.106	0.0008	250	1.369	0.473	0.003	10.27	13.66	0.04	0.05	SML	0.40
	620	7102	25	4	0.003	0.004	501	4.6	109.6	2.97	48.76	49.49	2.21	0.272	0.0020	500	1.000	0.345	0.003	10.27	13.66	0.03	0.04	SML	0.40
	720	7102.5	25	4	0.005	0.004	501	4.7	105.9	2.90	48.2	48.91	2.17	0.616	0.0045	NONE	1.000	0.677	0.005	10.39	13.63	0.05	0.06	SML	0.40
	820	7103	25	4	0.003	0.005	501	4.8	104.3	2.86	47.88	48.58	2.15	0.300	0.0022	NONE	1.000	0.335	0.003	10.46	13.73	0.03	0.04	SML	0.40
	830	7103	25	4	0.003	0.005	501	4.8	104.3	2.86	47.88	48.58	2.15	0.312	0.0023	NONE	1.000	0.335	0.003	10.46	13.73	0.03	0.04	SML	0.40
	930	7103.5	25	4	0.005	0.005	501	4.9	102.8	2.83	47.64	48.34	2.13	0.651	0.0049	NONE	1.000	0.663	0.005	10.52	13.87	0.05	0.06	SML	0.40
	1030	7104	25	4	0.005	0.005	501	4.9	102.8	2.83	47.64	48.34	2.13	0.664	0.0050	NONE	1.000	0.663	0.005	10.52	13.87	0.05	0.06	SML	0.40
	1130	7104.5	25	4	0.005	0.005	501	4.9	102.8	2.83	47.64	48.34	2.13	0.650	0.0049	NONE	1.000	0.663	0.005	10.52	13.87	0.05	0.06	SML	0.40
	1230	7105	25	4	0.005	0.005	501	4.9	102	2.81	47.48	48.17	2.11	0.634	0.0048	NONE	1.000	0.660	0.005	10.55	13.77	0.05	0.06	SML	0.40
CHANNEL P																									
	10	7101.3	20	4	0.035	0.005	446	4.9	90.4	2.87	42.96	43.67	2.07	2.120	0.0164	NONE	1.000	4.519	0.035	10.38	14.06	0.24	0.30	SML	0.40
	30	7102	20	4	0.030	0.001	173	2.2	79.5	2.61	40.88	41.52	1.91	0.973	0.0082	NONE	1.000	3.582	0.030	4.23	5.74	0.12	0.14	SML	0.40
HC5-8	50	7102.5	20	4	0.025	0.003	173	3	58.7	2.07	36.56	37.07	1.58	0.245	0.0025	NONE	1.000	2.464	0.025	4.73	6.21	0.11	0.13	SML	0.40
	70	7103	20	4	0.025	0.007	173	4.2	41.2	1.57	32.56	32.95	1.25	1.161	0.0149	NONE	1.000	1.954	0.025	5.31	6.59	0.12	0.14	SML	0.40
	110	7104	20	4	0.021	0.022	173	6.1	28.4	1.15	29.2	29.48	0.96	1.215	0.0203	NONE	1.000	1.317	0.022	5.92	7.02	0.11	0.13	SML	0.40
	200	7105.5	20	4	0.015	0.010	173	4.7	36.7	1.43	31.44	31.79	1.16	1.077	0.0149	NONE	1.000	1.053	0.015	5.50	6.72	0.08	0.09	SML	0.40
	240	7106	20	4	0.010	0.013	173	5.1	33.8	1.33	30.64	30.97	1.09	0.760	0.0112	NONE	1.000	0.882	0.013	5.65	6.78	0.07	0.08	SML	0.40
	300	7106.5	20	4	0.008	0.007	173	4.3	40.7	1.55	32.4	32.78	1.24	0.686	0.0089	NONE	1.000	0.598	0.008	5.34	6.67	0.05	0.05	SML	0.40
HC5-7	370	7107	20	4	0.007	0.007	173	4.2	41.4	1.58	32.64	33.03	1.26	0.549	0.0070	500	1.000	0.550	0.007	5.30	6.64	0.04	0.05	SML	0.40
	450	7107.5	20	4	0.006	0.006	173	4	43.2	1.63	33.04	33.44	1.29	0.504	0.0063	250	1.127	0.545	0.007	5.24	6.52	0.04	0.05	SML	0.40
	540	7108	20	4	0.007	0.006	173	3.8	45	1.68	33.44	33.85	1.33	0.544	0.0066	250	1.134	0.651	0.008	5.17	6.38	0.05	0.05	RM	0.15
	600	7108.5	20	4	0.008	0.008	173	4.3	40.3	1.54	32.32	32.70	1.23	0.554	0.0072	250	1.115	0.686	0.009	5.35	6.62	0.05	0.06	RM	0.15
	670	7109	20	4	0.006	0.007	173	4.2	41.2	1.57	32.56	32.95	1.25	0.544	0.0070	250	1.119	0.612	0.008	5.31	6.59	0.05	0.05	RM	0.15
	760	7109.5	20	4	0.006	0.006	173	3.8	45.3	1.69	33.52	33.94	1.33	0.516	0.0062	400	1.000	0.499	0.006	5.16	6.42	0.04	0.04	RM	0.15
	840	7110	20	4	0.006	0.006	173	4	43.7	1.64	33.12	33.52	1.30	0.477	0.0059	NONE	1.000	0.507	0.006	5.22	6.56	0.04	0.04	RM	0.15
CHANNEL Q																									
	100	7060.9	30	4	0.013	0.011	843	7.3	111.7	2.79	52.32	53.01	2.17	1.682	0.0124	NONE	1.000	1.802	0.013	16.11	20.37	0.15	0.17		
	130	7061.3	30	4	0.013	0.012	843	7.6	111	2.72	51.76	52.43	2.12	1.659	0.0125	NONE	1.000	1.691	0.013	16.29	20.67	0.14	0.17		
	220	7062.4	30	4	0.011	0.012	843	7.7	109.4	2.69	51.52	52.18	2.10	1.357	0.0103	NONE	1.000	1.573	0.012	16.36	20.71	0.14	0.16	INT	0.60
HC5-14	230	7062.5	30	4	0.018	0.024	843	9.7	110	2.23	47.84	48.39	1.79	2.481	0.0222	NONE	1.000	2.686	0.024	17.62	21.63	0.25	0.29	INT	0.60
	250	7063	30	4	0.023	0.021	843	9.3	91.2	2.32	48.56	49.13	1.85	2.489	0.0215	NONE	1.000	2.604	0.023	17.36	21.58	0.24	0.27	INT	0.60
	260	7063.2	30	4	0.025	0.02	833	9.1	92	2.34	48.72	49.30	1.87	2.520	0.0216	NONE	1.000	2.915	0.025	17.10	21.29	0.26	0.30	INT	0.60
	270	7063.5	30	4	0.025	0.015	823	8.2	100.2	2.5	50	50.62	1.98	2.807	0.0228	NONE	1.000	3.062	0.025	16.46	20.50	0.25	0.29	INT	0.60
	280	7063.7	30	4	0.025	0.022	813	9.3	87.8	2.25	48	48.55	1.81	2.614	0.0232	NONE	1.000	2.819	0.025	16.94	20.93	0.25	0.29	INT	0.60

TABLE 5-6. CHANNEL CONVEYANCE CHARACTERISTICS BASED ON HEC-2 MODEL SIMULATION (CONTINUED).

Channel Cross Section Name	Channel Station (ft)	Channel Base Elev. (ft+msl)	Channel Base Width (ft)	Channel Side Slope	Bottom Slope (ft/ft)	HEC-2 Energy Gradient (ft/ft)	Discharge (cfs)	HEC-2 Velocity (fps)	Area (ft^2)	Flow Depth (ft)	Top Width (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Calculated Average Shear (lb/ft^2)	Equivalent Slope For Average Shear (ft/ft)	Channel Bend Radius (ft)	Channel Bend Stress Ratio	Maximum Shear (lb/ft^2)	Calculated Slope For Rock Sizing (ft/ft)	Average Unit Discharge (cfs/ft)	Maximum Unit Discharge (cfs/ft)	Average Unit Discharge Stephenson Rock D50 (ft)	Maximum Unit Discharge Stephenson Rock D50 (ft)	Rock Type+	Target Riprap D50 (ft)
												CHANNEL Q													
	290	7064	30	4	0.025	0.021	803	9.1	88	2.26	48.08	48.64	1.81	2.415	0.0213	NONE	1.000	2.830	0.025	16.70	20.57	0.25	0.29	INT	0.60
	300	7064.2	30	4	0.025	0.02	792	8.9	88.5	2.27	48.16	48.72	1.82	2.536	0.0223	NONE	1.000	2.841	0.025	16.45	20.20	0.25	0.29	INT	0.60
	310	7064.5	30	4	0.025	0.015	782	8.1	96.7	2.43	49.44	50.04	1.93	2.795	0.0232	NONE	1.000	3.009	0.025	15.82	19.68	0.24	0.28	INT	0.60
	320	7064.7	30	4	0.025	0.021	772	9.1	84.9	2.19	47.52	48.06	1.77	2.858	0.0259	NONE	1.000	2.755	0.025	16.25	19.93	0.25	0.28	INT	0.60
	330	7065	30	4	0.025	0.029	761	10.1	75.5	1.99	45.92	46.41	1.63	3.681	0.0362	NONE	1.000	2.945	0.029	16.57	20.10	0.28	0.32	INT	0.60
	340	7065.2	30	4	0.033	0.046	751	11.7	64.2	1.74	43.92	44.35	1.45	3.534	0.0391	NONE	1.000	4.162	0.046	17.10	20.36	0.42	0.48	INT	0.60
	360	7066.1	30	4	0.045	0.045	751	11.6	64.5	1.74	43.92	44.35	1.45	4.033	0.0446	NONE	1.000	4.072	0.045	17.10	20.18	0.42	0.46	INT	0.60
	380	7067	30	4	0.047	0.045	751	11.6	64.8	1.75	44	44.43	1.46	4.249	0.0467	NONE	1.000	4.319	0.047	17.07	20.30	0.43	0.49	INT	0.60
	400	7068	30	4	0.047	0.043	751	11.4	65.7	1.77	44.16	44.60	1.47	4.181	0.0455	NONE	1.000	4.362	0.047	17.01	20.18	0.43	0.49	INT	0.60
	420	7068.9	30	4	0.045	0.039	751	11.1	67.9	1.82	44.56	45.01	1.51	3.647	0.0388	NONE	1.000	4.233	0.045	16.85	20.20	0.41	0.46	INT	0.60
	440	7069.8	30	4	0.035	0.025	751	9.5	78.8	2.06	46.48	46.99	1.68	3.469	0.0332	NONE	1.000	3.661	0.035	16.16	19.57	0.32	0.37	INT	0.60
HC5-12	500	7071.3	30	4	0.025	0.025	751	9.5	79.2	2.07	46.56	47.07	1.68	2.639	0.0251	NONE	1.000	2.626	0.025	16.13	19.67	0.25	0.28	INT	0.60
	540	7072.3	30	4	0.026	0.025	751	9.6	78.4	2.05	46.4	46.90	1.67	2.654	0.0255	NONE	1.000	2.657	0.026	16.19	19.68	0.25	0.29	INT	0.60
	590	7073.6	30	4	0.026	0.024	751	9.4	80	2.09	46.72	47.23	1.70	2.704	0.0255	NONE	1.000	2.701	0.026	16.07	19.65	0.25	0.29	INT	0.60
	690	7076.1	30	4	0.025	0.026	751	9.7	77.6	2.04	46.32	46.82	1.66	2.582	0.0249	NONE	1.000	2.697	0.026	16.21	19.79	0.26	0.29	INT	0.60
	790	7078.6	30	4	0.025	0.023	751	9.3	81.1	2.11	46.88	47.40	1.71	2.665	0.0250	NONE	1.000	2.669	0.025	16.02	19.62	0.25	0.28	INT	0.60
	870	7080.6	30	4	0.025	0.027	751	9.8	76.5	2.01	46.08	46.57	1.64	2.539	0.0248	NONE	1.000	2.766	0.027	16.30	19.70	0.26	0.30	INT	0.60
	970	7083.1	30	4	0.027	0.021	751	8.9	84.1	2.17	47.36	47.89	1.75	2.959	0.0271	NONE	1.000	3.007	0.027	15.86	19.31	0.26	0.30	INT	0.60
	980	7083.4	30	4	0.027	0.016	747	8.2	91.3	2.32	48.56	49.13	1.85	3.659	0.0316	NONE	1.000	3.183	0.027	15.38	19.02	0.26	0.30	INT	0.60
	1080	7085.9	30	4	0.059	0.093	706	14.5	48.7	1.37	40.96	41.30	1.18	5.206	0.0709	NONE	1.000	5.206	0.071	17.24	19.87	0.62	0.68	LRG	1.20
	1095	7087.3	30	4	0.094	0.093	706	14.5	48.8	1.37	40.96	41.30	1.18	6.852	0.0933	NONE	1.000	6.916	0.094	17.24	19.87	0.80	0.87	LRG	1.20
	1115	7089.2	30	4	0.093	0.092	706	14.4	48.9	1.38	41.04	41.38	1.18	6.686	0.0905	NONE	1.000	6.837	0.093	17.20	19.87	0.78	0.86	LRG	1.20
	1135	7091	30	4	0.092	0.089	706	14.3	49.5	1.39	41.12	41.46	1.19	6.546	0.0880	NONE	1.000	6.881	0.092	17.17	19.88	0.78	0.86	LRG	1.20
	1155	7092.9	30	4	0.095	0.079	706	13.8	51.3	1.44	41.52	41.87	1.23	6.043	0.0787	NONE	1.000	7.290	0.095	17.00	19.87	0.79	0.88	LRG	1.20
	1175	7094.8	30	4	0.047	0.053	706	12	58.9	1.61	42.88	43.28	1.36	0.904	0.0107	NONE	1.000	4.018	0.047	16.46	19.32	0.42	0.47	LRG	1.20
	1180	7094.8	30	4	0.003	0.009	706	6.4	109.7	2.69	51.52	52.18	2.10	7.518	0.0573	NONE	1.000	1.180	0.009	13.70	17.22	0.10	0.11	LRG	1.20
	1195	7094.9	10	4	0.003	0.046	706	13	54.6	2.64	31.12	31.77	1.71	8.739	0.0820	NONE	1.000	4.904	0.046	22.69	34.32	0.51	0.67	LRG	1.20
	1215	7094.9	0	4	0.000	0.033	706	11.8	60.3	3.86	30.88	31.83	1.87	4.946	0.0423	NONE	1.000	3.856	0.033	22.86	45.55	0.39	0.62	LRG	1.20
	1220	7094.9	0	3.7	0.005	0.03	706	11.6	61.5	4.05	29.97	31.05	1.95	6.980	0.0572	NONE	1.000	3.659	0.030	23.56	46.98	0.37	0.58	LRG	1.20
	1230	7095	0	3	0.005	0.015	706	9.4	64.6	5.02	30.12	31.75	2.38	5.388	0.0363	NONE	1.000	2.229	0.015	23.44	47.19	0.21	0.33	LRG	1.20
	1240	7095	0	2.8	0.000	0.02	706	10.4	77	4.91	27.5	29.20	2.31	1.338	0.0093	NONE	1.000	1.338	0.009	25.68	51.06	0.15	0.24	LRG	1.20
	1270	7095	0	2.5	0.000	0.018	706	10.3	71.4	5.24	26.2	28.22	2.43	1.488	0.0098	NONE	1.000	1.488	0.010	26.95	53.97	0.16	0.26	LRG	1.20
	1275	7095	0	2.4	0.000	0.022	706	11.2	75.4	5.13	24.62	26.68	2.37	2.872	0.0194	NONE	1.000	3.250	0.022	28.67	57.46	0.33	0.52	LRG	1.20
	1285	7095	0	2.2	0.000	0.02	706	11.1	69.3	5.39	23.72	26.05	2.45	5.576	0.0364	NONE	1.000	3.062	0.020	29.77	59.83	0.31	0.49	LRG	1.20
HC5-11	1295	7095	0	2	0.000	0.012	706	9.3	99.7	6.16	24.64	27.55	2.75	4.834	0.0281	NONE	1.000	2.063	0.012	28.65	57.29	0.20	0.32	LRG	1.20
	1320	7095	0	2	0.000	0.007	706	7.4	95.3	6.91	27.64	30.90	3.09	5.719	0.0297	NONE	1.000	1.350	0.007	25.54	51.13	0.12	0.19	LRG	1.20
	1325	7095	6	2.4	0.000	0.001	706	3.8	90.5	7.68	42.86	45.94	4.08	-140.244	-0.5502	NONE	1.000	0.000	0.000	16.47	29.18	0.00	0.00	SML	0.40
	1330	7095	12	2.8	0.000	0.001	706			PONDING						NONE	1.000							SML	0.40
	1335	7095	18	3.2	0.000	0.001	706			PONDING						NONE	1.000							SML	0.40
	1340	7095	24	3.6	0.000	0.001	706			PONDING						NONE	1.000							SML	0.40
	1345	7095	30	4	0.050	0.001	706			PONDING						NONE	1.000							SML	0.40
	1348	7095.3	30	4	0.112	0.001	700			PONDING						NONE	1.000							SML	0.40
	1352	7095.8	30	4	0.125	0.001	650			PONDING						NONE	1.000							SML	0.40
	1356	7096.3	30	4	0.113	0.001	600			PONDING						NONE	1.000							SML	0.40
	1360	7096.7	30	4	0.113	0.001	550			PONDING						NONE	1.000							SML	0.40
	1364	7097.2	30	4	0.112	0.001	500			PONDING						NONE	1.000							SML	0.40
	1368	7097.6	30	4	0.112	0.001	450			PONDING						NONE	1.000							SML	0.40
	1372	7098.1	30	4	0.112	0.001	400			PONDING						NONE	1.000							SML	0.40
	1376	7098.5	30	4	0.112	0.08	480	12.1	70.8	1.15	39.2	39.48	1.01	49.804	0.7920	NONE	1.000	7.075	0.112	12.24	13.92	0.75	0.81	LRG	1.20
	1380	7099	30	4	0.125	0.078	460	11.8	26.5	1.13	39.04	39.32	0.99	3.230	0.0522	NONE	1.000	7.738	0.125	11.78	13.33	0.81	0.88	LRG	1.20
	1384	7099.5	30	4	0.112	0.074	440	11.4	25.7	1.12	38.96	39.24	0.98	2.493	0.0406	NONE	1.000	6.909	0.112	11.29	12.77	0.71	0.77	LRG	1.20
	1388	7099.9	30	4	0.112	0.07	420	11	24.8	1.11	38.88	39.15	0.98	2.271	0.0373	NONE	1.000	6.854	0.112	10.80	12.21	0.69	0.75	LRG	1.20
	1392	7100.4	30	4	0.125	0.063	400	10.5	23.6	1.11	38.88	39.15	0.98	2.820	0.0463	NONE	1.000	7.616	0.125	10.29	11.66	0.74	0.80	LRG	1.20
	1396	7100.9	30	4	0.112	0.101	300	11.1	22	0.82	36.56	36.76	0.74	3.132	0.0676	NONE	1.000	5.211	0.112	8.21	9.10	0.57	0.61	LRG	1.20
	1400	7101.3	30	4	0.112	0.103	290	11	19.9	0.8	36.4	36.60	0.73	3.161	0.0698	NONE	1.000	5.095	0.112	7.97	8.80	0.56	0.60	LRG	1.20
	1404	7101.8	30	4	0.113	0.106	280	10.9	17.6	0.77	36.16	36.35	0.70	3.104	0.0710	NONE	1.000	4.919	0.113	7.74	8.39	0.55	0.58	LRG	1.20
	1408	7102.2	30	4	0.113	0.112	270	11	30.3	0.75	36	36.18	0.68	6.021	0.1411	NONE	1.000	4.802	0.113	7.50	8.25	0.54	0.57	LRG	1.20
	1412	7102.7	30	4	0.112	0.122	260	11.2	28.9	0.71	35.68	35.85	0.65	6.138	0.1513	NONE	1.000	4.951	0.122	7.29	7.95	0.57	0.61	LRG	1.20
	1416	7103.1	30	4	0.112	0.146	250	11.6	21.3	0.66	35.28	35.44	0.61	5.999	0.1582	NONE	1.000	5.537	0.146	7.09	7.66	0.67	0.71	LRG	1.20
	1420	7103.6	30	4	0.162	0.2	243	12.7	28.3	0.59	34.72	34.87	0.55	8.961	0.2623	NONE	1.000	6.834	0.200	7.00	7.49	0.93	0.97	LRG	1.20
	1427	7105	30	4	0.207	0.19	243	12.5	28.3	0.6	34.8	34.95	0.56	9.633	0.2775	NONE	1.000	7.190	0.207	6.98	7.50	0.97	1.01	LRG	1.20
	1434	7106.5	30	4	0.187	0.159	243	11.9	29.2	0.63	35.04	35.20	0.58	8.899	0.2450	NONE	1.000	6.798	0.187	6.93	7.50	0.86	0.90	LRG	1.20
	1444	7108.1	30	4	0.165	0.144	243	11.5	32.4	0.65	35.2	35.36	0.60	7.453	0.1993	NONE	1.000	6.170	0.165	6.90	7.48	0.75	0.79	LRG	1.20
	1454	7109.8	30	4	0.085	0.047	243	8	33	0.9	37.2	37.42	0.81	2.433	0.0482	NONE	1.000	4.286	0.085	6.53	7.20	0.38	0.40	LRG	1.20
	1455	7109.8	29	4	0.003	0.053	243	8.4	33.3	0.88	36.04	36.26	0.79	3.333	0.0677	NONE	1.000	2.610	0.053	6.74	7.39	0.26	0.27	LRG	1.20
	1475	7109.9	10	4	0.008	0.072	243	11.4	29.7	1.38	21.04	21.38	1.00	4.985	0.0797	NONE	1.000	4.501	0.072	11.55	15.73	0.48	0.59	LRG	1.20
	1485	7110	0	4	0.005	0.03	243	8.7	29.7	2.64	21.12	21.77	1.28	5.183	0.0649	NONE	1.000	2.397	0.030	11.51	22.97	0.23	0.36	LRG	1.20
	1490	7110	0	3.6	0.000	0.027	243	8.6	29.3	2.8	20.16	20.92	1.35	2.993	0.0356	NONE	1.000	2.273	0.027	12.05	24.08	0.22	0.34	LRG	1.20

TABLE 5-6. CHANNEL CONVEYANCE CHARACTERISTICS BASED ON HEC-2 MODEL SIMULATION (CONTINUED).

Channel Cross *Section* Name	Channel *Station* (ft)	Channel Base *Elev.* (ft+msl)	Channel Base *Width* (ft)	Channel *Side* Slope	Bottom *Slope* (ft/ft)	HEC-2 Energy *Gradient* (ft/ft)	*Discharge* (cfs)	HEC-2 *Velocity* (fps)	*Area* (ft^2)	Flow *Depth* (ft)	Top *Width* (ft)	Wetted *Perimeter* (ft)	Hydraulic *Radius* (ft)	Calc-ulated Average *Shear* (lb/ft^2)	Equivalent Slope For Average Shear (ft/ft)	Channel Bend Radius (ft)	Channel Bend Stress Ratio	Maximum Sheer (lb/ft^2)	Calc-ulated Slope For Rock Sizing (ft/ft)	Average Unit Discharge (cfs/ft)	Maximum Unit Discharge (cfs/ft)	Average Unit Discharge Stephenson Rock D50 (ft)	Maximum Unit Discharge Stephenson Rock D50 (ft)	Rock Type+	Target Riprap D50 (ft)
												CHANNEL Q													
	1499	7110	0	3	0.000	0.017	243	7.5	29.4	3.28	19.68	20.74	1.56	3.517	0.0362	NONE	1.000	1.650	0.017	12.35	24.60	0.15	0.24	LRG	1.20
	1500	7110	0	3	0.000	0.016	243	7.4	30.4	3.32	19.92	21.00	1.57	1.212	0.0123	NONE	1.000	1.212	0.012	12.20	24.57	0.12	0.19	LRG	1.20
HC5-10	1510	7110	0	2.7	0.003	0.019	243	7.9	28.8	3.37	18.2	19.41	1.58	1.554	0.0158	NONE	1.000	1.554	0.016	13.35	26.62	0.15	0.24	LRG	1.20
	1530	7110.1	0	2.2	0.003	0.022	243	8.7	30.6	3.56	15.66	17.21	1.62	2.909	0.0288	NONE	1.000	2.225	0.022	15.51	30.97	0.22	0.34	LRG	1.20
	1543	7110.1	1	2.2	0.000	0.004	243	4.7	47.1	4.59	21.2	23.18	2.20	5.970	0.0435	NONE	1.000	0.548	0.004	11.46	21.57	0.05	0.07	LRG	1.20
	1548	7110.1	3	2.4	0.000	0.002	243	3.4	60	4.81	26.09	28.01	2.50	2.610	0.0167	NONE	1.000	0.312	0.002	9.31	16.35	0.02	0.03	SML	0.40
	1553	7110.1	5	2.7	0.000	0.001	243	2.7	70.9	4.88	31.35	33.10	2.68	-62.836	-0.3758	NONE	1.000	0.000	0.000	7.75	13.18	0.00	0.00	SML	0.40
	1558	7110.1	7	2.9	0.000	0.001	243	----------PONDING----------																SML	0.40
	1563	7110.1	9	3.2	0.000	0.001	243	----------PONDING----------																SML	0.40
	1568	7110.1	11	3.5	0.000	0.001	243	----------PONDING----------																SML	0.40
	1573	7110.1	13	3.7	0.000	0.001	243	----------PONDING----------																	
	1578	7110.1	15	4	0.004	0.001	243	----------PONDING----------																	
	1590	7110.2	30	4	0.008	0.001	243	----------PONDING----------																	

+ Rock Type
LRG = Large Riprap
INT = Intermeditate Riprap
SML = Small Riprap
RM = Rock Mulch

TABLE 5-7. HYDRAULIC JUMP ANALYSIS.

CHANNEL H — PMF DISCHARGE - 620 CFS

STATION (ft)	CHANNEL BASE WIDTH (ft)	CHANNEL SIDE SLOPES	CHANNEL BOTTOM SLOPE (ft/ft)	MANNINGS n	FLOW DEPTH (ft)	FROUDE NUMBER	TURB-ULENT UNIT FLOW (1.5 * avg. q) (cfs/ft)	TURB-ULENT DESIGN ROCK D50 (ft)	DESIGN ROCK D50 (TABLE 5-5) (ft)	TARGET ROCK D50 (TABLE 5-5) (ft)	RATIO TARGET/ DESIGN D50
				DISCHARGE = 620 CFS							
50	40	4	0.002	0.035	2.99	0.45	17.9	0.04			
100	40	4	0.004	0.035	2.47	*0.62*	18.6	0.06		1.2	18.9
157	40	4	0.065	0.035	1.14	*2.10*	20.9	0.65		1.2	1.9
165	40	4	0.127	0.035	0.95	2.81			0.79	1.2	1.5
175	40	4	0.134	0.035	0.92	2.95			0.81	1.2	1.5
183	40	4	0.134	0.035	0.92	2.95			0.81	1.2	1.5
193	40	4	0.13	0.035	0.94	2.88			0.78	1.2	1.5
203	40	4	0.13	0.035	0.94	2.88			0.78	1.2	1.5
				DISCHARGE = 310 CFS							
50	40	4	0.002	0.035	2.06	0.42	9.6	0.02			
100	40	4	0.004	0.035	1.70	*0.56*	9.9	0.04		1.2	28.7
157	40	4	0.065	0.035	0.78	*1.92*	10.8	0.42		1.2	2.9
165	40	4	0.127	0.035	0.64	2.58			0.79	1.2	1.5
175	40	4	0.134	0.035	0.62	2.71			0.81	1.2	1.5
183	40	4	0.134	0.035	0.62	2.71			0.81	1.2	1.5
193	40	4	0.13	0.035	0.62	2.71			0.78	1.2	1.5
203	40	4	0.13	0.035	0.62	2.71			0.78	1.2	1.5
				DISCHARGE = 62 CFS							
50	40	4	0.002	0.035	0.84	0.34	2.1	0.01		1.2	
100	40	4	0.004	0.035	0.69	*0.47*	2.2	0.02		1.2	79.0
157	40	4	0.065	0.035	0.31	*1.56*	2.3	0.15	0.79	1.2	8.2
165	40	4	0.127	0.035	0.26	2.09			0.81	1.2	1.5
175	40	4	0.134	0.035	0.26	2.09			0.81	1.2	1.5
183	40	4	0.134	0.035	0.26	2.09			0.78	1.2	1.5
193	40	4	0.13	0.035	0.26	2.03			0.78	1.2	1.5
203	40	4	0.13	0.035	0.26	2.03			0.88	1.2	1.4

CHANNEL H — PMF DISCHARGE - 620 CFS

STATION (ft)	CHANNEL BASE WIDTH (ft)	CHANNEL SIDE SLOPES	ENERGY GRAD. (ft/ft)	MANNINGS n	FLOW DEPTH (ft)	FROUDE NUMBER	TURB-ULENT UNIT FLOW (1.5 * avg. q) (cfs/ft)	TURB-ULENT DESIGN ROCK D50 (ft)	DESIGN ROCK D50 (TABLE 5-5) (ft)	TARGET ROCK D50 (TABLE 5-5) (ft)	RATIO TARGET/ DESIGN D50
				DISCHARGE = 620 CFS							
1100	40	4	0.007	0.035	2.11	0.80			0.06	1.2	20.0
1200	40	4	0.004	0.035	2.46	0.62			0.04	1.2	30.0
1240	40	4	0.004	0.035	2.46	0.62			0.05	1.2	24.0
1280	38	4	0.018	0.035	1.67	1.21			0.03	1.2	40.0
1303	35	4	0.016	0.035	1.80	1.17			0.14	1.2	8.6
1351	29	4	0.03	0.035	2.88	0.63			0.3	1.2	4.0
1402	5	4	0.041	0.035	4.82	0.57			0.51	1.2	2.4
1470	0	4	0.006	0.035	5.42	0.56			0.09	1.2	13.3

TABLE 5-7. HYDRAULIC JUMP ANALYSIS (CONTINUED).

CHANNEL Q — PMF DISCHARGE - 843 CFS

STATION (ft)	CHANNEL BASE WIDTH (ft)	CHANNEL SIDE SLOPES	CHANNEL BOTTOM SLOPE (ft/ft)	MANNINGS n	FLOW DEPTH (ft)	FROUDE NUMBER	TURBULENT UNIT FLOW (1.5 * avg. q) (cfs/ft)	TURBULENT DESIGN ROCK D50 (ft)	DESIGN ROCK D50 (TABLE 5-10) (ft)	TARGET ROCK D50 (TABLE 5-10) (ft)	RATIO TARGET/ DESIGN D50
			DISCHARGE = 843 CFS								
100	30	4	0.013	0.015	2.02	1.49			—	—	—
130	30	4	0.013	0.015	2.02	1.49			—	—	—
220	30	4	0.011	0.035	2.76	***0.89***	30.8	0.20		0.60	3.0
230	30	4	0.018	0.035	2.42	***1.11***	31.9	0.30		0.60	2.0
250	30	4	0.023	0.035	2.25	1.25			0.24	0.60	2.5
260	30	4	0.025	0.035	2.20	1.30			0.26	0.60	2.3
270	30	4	0.025	0.035	2.20	1.30			0.25	0.60	2.4
280	30	4	0.025	0.035	2.20	1.30			0.25	0.60	2.4
			DISCHARGE = 422 CFS								
100	30	4	0.013	0.015	1.37	1.41			—	—	—
130	30	4	0.013	0.015	1.39	1.37			—	—	—
220	30	4	0.011	0.035	1.87	***0.85***	16.9	0.13		0.60	4.6
230	30	4	0.018	0.035	1.64	***1.06***	17.3	0.20		0.60	3.0
250	30	4	0.023	0.035	1.52	1.19			0.24	0.60	2.5
260	30	4	0.025	0.035	1.49	1.23			0.26	0.60	2.3
270	30	4	0.025	0.035	1.48	1.24			0.25	0.60	2.4
280	30	4	0.025	0.035	1.48	1.24			0.25	0.60	2.4
			DISCHARGE = 84 CFS								
100	30	4	0.013	0.015	0.43	1.71			—	—	—
130	30	4	0.013	0.015	0.43	1.74			—	—	—
220	30	4	0.011	0.035	0.75	***0.73***	3.8	0.05		0.60	12.2
230	30	4	0.018	0.035	0.65	***0.90***	3.9	0.07		0.60	8.2
250	30	4	0.023	0.035	0.60	***1.02***	3.9	0.09		0.60	6.7
260	30	4	0.025	0.035	0.58	1.08			0.26	0.60	2.3
270	30	4	0.025	0.035	0.59	1.06			0.25	0.60	2.4
280	30	4	0.025	0.035	0.59	1.06			0.25	0.60	2.4

TABLE 5-8. CHANNEL AND OVERLAND SCOUR ANALYSIS.

CHANNEL STATION (ft)	CHANNEL BASE ELEV. (ft+msl)	CHANNEL BASE WIDTH (ft)	CHANNEL SIDE SLOPE	BOTTOM SLOPE (ft/ft)	DISCHARGE (cfs)	MANNINGS n	FLOW AREA (ft^2)	FLOW DEPTH (ft)	TOP WIDTH (ft)	WETTED PERIMETER (ft)	HYDRAULIC RADIUS (ft)	ROCK TYPE+	TARGET RIPRAP D50 (ft)	PEAK FLOW DURATION (min)	BASE FLOW DURATION (min)	CLAY AND SHALE USDOT SCOUR DEPTH (ft)	GRADED SAND USDOT SCOUR DEPTH (ft)	FHA SCOUR DEPTH (ft)
CHANNEL H																		
0	6963.6	40	4	0.0020	620	0.015	97.3	2.02	56.2	56.69	1.72	— NO ROCK* —		40	400	4.4	3.9	13.8
20	6963.65	40	4	0.017	620	0.035	83.9	1.78	54.3	54.69	1.53	LRG	1.20	40	400			
203	6970.1	40	4	0.025	620	0.035	73.9	1.59	52.8	53.14	1.39	LRG	1.20	40	400			
300	6983.5	40	4	0.045	620	0.035	61.0	1.34	50.8	51.09	1.19	LRG	1.20	40	400			
CHANNEL N																		
0	7072.6	30	4	0.0330	229	0.015	19.0	0.59	34.7	34.85	0.55	— NO ROCK* —		40	200	1.7	4.4	9.0
100	7076.2	30	4	0.040	229	0.035	30.7	0.91	37.3	37.53	0.82	INT	0.60	40	200			
140	7078.3	30	4	0.047	180	0.035	25.0	0.76	36.1	36.24	0.69	INT	0.60	40	200			
190	7079	30	4	0.022	180	0.035	31.9	0.94	37.6	37.79	0.84	INT	0.60	40	200			
CHANNEL Q																		
100	7060.9	30	4	0.013	843	0.015	60.1	1.64	43.1	43.54	1.38	— NO ROCK* —		17	100			
130	7061.3	30	4	0.013	843	0.015	60.1	1.64	43.1	43.54	1.38	— NO ROCK* —		17	100	5.1	6.9	14.0
220	7062.4	30	4	0.011	843	0.035	113.4	2.76	52.1	52.78	2.15	INT	0.60	17	100			
230	7062.5	30	4	0.018	843	0.035	95.6	2.41	49.3	49.89	1.92	INT	0.60	17	100			
280	7063.7	30	4	0.022	843	0.035	89.3	2.28	48.3	48.81	1.83	INT	0.60	17	100			
OVERLAND FLOW PATH OM-2																		
OM-2B	—	1	0	0.052	0.257	0.015	0.1	0.07	1.0	1.14	0.06	— NO ROCK* —		10	60	0.1	0.3	0.5
OM-2B	—	1	0	0.063	0.257	0.035	0.1	0.12	1.0	1.23	0.09	RM	0.15	10	60			

TABLE 5-9. END PROTECTION AND TOE PROTECTION STRUCTURE DESIGN

Channel Or Overland Name	Channel Base Width (ft)	Channel Side Slope	End Protection Bottom Slope (ft/ft)	Manning's n	Discharge (cfs)	Flow Area (ft^2)	Flow Depth (ft)	Top Width (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Unit Discharge (cfs/ft)	Stephenson Rock D50 (ft)	Rock Type+	Riprap D50 (ft)	End Protection Length (ft)
H	40	2	0.160	0.035	620	39.301	0.92	43.7	44.10	0.89	14.20	1.17	LRG	1.20	28
N	30	3	0.250	0.035	229	16.923	0.54	33.2	33.39	0.51	6.89	1.20	LRG	1.20	60
Q	30	4	0.130	0.035	843	49.043	1.38	41.0	41.38	1.19	20.54	1.21	LRG	1.20	54
Basin 5-4	--	--	0.180	--	--	--	--	--	--	--	--	--	INT	0.6	25
OM-2B	1	0	0.270	0.035	0.257	0.100	-0.57	1.0	2.14	0.05	0.26	0.15	RM	0.15	

\+ Rock Type

LRG = Large Riprap
INT = Intermeditate Riprap
SML = Small Riprap
RM = Rock Mulch

TABLE 5-10. NON-TAILINGS CHANNEL DESIGN

CROSS-SECTION NAME	Channel Base Width (ft)	Channel Side Slope	Bottom Slope (ft/ft)	Manning's n	1000-Yr Discharge (cfs)	1000-Yr Flow Area (ft^2)	1000-Yr Flow Depth (ft)	1000-Yr Top Width (ft)	1000-Yr Wetted Perimeter (ft)	1000-Yr Hydraulic Radius (ft)	1000-Yr Unit Discharge (cfs/ft)	1000-Yr Stephenson Rock D50 (ft)	Rock Type+	Target Riprap D50 (ft)
HCN-1	0	2	0.002	0.035	304	79.879	6.32	25.3	28.26	2.83	12.03	0.03	LRG	1.20
HCN-2	25	3	0.017	0.015	349	28.669	1.02	31.1	31.46	0.91	11.21	---------NO ROCK---------		
HCN-3	25	4	0.055	0.035	349	34.844	1.17	34.4	34.68	1.00	10.15	0.35	INT	0.60
HCN-4	0	2	0.002	0.035	75	26.221	3.23	12.9	14.44	1.82	5.81	0.02	LRG	1.20
HCN-5	25	4	0.167	0.035	75	9.091	0.34	27.8	27.84	0.33	2.70	0.40	LRG	1.20
HCS-1	10	3	0.001	0.015	186	42.221	2.44	24.6	25.42	1.66	7.55	---------NO ROCK---------		
HCS-2	10	3	0.001	0.015	127	32.079	2.00	22.0	22.67	1.41	5.77	---------NO ROCK---------		
HCS-3	15	4	0.006	0.015	49	3.037	0.18	16.5	1.00	3.04	2.97	---------NO ROCK---------		
HCS-4	15	4	0.09	0.035	49	2.241	0.14	16.1	1.00	2.24	3.04	0.24	SML	0.40

\+ Rock Type

LRG = Large Riprap
INT = Intermediate Riprap
SML = Small Riprap
RM = Rock Mulch

TABLE 5-11. SUMMARY OF CONSOLIDATION ANALYSIS.

Description of Soil	SAMPLE TW4-1B (25'-27')
Specimen Diameter (in)	1.940
Initial Mositure Content (%)	36.000
Dry Soil Density (PCF)	85.000
Weight of Dry Soil Specimen (lb)	0.145
Soil Specific Gravity	2.650
Initial Specimen Height (in)	1.000
Height of solids (in)	0.514

Pressure (ksf)	Change in Specimen Height (in)	Final Specimen Height (in)	Height of Void (in)	Final Void Ratio	Compression Index Cc
0.000		1.000	0.486	0.945	
	-0.012				
0.500		0.988	0.474	0.922	
	-0.032				0.131
1.000		0.968	0.454	0.883	
	-0.068				0.227
2.000		0.933	0.418	0.814	
	-0.098				0.194
4.000		0.903	0.388	0.756	

Description of Soil	SAMPLE TW4-2C (40'-42')	
Specimen Diameter (in)	1.940	
Initial Mositure Content (%)	80.000	
Dry Soil Density (PCF)	55.000	
Weight of Dry Soil Specimen (lb)	0.094	
Soil Specific Gravity	2.650	(Est.)
Initial Specimen Height (in)	1.000	
Height of solids (in)	0.333	

Pressure (ksf)	Change in Specimen Height (in)	Final Specimen Height (in)	Height of Void (in)	Final Void Ratio	Compression Index Cc
0.000		1.000	0.667	2.007	
	-0.038				
0.500		0.962	0.630	1.893	
	-0.047				0.089
1.000		0.954	0.621	1.867	
	-0.054				0.074
2.000		0.946	0.613	1.844	
	-0.064				0.101
4.000		0.936	0.603	1.814	

TABLE 5-12. PREDICTED SETTLEMENT FOR PONDS 4 AND 5.

Compression Index = 0.184
Estimated Void Ratio = 1.000

Well No	Tailings Depth (ft)	Estimated Settlement (ft)
TW4-1C	44.000	1.290
TW4-2C	44.000	1.290
TW4-3C	49.000	1.400
TW4-4C	28.000	0.930
TW4-5C	34.000	1.070
TW5-1C	53.000	1.480
TW5-2C	38.000	1.160
TW5-3	43.000	1.270

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TABLE 5-13. INFILTRATION ESTIMATED DURING THE PMF.

Channel Control Site	Maximum Ponding Time (Hour)	Maxium Ponding Height (Feet)	Infiltration Depth (cm)	Infiltration Depth (in)	Time Required To Remove By Evapotranspiration (Days)
HCT-1	15	5	3.92	1.54	2.71
HC5-3	16.2	6	4.13	1.63	2.85
HC5-11	1.5	5.3	2.55	1.00	1.76

NOTE: PONDING TIME IS FOR PORTION OVER TAILINGS MATERIAL

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6.0 LONG-TERM POTENTIAL HAZARDS

Several other possible long-term hazards have been considered during the formation of this reclamation plan. They include animal or root penetration of covers, root uptake of hazardous substances, upward migration of hazardous substances through cover materials, frost damage to the radon/infiltration barrier, earthquake damage to the tailings encapsulation system, flooding by nearby streams and geotechnical stability of the area. After consideration, none of the above are thought to pose a significant threat to the tailings protection which could result in exposure of tailings.

Animal or root penetration of the cover are considered two of the more significant potential long term hazards. The majority of the tailings area is covered with rock mulch and underlying filter. The presence of the rock will prevent animal burrowing in these areas. The thick, dense clay radon/infiltration barrier underneath the rock mulch filter should also serve to prevent burrowing if an animal is persistent enough to dig through the rock mulch. In areas where the rock mulch is not present, the topsoil layer will be relatively shallow and will again be underlain by a dense clay barrier. In addition to the difficulty in digging through the compacted clay barrier, the non-rocked tailings areas should be an undesirable burrowing animal habitat because of exposure to predators. The surfaces are very flat with only sparse grass vegetation expected on non-rocked areas, thus giving very little cover for small animals.

Root penetration of the clay barrier is not expected to be a problem. In rock mulched areas, the rock should prevent emergence of the majority of plant species because of its thickness and low water holding capacity. The underlying clay barrier has a very low permeability (2.6×10^{-8} cm/sec), and water is not expected to penetrate the barrier more than a few inches under worst case conditions. Thus, the available water in the clay barrier is also very limited. In non-rocked areas, the depth of uncompacted material will be very limited and will only be capable of supporting shallow rooted plants. Infiltration into the clay barrier will be very limited, and deep rooted plants will not be able to penetrate the dense, thick barrier, or survive on the limited water available.

For the reasons discussed above, root penetration through the barrier resulting in uptake of radioactive materials is not expected. Migration of hazardous substances from the tailings through the clay cover is not expected because of the small permeability of the clay cover. The clay barrier will be compacted to the point where flux of fluids through the barrier is very limited. Soil gas or water transfer across the barrier from one interface to the other is not anticipated.

Frost heaving or damage is associated with relatively moist conditions. In order for frost heave to occur, sufficient water must be present to result in expansive ice lenses. According to the Earth Manual (1974), "The freezing of the pore water in saturated fine-grained soils will decrease the density of the mass by expansion, but will not result in an appreciable frost heave unless water movement from below can take place.". The tailings will be dewatered to the point where the near-surface tailings are at or near the wilting point moisture content, and movement of water from the tailings into the clay barrier will be minimal. The clay barrier is also designed to preclude water infiltration, and the moisture content in the clay barrier should be relatively constant at or near the predicted long-term moisture content. The topsoil material and possibly the top few inches the clay barrier may be subject to frost action, but damage to the barrier is not likely.

An earthquake risk evaluation for the area was conducted prior to construction to the No. 5 tailings dam (Dames and Moore, 1975).

The historic seismicity for central Wyoming is low and the maximum magnitude for earthquakes cited by Dames and Moore, (1975) is a VII on the Modified Mercalli scale. The tailings material will be largely dewatered and liquefaction potential should be relatively low.

The primary area of concern for slope stability is the dam outslope area. This concern is all but eliminated for the Pond 4 dam due to back filling of tailings and cover material on the outslope. Outslope areas on the Pond 5 and Pond 3 dams will be modified under the reclamation plan to enhance hydrologic stability, and this will dramatically increase slope stability to the point where it is no longer a concern.

Several factors will enhance stability of the existing dam areas following completion of the reclamation. The water level within each former impoundment will be near the original ground surface and very little of the upstream dam face will be under saturated conditions. A potential failure surface along the upstream face is no longer considered applicable. Drainage channel outlets in the dams will assure complete drainage of runoff from the tailings and, in conjunction with the clay cap, will prevent resaturation of the tailings. The slope of the outslope areas is currently 2.5 ft horizontal to 1 ft vertical and will be reduced to a maximum of 5 ft horizontal to 1 ft vertical.

A slope stability analysis for the No. 5 dam was conducted by Dames and Moore (1976) prior to construction of the dam. The Modified Bishop method was used for this analysis. Static and earthquake (a=0.025g) loading conditions gave factors of safety of 2.0 and 1.8, respectively, for the maximum section. The static and earthquake loading conditions gave factors of safety of 1.8 and 1.7, respectively, for the end section. Given the dramatic increase in stability that will occur with modifications under the reclamation plan, the potential for slope failures on the dam outslopes does not appear to be a concern. The existing dam has met NRC Regulatory Guide 3.1.1 criteria for dam stability and will become significantly more stable with reclamation. Refer to additional seismic analysis conducted and reported by Inberg-Miller Engineers under title "SLOPE STABILITY & LIQUEFACTION POTENTIAL ANALYSIS - PROPOSED TAILINGS RECLAMATION, SHIRLEY BASIN MINE SITE, SHIRLEY BASIN, WYOMING".

The resistance of the cover materials to dispersion is not considered an issue for the tailings surface. In general, the susceptibility of the clay radon/infiltration barrier material to dispersion is not considered a significant problem because additional cover of sandy capillary barrier and rock mulch and filter or topsoil will be present. Crumb dispersibility tests were conducted on four clay cover samples (STH-4, 30'-37'; STH-6, 20'-27'; STH-5, 40'-47'; and STH-2, 60'-67') and indicated that the clay was not dispersive. The results of the test are included in Appendix C.

The potential for damage of the topsoil resulting from dispersion is considered very low. A significant portion of each topsoil sample was sand, and this should make the soils resistant to dispersion. On the tailings surface, the topsoil will only be placed on areas of very mild slopes and the probability of piping or erosion of soil is considered very low.

The potential for flooding of the tailings by Spring Creek under PMF conditions was evaluated using the HEC-1 model as described in Section 5. The drainage area for Spring Creek is 27.7 square miles and the flow is routed through a culvert and around the Area 3 pit in the Spring Creek Diversion. Under PMF conditions, the culvert and diversion would most likely fail, and there would not be backwater conditions at the culvert. The one-hour 1 square mile PMP for Shirley Basin is 9.03 inches. The

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channel length and elevation change for the drainage is 24,550 feet and 498 feet, respectively, giving a time of concentration of 1.4 hours. The resulting peak flow using the HEC-1 model and a SCS curve number of 75 is 86,750 cfs. When the SCS curve number is increased to 90, the peak flow increases to 112650 cfs.

The Spring Creek floodplain was approximated as a three-stage compound channel. The most constrictive portion of the Spring Creek channel appears to be the section northeast of the No. 5 dam. A ridge northeast of the channel and the No. 5 dam southwest of the channel form the narrowest section of floodplain. Two floodplain cross sections were taken in this region and approximated as the three-stage compound channels. The details of the channel geometry are included in Tables 6-1 through 6-4 (looking upstream). Using a Manning's n value of 0.02, the resulting flow depth for two cross sections and two flow depths ranges from 17.5 feet to 19.5 feet. This places the maximum flood stage approximately a minimum of 300' from the covered tailings under the most severe runoff conditions. The less severe combination of cross section and discharge places the maximum flood stage approximately 450 feet from the covered tailings.

TABLE 6-1. PMF ANALYSIS FOR SPRING CREEK CROSS SECTION 1 AT 112650 CFS.

MULTI-COMPOUND CHANNEL:
Channel- SPRING CREEK   Storm- PMP   Yrs., 1 hr.

INPUT:

DISCHARGE	=	112650CFS
SLOPE	=	.00300 FT./FT.
MANNING`S ROUGHNESS COEFFICIENT	=	.02000
RIGHT SIDE SLOPE OF FIRST STAGE	=	7.00 :1
LEFT SIDE SLOPE OF FIRST STAGE	=	13.00 :1
BOTTOM WIDTH OF FIRST STAGE	=	.00 FT.
DEPTH OF FIRST STAGE	=	3.000 FT.
RIGHT SIDE SLOPE OF SECOND STAGE	=	8.00 :1
LEFT SIDE SLOPE OF SECOND STAGE	=	24.00 :1
BOTTOM WIDTH OF SECOND STAGE	=	60.00 FT.
DEPTH OF SECOND STAGE	=	7.500 FT.
TOP WIDTH OF SECOND STAGE	=	300.00 FT.
RIGHT SIDE SLOPE OF THIRD STAGE	=	26.00 :1
LEFT SIDE SLOPE OF THIRD STAGE	=	53.00 :1
BOTTOM WIDTH OF THIRD STAGE	=	300.00 FT.

OUTPUT:

=> AREA	=	7362.63 FT.^2
=> WETTED PERIMETER OF STAGE1	=	60.3 FT.
=> WETTED PERIMETER OF STAGE2	=	240.6 FT.
=> WETTED PERIMETER OF STAGE3	=	713.1 FT.
=> WETTED PERIMETER	=	1014.0 FT.
=> HYDRAULIC RADIUS	=	7.261 FT.
=> TOP WIDTH OF FLOW	=	1012.81 FT.
=> TOTAL DEPTH OF FLOW	=	19.523 FT.
=> FROUDE NUMBER	=	1.000
=> AVERAGE VELOCITY	=	15.30 FT./SEC.
=> SHEAR USED IN DESIGN	=	1.36 LBS/FT^2
=> SHEAR STRESS COEFFICIENT	=	1.000

TABLE 6-2. PMF ANALYSIS FOR SPRING CREEK CROSS SECTION 1 AT 86750 CFS.

MULTI-COMPOUND CHANNEL:
Channel- SPRING CREEK Storm- PMP Yrs., 1 hr.

==

INPUT:

DISCHARGE	=	86750.00 CFS
SLOPE	=	.00300 FT./FT.
MANNING'S ROUGHNESS COEFFICIENT	=	.02000
RIGHT SIDE SLOPE OF FIRST STAGE	=	7.00 :1
LEFT SIDE SLOPE OF FIRST STAGE	=	13.00 :1
BOTTOM WIDTH OF FIRST STAGE	=	.00 FT.
DEPTH OF FIRST STAGE	=	3.000 FT.
RIGHT SIDE SLOPE OF SECOND STAGE	=	8.00 :1
LEFT SIDE SLOPE OF SECOND STAGE	=	24.00 :1
BOTTOM WIDTH OF SECOND STAGE	=	60.00 FT.
DEPTH OF SECOND STAGE	=	7.500 FT.
TOP WIDTH OF SECOND STAGE	=	300.00 FT.
RIGHT SIDE SLOPE OF THIRD STAGE	=	26.00 :1
LEFT SIDE SLOPE OF THIRD STAGE	=	53.00 :1
BOTTOM WIDTH OF THIRD STAGE	=	300.00 FT.

OUTPUT:

=> AREA	=	6006.71 FT.^2
=> WETTED PERIMETER OF STAGE1	=	60.3 FT.
=> WETTED PERIMETER OF STAGE2	=	240.6 FT.
=> WETTED PERIMETER OF STAGE3	=	601.1 FT.
=> WETTED PERIMETER	=	902.0 FT.
=> HYDRAULIC RADIUS	=	6.659 FT.
=> TOP WIDTH OF FLOW	=	900.85 FT.
=> TOTAL DEPTH OF FLOW	=	18.106 FT.
=> FROUDE NUMBER	=	.986
=> AVERAGE VELOCITY	=	14.44 FT./SEC.
=> SHEAR USED IN DESIGN	=	1.25 LBS/FT^2
=> SHEAR STRESS COEFFICIENT	=	1.000

TABLE 6-3. PMF ANALYSIS FOR SPRING CREEK CROSS SECTION 2 AT 112650 CFS.

```
 MULTI-COMPOUND CHANNEL:
Channel- SPRING CREEK                    Storm- PMP   Yrs., 1  hr.
===============================================================

INPUT:
~~~~~~~~~~~~~~~~~~~~~~~~

 DISCHARGE                             =  112650 CFS
 SLOPE                                 =   .00300 FT./FT.
 MANNING'S ROUGHNESS COEFFICIENT       =   .02000
 RIGHT SIDE SLOPE OF FIRST STAGE       =  12.00 :1
 LEFT SIDE SLOPE OF FIRST STAGE        =   8.00 :1
 BOTTOM WIDTH OF FIRST STAGE           =     .00 FT.
 DEPTH OF FIRST STAGE                  =  5.000 FT.
 RIGHT SIDE SLOPE OF SECOND STAGE=  28.00 :1
 LEFT SIDE SLOPE OF SECOND STAGE       =  24.00 :1
 BOTTOM WIDTH OF SECOND STAGE          =  100.00 FT.
 DEPTH OF SECOND STAGE                 =  5.000 FT.
 TOP WIDTH OF SECOND STAGE             =  360.00 FT.
 RIGHT SIDE SLOPE OF THIRD STAGE       =  14.00 :1
 LEFT SIDE SLOPE OF THIRD STAGE        =  46.00 :1
 BOTTOM WIDTH OF THIRD STAGE           =  360.00 FT.

OUTPUT:
~~~~~~~~~~~~~~~~~~~~~~~~

   => AREA                             = 7010.65 FT.^2
   => WETTED PERIMETER OF STAGE1 =    100.5 FT.
   => WETTED PERIMETER OF STAGE2 =    260.2 FT.
   => WETTED PERIMETER OF STAGE3 =    536.5 FT.
   => WETTED PERIMETER                 =    897.2 FT.
   => HYDRAULIC RADIUS                 =    7.814 FT.
   => TOP WIDTH OF FLOW                =  896.03 FT.
   => TOTAL DEPTH OF FLOW              =  18.934 FT.
   => FROUDE NUMBER                    =    1.012
   => AVERAGE VELOCITY                 =   16.07 FT./SEC.
   => SHEAR USED IN DESIGN             =     1.46 LBS/FT^2
   => SHEAR STRESS COEFFICIENT         =   1.000
```

TABLE 6-4. PMF ANALYSIS FOR SPRING CREEK CROSS SECTION 2 AT 86750 CFS.

MULTI-COMPOUND CHANNEL:
Channel- SPRING CREEK Storm- PMP Yrs., 1 hr.

INPUT:

DISCHARGE	=	86750.00 CFS
SLOPE	=	.00300 FT./FT.
MANNING'S ROUGHNESS COEFFICIENT	=	.02000
RIGHT SIDE SLOPE OF FIRST STAGE	=	12.00 :1
LEFT SIDE SLOPE OF FIRST STAGE	=	8.00 :1
BOTTOM WIDTH OF FIRST STAGE	=	.00 FT.
DEPTH OF FIRST STAGE	=	5.000 FT.
RIGHT SIDE SLOPE OF SECOND STAGE	=	28.00 :1
LEFT SIDE SLOPE OF SECOND STAGE	=	24.00 :1
BOTTOM WIDTH OF SECOND STAGE	=	100.00 FT.
DEPTH OF SECOND STAGE	=	5.000 FT.
TOP WIDTH OF SECOND STAGE	=	360.00 FT.
RIGHT SIDE SLOPE OF THIRD STAGE	=	14.00 :1
LEFT SIDE SLOPE OF THIRD STAGE	=	46.00 :1
BOTTOM WIDTH OF THIRD STAGE	=	360.00 FT.

OUTPUT:

=> AREA	=	5748.44 FT.^2
=> WETTED PERIMETER OF STAGE1	=	100.5 FT.
=> WETTED PERIMETER OF STAGE2	=	260.2 FT.
=> WETTED PERIMETER OF STAGE3	=	447.4 FT.
=> WETTED PERIMETER	=	808.2 FT.
=> HYDRAULIC RADIUS	=	7.113 FT.
=> TOP WIDTH OF FLOW	=	807.10 FT.
=> TOTAL DEPTH OF FLOW	=	17.452 FT.
=> FROUDE NUMBER	=	.997
=> AVERAGE VELOCITY	=	15.09 FT./SEC.
=> SHEAR USED IN DESIGN	=	1.33 LBS/FT^2
=> SHEAR STRESS COEFFICIENT	=	1.000

7.0 GROUND-WATER CONSIDERATIONS

Ground-water restoration on the east side of the No. 5 tailings area in the Surficial aquifer started in 1984. Collection of impacted water was the initial approach to clean up the seepage in this area. Fresh-water injection into a horizontal recharge line downgradient of the collection has been in progress since 1986. Fresh-water injection, in combination with the collection, is gradually restoring the ground-water quality downgradient of the No. 5 tailings. The average rate of injection in 1992 was 69 gpm and the average rate of collection was 29 gpm.

Operation of the collection and injection system to restore the ground water downgradient of the No. 5 tailings in the Surficial aquifer will continue for several more years. The results of monitoring of wells in this area will be used to determine when the aquifer is adequately restored. The latest report on the fresh-water injection and collection system was submitted to the NRC in February 1993. Dewatering of the tailings is a key part of the restoration of the ground water in the Surficial aquifer. Dewatering of the tailings will begin in late 1993 and will be attempted to be dewatered at a similar rate to the decline in the ponded water. Collection of the tailings solution in the tailings will continue for several years. Collection wells were installed in the summer of 1993 in the No. 4 and 5 tailings. Restoration of the Surficial aquifer under the tailings will be conducted as the tailings are dewatered. Pathfinder's present monitoring program, established under license conditions to define changes in the ground-water quality adjacent to the tailings, will be used to define ground-water quality changes in the future. With the dewatering of tailings, seepage of tailings solution into the Surficial aquifer will diminish. Recharge of the Surficial aquifer through the tailings will be prevented by the clay infiltration barrier on the tailings. Section 5.5 presents estimates of infiltration into the clay barrier. This evaluation shows that infiltration through the barrier should not occur during the PMF event. The 2.5 to 3 feet of low permeability material should be very adequate in restricting infiltration into the reclaimed tailings.

8.0 TAILINGS AREA/MILL RECLAMATION VOLUME ESTIMATES

The following estimates of volumes are provided to allow preliminary assessment of the cost of reclamation. Upon plan approval, a more detailed volume analysis will be performed for bonding purposes.

	Estimated Volume
Rock	
Large Riprap	16400 yd^3
Intermediate Riprap	7700 yd^3
Small Riprap	16400 yd^3
Rock Mulch	89500 yd^3
Filter	119200 yd^3
	249200
Contaminated Excavation	
Low-Grade Waste Pile	454000 yd^3
Ore Pad	70000 yd^3
Southwest Area	96800 yd^3
Windblown Tailings	67000 yd^3
	687800
Contaminated Fill	
Pond 4	391000 yd^3
Pond 5	290000 yd^3
	681000
Uncontaminated Cut	
Area 2/8 Channel Cut	228000 yd^3
North Area Channel Cut	100000 yd^3
Pond 4 Channel Cut	69000 yd^3
Freshwater Pond Channel Cut	70000 yd^3
	467000
Mill Area Fill	70000 yd^3
Radon Barrier	
Clay	1158000 yd^3
Sand	215000 yd^3
	1374000
Topsoil	318500 yd^3

Some of the volume estimates are somewhat speculative. In particular, the cleanup depths are estimates and the contaminated excavation volumes could change a great deal. Also, the topsoil volume estimate includes partial replacement in windblown tailings areas and this may not be necessary.

The primary distinction between general earth volumes is that of contaminated or uncontaminated material. The contaminated materials includes the low-grade waste pile, ore pad cleanup, windblown cleanup, and southwest area cleanup. The following estimation techniques were used in deriving the volume estimates:

Windblown Tailings Cleanup - 83 acres @ 0.5 feet excavation.

Ore Pad Cleanup - 14.7 acres @ 4 feet excavation.

Southwest Area Cleanup - 100 acres @ 0.5 feet excavation.

Topsoil volume estimates are based on a general placement thickness of 0.67 feet with 0.5 feet replacement in the windblown area. The following areas were used in developing topsoil volume estimates:

Windblown Area Replacement - 83 acres @ 0.5' thickness

Southwest Area Replacement - 130 acres @ 0.67' thickness

Tailings Area Placement - 102.7 acres @ 0.67' thickness

The radon barrier volumes are based on areas as presented in Exhibit 10-3. The volume estimates do not include grading estimates for the No. 5 dam outslope, access road recontouring, or tailings recontouring. The No. 5 dam outslope grading is intended to be approximately a cut/fill balance.

The fill areas within the tailings are the southwest side of the No. 4 pond and the base of the existing No 5. pond. These fill estimates are based on pond topography determined from soundings and are subject to some adjustment.

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APPENDIX A

TEST HOLE INFORMATION

APPENDIX A

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A.1 TEST HOLE LITHOLOGIC LOGS

The lithologic logs that were developed during the drilling of test holes and wells in the mill and tailings area are presented in Appendix A in Section A.1. Lithologic logs for wells that were located in No. 3, No. 4, and No. 5 tailings areas are presented initially, followed by those placed in the South and North overburden piles. Lithologic logs from wells in Tailings No. 3, No. 4, and No. 5 are listed with the prefix TW3, TW4, and TW5, respectively. Wells NS-1 and NS-2 are located on the northeast edge of the No. 5 tailings area. More than one lithologic log is presented on one page to save space. Table A.1-1 of Appendix A presents the lithologic log for sites TW3-1, TW4-1B, and TW4-1C.

Several test holes were drilled in the South and North overburden pile areas to define material properties of these two piles for cover material. The lithologic logs for these test holes follow the tailings logs. STH-1 through STH-11 sites are located on the South overburden pile. NTH-1 through NTH-8 are located in the North overburden pile area.

Exhibit 1Ø-1 presents the location of the test holes. Appendix C presents the materials laboratory results for samples taken from the test holes, while Appendix D gives the radiological laboratory reports.

The lithologic logs present a description of the cuttings that were observed during the drilling of these test holes. In general, five foot intervals were used to define the lithologic conditions.

Shelby tubes were used to collect undisturbed samples from the tailings. Soil radium concentrations for the tailings were measured only from Shelby tube samples. The five foot log samples from some test holes in the overburden pile were used for radiological analysis.

TABLE A.1-1. LITHOLOGIC LOGS FOR TW3-1, TW4-1B, & TW4-1C.

WELL: TW3-1
DATE: 3/5/93
DRILLER: NUNN
ENGINEER: GLH

DEPTH	DESCRIPTION
0-5	TAN SAND, SILT AND CLAY
5-15	VERY FINE TO VERY COARSE SAND AND CLAY
15-20	RED CLAY AND VERY FINE TO VERY COARSE SAND AND FINE GRAVEL
20-25	TAN VERY FINE TO VERY COARSE SAND W/ 30% CLAY
25-30	RED CLAY W/ 40% TAN VERY FINE TO VERY COARSE SAND
30-45	TAN VERY FINE TO VERY COARSE SAND, LITTLE RED CLAY
45-50	VERY COARSE SAND W/ 20% RED CLAY
50-55	VERY FINE TO VERY COARSE SAND
55-60	TAN AND RED CLAY W/ SOME SAND
60-65	OLIVE CLAY
65-70	VERY FINE TO VERY COARSE SAND W/ LITTLE CLAY
70-75	OLIVE CLAY

DRILL TIME LOG	
12:30	ON SITE
13:45	PILOT TO 80'
14:25	START REAMING
15:20	STOP REAMING
15:35	CASING IN
15:40	START WASHING
15:43	START SAND, SAND TO 26'
16:00	FINISH W/ SAND, BENTONITE TO 7.5'
16:05	START AIR
16:30	STOP AIR
16:45	OFF SITE

WELL: TW4-1B
DATE: 3/2/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	FINE TO MEDIUM TAN SAND
3-5	SHELBY TUBE
5-10	FINE TO MEDIUM TAN AND GREY SAND
10-20	FINE TO COARSE GREY SAND
20-25	FINE TO COARSE GREY SAND, SOME SLIMES
25-30	FINE TO MEDIUM GREY SAND, ≈ 50% SLIMES
30-35	BROWN CLAY - 30% FINE TO MEDIUM SAND
35-40	BROWN CLAY
40-45	BROWN CLAY ≈ 20% FINE TO COARSE WHITE SAND
45-50	BROWN CLAY ≈ 40% COARSE BLACK SAND
50-60	MEDIUM TO VERY COARSE ORANGE AND WHITE SAND, SOME BROWN CLAY
60-65	RED CLAYSTONE - 30% MEDIUM TO VERY COARSE SAND
65-68	RED AND WHITE CLAYSTONE

DRILL TIME LOG	
12:30	SET UP - SET SHELBY TUBE @ 3-5'
12:35	MIXING MUD
13:10	@ 68' WITH 5" DRAG BIT, GETTING READY TO LOG
13:29	REAMING - 7 7/8" TRICONE
14:30	REAMED 12 1/4"
14:33	SETTING CASING - 20' #35
14:54	5" CASING
15:21	ALL CASING IN
15:30	AIR LIFT, VERY DIRTY, 2-3 gpm
15:56	END AIR LIFT, 5+ gpm, FAIRLY CLEAN
16:10	DRILLER'S LEAVING

WELL: TW4-1C
DATE: 3/2/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	TAN MEDIUM SAND, SHELBY TUBE 3-5'
5-30	GREY FINE TO MEDIUM SAND
30-50	BROWN CLAY ≈ 30% MEDIUM TO COARSE SAND
50-55	GREY FINE TO MEDIUM SAND ≈ 10% BROWN CLAY

DRILL TIME LOG	
7:20	DRILLER'S ON SITE
8:35	TRYING TO TAKE SHELBY TUBES
9:09	@ 40', 5" HOLE
9:18	LOGGING
10:00	REAMING 12 1/4" TRICONE
10:24	SETTING CASING
10:30	CASING IN
10:58	SAND IN
11:05	AIR LIFT, 12+ gpm, VERY DIRTY, PRODUCING FINE SAND
12:00	END AIR LIFT, 12 gpm, CLEAN

TABLE A.1-2. LITHOLOGIC LOGS FOR TW4-2B & TW4-2C.

WELL: TW4-2B
DATE: 2/26/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	VERY FINE TO MEDIUM GREY SAND
5-10	VERY FINE TO MEDIUM GREY SAND, SOME FINES
10-25	FINE TO MEDIUM GREY SAND
25-40	VERY FINE TO MEDIUM GREY SAND
40-45	VERY FINE TO MEDIUM GREY SAND ≈ 20% BROWN CLAY
45-50	BROWN AND RED CLAY, ≈ 20% FINE TO MEDIUM SAND
50-55	BROWN CLAY, ≈ 20% FINE TO MEDIUM SAND
55-60	MEDIUM TO VERY COARSE CLAYEY SAND - RED AND WHITE AND GREY SAND
60-80	MEDIUM TO VERY COARSE CLAYEY SAND - RED AND WHITE SAND
80-90	MEDIUM TO VERY COARSE RED AND WHITE AND GREY SAND, SOME FINES
90-92	MEDIUM TO VERY COARSE WHITE AND GREY SAND - SOME FINES
92-95	BROWN CLAY

DRILL TIME LOG

7:50	DRILLER'S ON SITE - WAITING FOR EQUIPMENT
9:15	DRILLER'S SETTING UP
9:30	TAKING SHELBY TUBE
10:30	@ 95'- 5" PILOT
10:45	LOGGING
11:00	REAMING 9 5/6"
11:54	@ 80' - KEEP PLUGGING BIT
12:08	CIRCULATING
12:22	GETTING READY TO SET CASING
13:29	CASING AND SAND IN 20' #35 PERF ON BOTTOM
13:38	AIR LIFT, ≈ 10 gpm, CLOUDY, LOTS OF FINE SAND
14:12	END AIR LIFT, ≈ 15 gpm, SLIGHTLY CLOUDY, VERY LITTLE SAND

WELL: TW4-2C
DATE: 3/3/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	FINE TO MEDIUM GREY SAND
5-15	VERY FINE TO MEDIUM GREY SAND
15-20	VERY FINE TO MEDIUM GREY SAND, ≈ 40% BROWN CLAY
20-40	BROWN CLAY
40-45	BROWN CLAY AND MEDIUM TO VERY COARSE SAND (50/50)
45-47	BROWN CLAY AND MEDIUM TO VERY COARSE SAND

DRILL TIME LOG

14:30	SET UP - TAKING SHELBY TUBE 3-5', TAKE SHELBY TUBE 40-42
15:00	LOGGING
15:12	REAMING 12 1/4"
15:52	CASING IN 40' - #25
16:20	AIR LIFT, 2 gpm, VERY DIRTY, LOTS OF SAND
16:42	ENGINEER LEAVING, DRILLER STAYING UNTIL 17:00
17:00	END AIR LIFT, START AGAIN TOMORROW

3/4/93

7:30	DRILLER'S ON SITE
7:45	AIR LIFT, 2 gpm, SLIGHTLY CLOUDY

TABLE A.1-3. LITHOLOGIC LOGS FOR TW4-3B & TW4-3C.

WELL: TW4-3B
DATE: 3/4/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	VERY FINE TO MEDIUM TAN SAND
5-10	GREY TO BROWN SANDY CLAY, VERY FINE TO MEDIUM SAND
10-15	GREY TO BROWN CLAYEY SAND, FINE TO COARSE SAND
15-30	VERY FINE TO MEDIUM GREY SAND
30-50	BROWN CLAY
50-55	BROWN CLAY 3', BLACK CLAY 2'
55-65	CLAYEY SAND, MEDIUM TO VERY COARSE, ORANGE AND WHITE SANDS
65-70	3' MEDIUM TO VERY COARSE ORANGE AND WHITE SAND, 2' RED CLAYSTONE
70-75	FINE TO VERY COARSE ORANGE AND WHITE SAND - 1-2' WHITE CLAY LENSE
75-85	FINE TO VERY COARSE ORANGE AND WHITE SAND, THIN WHITE CLAY LENSE
85-90	YELLOW CLAY
90-95	WHITE CLAY

DRILL TIME LOG	
10:00	MOVING TO SITE
10:50	DRILLING
11:11	@ 80', 5" PILOT
11:30	LOGGING
12:42	REAMING 7 7/8" @ 90'
14:02	REAMED 12 1/4" @ 90'
14:44	5" CASING IN
15:35	ALL CASING IN
15:40	AIR LIFT, VERY DIRTY, 3 gpm
16:20	≈ 4 gpm, STILL PRODUCING FINE SAND
16:36	END AIR LIFT
17:10	DRILLER'S LEAVING

WELL: TW4-3C
DATE: 3/5/93
DRILLER: NUNN
ENGINEER: GLH

DEPTH	DESCRIPTION
0-5	TAN VERY FINE TO MEDIUM SAND W/ CLAY
5-10	GREY TO TAN VERY FINE TO MEDIUM SAND
10-35	GREY VERY FINE TO COARSE SAND
35-40	BROWN CLAY AND GREY VERY FINE TO MEDIUM SAND
40-50	BROWN CLAY W/ SAND PROBABLY FROM ABOVE - SAMPLES 40-50 NOT BAGGED

DRILL TIME LOG	
8:30	PILOT START
9:30	DRILLING @ 50' - START LOGGER
9:40	FINISH LOGGING
9:50	START REAMING
10:35	STOP REAMING
10:45	CASING IN HOLE TO ≈ 50'
10:48	START WASHING
10:54	START SAND
11:20	START AIR LIFTING
11:27	Q ≈ 10 gpm
12:10	STOP AIR ≈ 10 gpm

TABLE A.1-4. LITHOLOGIC LOGS FOR TW4-4B & TW4-4C.

WELL: TW4-4B
DATE: 3/1/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	VERY FINE TO COARSE TAN SAND
5-10	FINE TO MEDIUM GREY AND TAN SAND
10-30	VERY FINE TO MEDIUM GREY SAND
30-35	BROWN AND RED CLAYSTONE W/ 30% FINE TO MEDIUM SAND
35-45	BROWN AND RED CLAYSTONE W/ 15% FINE TO MEDIUM SAND
45-65	GREY CLAY W/ 30% MEDIUM TO VERY COARSE SAND
65-70	WHITE CLAYSTONE

DRILL TIME LOG	
7:20	DRILLER'S ON SITE, WARMING UP
8:30	PUSHING SHELBY TUBES
9:00	MIXED MUD
9:15	@ 70' 5"
9:40	LOGGING
10:00	HAD TROUBLE RODDING OUT - FINISHED LOGGING
10:01	FILLED COMPRESSOR WITH WATER, WORKING ON RIG
10:40	RIG READY
11:28	@ 70' 95/16" TRICONE, WASHING - CLAY STICKING
11:45	SETTING CASING
11:56	CASING IN
12:20	AIR LIFT, 15+ gpm
12:55	END DEVELOPMENT, CLEAR, JUST A FEW SAND GRAINS

WELL: TW4-4C
DATE: 3/1/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	VERY FINE TO COARSE TAN SAND
5-10	FINE TO MEDIUM GREY AND TAN SAND
10-15	FINE TO MEDIUM GREY SAND
15-20	FINE TO MEDIUM GREY SAND
20-25	VERY FINE TO MEDIUM GREY SAND
25-30	VERY FINE TO MEDIUM GREY SAND
30-35	RED CLAYSTONE W/ GREY SAND FROM ABOVE

DRILL TIME LOG	
13:00	READY TO DRILL - CAN'T, SET SHELBY TUBES
13:20	@ 32'
13:30	LOGGING
13:40	LOGGED - GETTING READY TO REAM
13:57	CHANGING BIT
14:20	@ 33' - 12 1/4" TRICONE
14:35	CASING IN, 20' OF #25 SLOT 5", POURING SAND
15:00	AIR LIFT - SLIGHTLY CLOUDY, SOME SUN, 15+ gpm
15:30	END AIR LIFT - STILL PRODUCING SMALL AMOUNT OF SAND

TABLE A.1-5. LITHOLOGIC LOGS FOR TW4-5B & TW4-5C.

WELL: TW4-5B
DATE: 2/26/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	FINE TO COARSE YELLOW/TAN SAND, SMALL FRACTION, SMALL GRAVEL
5-10	FINE TO COARSE YELLOW/TAN SAND, SMALL FRACTION, SMALL GRAVEL
10-15	FINE TO COARSE GREY SAND
15-30	FINE TO MEDIUM GREY SAND ≈ 10% FINES
30-35	FINE TO MEDIUM GREY SAND
35-40	GREY CLAY W/ ≈ 30% MEDIUM TO COARSE SAND
40-45	BROWN CLAY W/ ≈ 30% MEDIUM TO COARSE SAND
45-50	REDDISH BROWN CLAYSTONE
50-55	WHITE SAND, MEDIUM TO VERY COARSE, SMALL GRAVEL
55-65	WHITE AND RED SAND, MEDIUM TO VERY COARSE, SMALL GRAVEL
65-70	LIGHT TAN CLAYSTONE - SANDS PROBABLY COMING FROM ABOVE

DRILL TIME LOG

15:00	ON SITE
15:30	TAKING SHELBY TUBES, GOT 1 TUBE 5 1/2-8'
15:40	DRILLING
16:07	@ 70' - 5" DRAG BIT
16:10	LOGGING
16:20	DRILLER'S LEAVING
2/27/93	
7:25	AT GATE
7:50	ON SITE
9:05	START REAMING
10:00	START CASING
10:15	CASING TO ≈ 60.5'
10:20	SAND TO 41.5', 8-12-6 BAGS
10:30	BENTONITE TO 31', 8 BAGS
10:40	START AIR LIFTING
11:10	≈ 2 gpm
11:31	STOP AIR LIFTING

WELL: TW4-5C
DATE: 2/27/93
DRILLER: NUNN
ENGINEER: GLH

DEPTH	DESCRIPTION
0-5	TAN SANDY CLAY, FILL
5-15	FINE TO COARSE GREY SAND
15-20	VERY FINE TO COARSE GREY SAND W/ SOME RED SLIME
20-25	VERY FINE TO MEDIUM GREY SAND W/ SOME SLIMES
25-35	VERY FINE TO COARSE GREY SAND
35-40	GREY CLAY W/ SOME SAND
40-42	VERY FINE TO COARSE SAND AND CLAY

DRILL TIME LOG

12:00	START DRILLING
12:30	STOP DRILLING - LOGGING
12:45	START REAMING
13:28	CASING IN
13:30	START WASHING
13:35	START SAND
14:00	START AIR, ≈ 10 gpm
15:00	STOP AIR

TABLE A.1-6. LITHOLOGIC LOGS FOR TW5-1B & TW5-1C.

WELL: TW5-1B
DATE: 2/15/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-2	MIXED BROWN
3-5	FINE TO MEDIUM GREY SAND
5-15	MEDIUM TO FINE GREY AND TAN SAND
15-40	MEDIUM TO FINE GREY SAND
40-60	GREY CLAY
60-65	GREY CLAY, ≈ 10% FINE TO MEDIUM SAND
65-75	GREY AND YELLOW CLAY, ≈ 30% FINE TO COARSE SAND
75-80	WHITE AND TAN FINE TO MEDIUM SAND, ≈ 10% GREY CLAY
80-85	WHITE AND TAN FINE SAND
85-90	MEDIUM TO COARSE SAND W/ RED AND BROWN CLAYSTONE
90-93	RED AND BROWN CLAYSTONE

DRILL TIME LOG

12:00	ON SITE - TAKING 3 SAMPLES
12:38	THAWING VALVES
12:45	DRILLING
13:04	@ 40'
13:30	@ 93'
13:35	LOGGING
14:00	PROBE STUCK
14:30	REAMING - 7 7/8" TRICONE
15:00	CLAY STICKING - HOLE WON'T CLEAN
15:30	REAMING - 12 1/4" TRICONE
16:30	FROZE UP - CAN'T KEEP PUMP THAWED

2/24/93

8:00	DRILLER'S ON SITE
8:40	AT WELL - DOZER CLEANING SNOW
10:50	BACKHOE CLEANING PITS
11:20	DRILLING - 12 1/4" TRICONE
12:20	@ 80'
12:30	@ 95' - CIRCULATING
13:00	SETTING 5" CASING
13:20	WASHING
13:30	POURING SAND
14:41	START AIR DEVELOPMENT
14:48	10+ gpm, MILKY, SOME FINE SAND
15:07	10+ gpm, SOME FINE SAND
15:12	END DEVELOPMENT, A LITTLE BIT OF VERY FINE SAND, 10+ gpm

WELL: TW5-1C
DATE: 2/24/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-10	BROWN AND TAN FINE TO MEDIUM SAND
10-25	GREY FINE TO MEDIUM SAND
25-30	GREY FINE TO MEDIUM SAND - GRADING TO BROWN CLAY
30-55	BROWN CLAY AND SILT
55-60	BROWN CLAY - GRADING TO MEDIUM SAND

DRILL TIME LOG

15:30	SET UP
15:38	DRILLING
15:56	@ 20'
16:05	@ 60', WAITING FOR LOGGER
17:00	LOGGED, DRILLER'S LEAVING

2/25/93

7:30	DRILLER'S ON SITE, WARMING UP
8:55	DRILLING, REAMING 7 7/8" TRICONE
9:18	DRILLING, REAMING 12 3/4" TRICONE
10:58	AIR LIFT, ≈ 2 gpm, VERY MILKY, VERY LITTLE SAND
11:36	AIR LIFT, ≈ 3 gpm, STILL VERY MILKY
12:08	END AIR LIFT, STILL SLIGHTLY MILKY, ≈ 3 gpm

TABLE A.1-7. LITHOLOGIC LOGS FOR TW5-2B, TW5-2C, & TW5-3.

WELL: TW5-2B
DATE: 2/25/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-6"	COVER
0-10	TAILINGS, FINE TO MEDIUM TAN SAND
10-35	GREY TO TAN FINE TO MEDIUM SAND - TAILINGS
35-40	GRADING - FINE TO MEDIUM SAND TO BROWN CLAY
40-50	REDDISH BROWN CLAYSTONE
50-60	VERY FINE TO MEDIUM SAND - SOME SMALL GRAVEL
60-73	FINE TO COARSE SAND
73-76	WHITE CLAYSTONE - SAND CAVING FROM ABOVE

DRILL TIME LOG	
12:20	ON SITE - PITS SLOUGHING, MOVED SOUTH ≈ 25'
13:04	TRYING TO GET SHELBY TUBES - SAND TOO SOFT
13:06	DRILLING
13:40	@ 75'
14:00	LOGGING
14:57	@ 75', 9 5/11" TRICONE
15:30	SETTING CASING
15:50	CASING IN
16:50	AIR LIFT, ≈ 15 MINUTES, ≈ 2 gpm, MILKY
17:10	DRILLER'S LEAVING
2/26/93	
7:45	DRILLER'S ON SITE
8:30	START DEVELOPMENT - AIR LIFT, ≈ 5 gpm, SLIGHTLY CLOUDY, SOME FINE SAND
9:05	STOP AIR LIFTING, ADD 20' 2" PERF, PUSHED DOWN AS FAR AS POSSIBLE
9:13	AIR LIFT, CLEARING UP, STILL SOME FINE SAND
10:00	END AIR LIFT, STILL PRODUCING SMALL AMOUNT OF FINE SAND
10:20	MOVING TO TW5-2C

WELL: TW5-2C
DATE: 2/26/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	FINE TO MEDIUM TAN SAND ≈ 25% FINES; MIXED COVER AND TAILINGS
5-10	FINE TO MEDIUM GREY SAND ≈ 15% FINES
10-15	MEDIUM TO COARSE GREY SAND
15-20	MEDIUM TO COARSE GREY SAND
20-25	FINE TO MEDIUM GREY SAND
25-30	FIND TO MEDIUM GREY SAND
30-35	FINE TO MEDIUM GREY SAND ≈ 25% FINES
35-40	BROWN CLAY

DRILL TIME LOG	
10:45	SETTING UP
11:00	DRILLING
11:15	DRILLING @ 40'
11:30	TRYING TO LOG - PROBE WON'T WORK
11:45	REAMING - 12 1/4" TRICONE @ 43'
12:10	CASING IN 40', #25 SLOT, 5"-2' STUB ON TOP
12:20	POURING SAND
12:50	3 SACKS BENTONITE; INTERMITTENT AIR LIFT; TRYING TO SETTLE SAND
13:10	AIR LIFT - 25 gpm - LOTS OF SAND, MILKY, WON'T SEAL AT TOP
13:30	AIR LIFT - 25+ gpm
14:06	AIR LIFT - 30+ gpm; STILL PRODUCING FINE SAND
14:26	END AIR LIFT

WELL: TW5-3
DATE: 2/12/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-2	COVER
2-4	SHELBY TUBE
4-6	SHELBY TUBE
6-8	SHELBY TUBE
5-10	TAN AND GREY; FINE TO MEDIUM SAND
10-15	GREY SAND, FINE TO MEDIUM SAND ≈ 15% BROWN CLAY
15-20	FINE TO MEDIUM GREY SAND
20-25	FINE TO MEDIUM GREY SAND
25-30	FIND TO MEDIUM GREY SAND
30-35	FINE TO MEDIUM GREY SAND
35-40	FINE TO MEDIUM GREY SAND
40-45	FINE TO MEDIUM GREY SAND
45-50	FINE TO COARSE TAN SAND; SOME CLAY ≈ 10%

DRILL TIME LOG	
11:30	ON SITE, SETTING UP
12:30	PIT DUG, DRILLER STILL SETTING UP
12:40	DRILLING W/ AIR & SAMPLING - SHELBY TUBES
13:20	MIXING MUD AND DRILLING
13:26	DRILLING @ 20'
14:00	CASING
15:30	PLACING SAND, 30 BAGS - 21' BELOW SURFACE
16:00	OUT OF SAND, LEAVE UNTIL MONDAY
17:00	GOT 20 BAGS 8-12 SAND, PUT 14 IN HOLE
2/15/93	
8:10	DRILLERS ON SITE
8:40	WARMING EQUIPMENT
9:30	SAND 2' FROM SURFACE, TOPPED W/ 2 BAGS BENTONITE
10:00	SAND DROPS WHEN AIR IS APPLIED, WATER BUBBLING UP ANNULOS; ADDED 2 BAGS BENTONITE

TABLE A.1-8. LITHOLOGIC LOGS FOR NS-1 & NS-2.

WELL: NS-1
DATE: 3/8/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	SANDY CLAY, MIXED COVER
5-10	CLAYEY SAND
10-15	SANDY CLAY
15-20	SANDY CLAY, RED AND WHITE
20-25	WHITE SANDY CLAY
25-50	BROWN AND RED CLAYSTONE
50-55	WHITE CLAYSTONE
55-60	RED AND WHITE CLAYSTONE
60-65	WHITE SANDY CLAY, MEDIUM TO VERY COARSE SAND
65-70	WHITE SANDY CLAY W/ SMALL GRAVEL
70-75	MEDIUM TO VERY COARSE SAND, LENSE OR RED CLAYSTONE
75-80	MEDIUM TO COARSE SAND AND GRAVEL, SOME CLAY
80-85	WHITE SANDY CLAY
85-90	MEDIUM TO COARSE ORANGE AND WHITE SAND
90-95	WHITE SANDY CLAY, COARSE SAND
95-100	RED CLAYSTONE AND WHITE SANDY CLAY

DRILL TIME LOG

7:45	DRILLER'S ON SITE
8:00	MOVING TO WELL LOCATION
8:30	SETTING UP
9:13	@ 60', 5" PILOT
9:37	@ 100', 5" PILOT
9:40	LOGGING
10:35	REAMING 9 5/16"
11:51	CASING IN
12:20	SAND IN
12:25	AIR LIFT, 7-8 gpm, VERY DIRTY
12:38	4-5 gpm, MILKY, PRODUCING SOME SAND
13:14	END AIR LIFT, ≈ 3 gpm, CLEAR WITH A LITTLE BIT OF VERY FINE SAND

WELL: NS-2
DATE: 3/8/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	BROWN CLAY
5-15	LIGHT BROWN CLAYSTONE, FIRM
15-20	LIGHT BROWN CLAYSTONE (3'), WHITE SANDY SILTSTONE (2')
20-25	WHITE SANDY SILTSTONE
25-30	WHITE SANDY SILTSTONE W/ SOME SMALL GRAVEL
30-35	WHITE SANDY SILTSTONE
35-40	SANDY SILTSTONE W/ VERY COARSE RED SAND
40-45	SANDY SILTSTONE W/ VERY COARSE SAND AND SMALL GRAVEL
45-50	OLIVE CLAYSTONE
50-55	OLIVE CLAYSTONE W/ WHITE CLAY AND SILTSTONE

DRILL TIME LOG

13:45	@ LOCATION, SETTING UP
14:01	DRILLING
14:35	@ 55' - LOGGING
14:49	DUMPED 2 BAGS PLUG IN HOLE, REAMING 9 5/16" TO 47'
15:37	CASING IN
15:50	SAND IN
16:00	AIR LIFT, VERY DIRTY, 3-4 gpm
16:27	END AIR LIFT, 3 gpm, SLIGHTLY CLOUDY
16:50	DRILLER'S LEAVING

TABLE A.1-9. LITHOLOGIC LOGS FOR STH-1 & STH-1A.

WELL: STH-1
DATE: 4/12/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	BROWN, SANDY CLAY
5-10	BLUISH GREY CLAY, ≈ 30% BROWN, SANDY CLAY
10-40	BLUISH DARK CLAY
70-80	SEE STH-1A

NOTE: NO RETURNS 40'-70'

DRILL TIME LOG	
12:30	ON SITE
16:30	DRILLER'S LEAVING; @ 40'
4/28/93	
7:50	DRILLER'S ON SITE; SETTING UP

WELL: STH-1A
DATE: 4/12/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
SHELBY TUBE SAMPLE	
60-63.5	SAND ON BOTTOM, CLAY ON TOP
63.5-67	SAND - CLAY & DARK CARBONACEOUS SHALE, SHALE ON TOP
70-73	RED & GREY CLAY
73-76	BROWN CLAY
76-80	LIGHT TO DARK GREY CLAY

NOTE: NO RETURNS 40'-70'

DRILL TIME LOG	
8:01	DRILLING
10:00	@ 60' - GETTING TUBE SAMPLES 60'-67'
11:00	DONE @ 90' - LOGGING

TABLE A.1-10. LITHOLOGIC LOGS FOR WELLS STH-2 & STH3.

WELL: STH-2
DATE: 4/28/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-10	MIXED TAN & BROWN SAND W/ SOME GREY SHALE
10-15	TAN & ORANGE SAND W/ SOME GREY CLAY
15-25	TAN & WHITE FINE TO VERY FINE SAND, SOME CLAY
25-30	1/2 ABOVE; 1/2 GRAYISH BLUE CLAY
30-40	GRAYISH BLUE CLAY
40-45	GREY TO BLACK CLAY
45-50	ADDING WATER
50-55	MIXED COARSE TO VERY COARSE SAND W/ SMALL FRACTION CLAY FROM ABOVE
55-75	BLUISH GREY CLAY
75-80	BLUISH GREY CLAY GRADING TO BROWN CLAY
80-85	TAN & ORANGE SAND, ≈ 30% DARK COLORED CLAY
85-90	VERY FINE WHITE SAND
90-95	FINE TO MEDIUM WHITE SAND, ≈ 10% BLUE CLAY
95-100	TAN & WHITE FINE TO COARSE SAND

DRILL TIME LOG

11:15	DRILLING
11:27	SAMPLE 10'-17'
12:40	SAMPLE 40'-47'
14:00	PUT WATER IN THROUGH RIG
14:30	TRIED TO LOG; HOLE CAVED @ ≈ 15'; DRILLER

WELL: STH-3
DATE: 4/28/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	BROWN CLAY
5-40	BLUISH GRAY CLAY
	CAVED IN - HAD TO MOVE
40-70	BLUISH GRAY CLAY - MOIST
70-75	DARK GRAY & BROWN CLAY

DRILL TIME LOG

15:00	DRILLING
15:30	SAMPLE @ 20'
4/29/93	
9:15	DRILLER'S @ 80'
9:50	DRILLER'S MOVING TO STH-4

TABLE A.1-11. LITHOLOGIC LOGS FOR STH-4, STH-5, & STH-6.

WELL: STH-4
DATE: 4/29/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION	DRILL TIME LOG	
0-5	BROWN CLAY, SOME COARSE SAND	11:10	MOVING TO STH-5
5-10	BLUE & BROWN CLAY		
10-40	BLUISH GRAY CLAY		

WELL: STH-5
DATE: 4/29/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION	DRILL TIME LOG	
0-5	BROWN & TAN (OXIDIZED) SAND	11:30	SET UP
5-25	VERY FINE TO MEDIUM BROWN & TAN SAND W/ BLUE CLAY LENSES	14:00	DONE
25-30	PREDOMINANTLY BLUE CLAY, SOME SAND		
30-40	BLUE CLAY		
40-45	BLUE CLAY W/ FINE RED SAND		
45-50	BLUE CLAY, SOME SAND AND SILT		
50-55	DARK CARBONACEOUS CLAYSTONE		
55-60	BLUISH CLAY W/ SOME BROWN & RED CLAY		

WELL: STH-6
DATE: 4/29/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION	DRILL TIME LOG	
0-5	BROWN & BLUE CLAY	16:00	MOVED TO STH-7
5-35	BLUE CLAY		
35-40	BLUE CLAY W/ SOME LENSE OF LIGHT BROWN SAND		
40-45	1/2 BLUE CLAY, 1/2 BROWN SAND		
45-55	FINE TO COARSE LIGHT BROWN SAND		
55-60	BLUE CLAY		
60-75	LIGHT BROWN SAND W/ ≈ 30% BLUE CLAY		
75-80	DARK CLAY & BROWN CLAY		

TABLE A.1-12. LITHOLOGIC LOGS FOR STH-7, STH-8, & STH-9.

WELL: STH-7
DATE: 4/30/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	BROWN & RED CLAY
5-40	BLUE CLAY
40-50	BROWN & RED CLAY
50-55	LIGHT BROWN & TAN SANDY CLAY
55-60	VERY FINE TO MEDIUM WHITE SAND

DRILL TIME LOG	
9:30	DONE - MOVING TO STH-8

WELL: STH-8
DATE: 4/30/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	LIGHT BROWN CLAY
5-10	BROWN CLAY
10-25	BLUE CLAY
25-35	BLUE CLAY W/ SAND LENSE, 1/2 & 1/2
35-40	BLUE CLAY
40-45	CLAY - GRADING TO LIGHT COLORED COARSE TO VERY COARSE SAND
45-50	FINE TO MEDIUM TAN & LIGHT BROWN SAND W/ BLUE CLAY BELOW

DRILL TIME LOG	
9:40	SET UP & DRILLING
10:59	MOVING TO STH-9

WELL: STH-9
DATE: 4/30/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-10	BROWN CLAY
10-30	BLUISH GRAY CLAY
30-35	BROWN-GRAY CLAY

DRILL TIME LOG	
12:59	MOVING TO STH-10

TABLE A.1-13. LITHOLOGIC LOGS FOR STH-1Ø & STH-11.

WELL: STH-1Ø
DATE: 5/3/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
Ø-2Ø	BROWN & BLUISH CLAY
2Ø-25	GRADING DARKER
25-3Ø	MIXED CLAY; BLUE BROWN CLAY
3Ø-35	BLUISH GRAY CLAY
35-4Ø	GRAY & BROWN CLAY W/ VERY COARSE SAND & SMALL GRAVEL

DRILL TIME LOG

8:ØØ	SET UP - START DRILLING
9:31	MOVING TO STH-11

WELL: STH-11
DATE: 5/3/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
Ø-5	BROWN CLAY
5-1Ø	BLUISH CLAY
1Ø-15	DARK GRAY CLAY
15-3Ø	GRAY & BLUISH CLAY

DRILL TIME LOG

1Ø:13	FOLDING DOWN; MOVING TO NORTH DUMP

TABLE A.1-14. LITHOLOGIC LOG FOR WELL NTH-1 & NTH-2.

WELL: NTH-1
DATE: 5/3/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-20	LIGHT BROWN CLAYEY SAND
20-25	1/2 LIGHT BROWN SANDY CLAY, 1/2 BLUISH CLAY
25-90	BLUISH CLAY
90-95	SAND LENSE, VERY FINE TO MEDIUM TAN SAND
95-115	BLUE CLAY W/ VERY FINE TO FINE SAND
115-120	FINE TO COARSE SAND W/ BLUE CLAY

DRILL TIME LOG	
11:10	SETTING UP
12:21	@ 60'
14:42	MOVING TO NTH-2

WELL: NTH-2
DATE: 5/3/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	VERY FINE LIGHT BROWN SAND W/ SOME SILT
5-10	LIGHT BROWN SILTY SAND
10-20	BLUISH GRAY CLAY
20-25	VERY FINE TO MEDIUM WHITE SAND
25-30	FINE TO MEDIUM LIGHT BROWN SAND
30-35	FINE TO VERY COARSE TAN SAND
35-40	FINE TO VERY COARSE TAN SAND W/ STRINGER OF BLUE CLAY
40-45	TAN & BROWN CLAYEY SAND
45-50	FINE TO COARSE LIGHT BROWN SAND
50-55	MEDIUM TO VERY COARSE BROWN CLAYEY SAND
55-60	MEDIUM TO VERY COARSE REDDISH BROWN CLAYEY SAND
60-95	VERY FINE TO MEDIUM RED SILTY SAND
95-100	MEDIUM TO COARSE ORANGE (OXIDIZED) SAND; LITTLE CLAY
100-115	VERY FINE TO MEDIUM ORANGE SAND
115-160	FINE TO COARSE REDDISH BROWN CLAYEY SAND

DRILL TIME LOG	
15:30	@ 50'
17:00	DRILLER'S FUELING TRUCK; GETTING READY TO LEAVE

TABLE A.1-15. LITHOLOGIC LOGS FOR NTH-3 & NTH-4.

WELL: NTH-3
DATE: 5/4/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-5	GREENISH BROWN CLAY
5-10	WHITE SANDY CLAY; VERY FINE SAND
10-15	BROWN & TAN CLAY; SOME SAND
15-20	DARK CARBONACEOUS CLAY
20-25	BLUISH CLAY - SHALE-LIKE STRUCTURE
25-35	BLUISH CLAY - SHALE-LIKE STRUCTURE, SHADING DARKER
35-40	VERY COARSE SAND, SOME CLAY AS ABOVE
40-45	FINE TO COARSE SAND, SOME BLUE CLAY
45-50	REDDISH BROWN SAND - FINE TO COARSE W/ SMALL GRAVEL
50-60	REDDISH BROWN SAND - FINE TO COARSE W/ SMALL GRAVEL; LIGHTER COLOR
60-80	VERY FINE TO MEDIUM LIGHT REDDISH SAND, SOME CLAY
80-90	FINE TO VERY COARSE LIGHT COLORED SAND - SMALL GRAVEL
90-95	FINE TO VERY COARSE LIGHT COLORED SAND - SMALL GRAVEL; GETTING FINER
95-105	VERY FINE TO MEDIUM LIGHT COLORED SAND, SOME RED CLAY
105-120	FINE TO VERY COARSE ORANGISH SAND

DRILL TIME LOG

8:00	DRILLER'S SET UP
10:50	SAMPLING @ 40'
12:20	MOVING TO NTH-4

WELL: NTH-4
DATE: 5/4/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-10	BROWN CLAY
10-15	VERY FINE LIGHT CLAYEY SAND
15-35	DARK CLAY - BLUE TINT
35-40	MEDIUM TO VERY COARSE ORANGE SAND
40-50	VERY FINE TO MEDIUM GRAY SAND
50-70	FINE TO VERY COARSE ORANGE SAND; SMALL CLAY FRACTION
70-75	SAME AS ABOVE - MORE CLAY
75-80	FINE TO COARSE CLAYEY SAND
80-85	MEDIUM TO VERY COARSE CLAYEY SAND
85-105	MEDIUM TO VERY COARSE LIGHT COLORED SAND
105-120	MEDIUM TO VERY COARSE ORANGE SAND, SOME CLAY

DRILL TIME LOG

12:30	DRILLER'S EATING LUNCH
12:40	SETTING UP
15:45	@ 145'
16:00	FUELING TRUCK, LEAVING

TABLE A.1-16. LITHOLOGIC LOGS FOR NTH-5 & NTH-6.

WELL: NTH-5
DATE: 5/5/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-15	VERY FINE LIGHT COLORED CLAYEY SAND
15-20	1/2 DARK CLAY - 1/2 LIGHT CLAYEY SAND
20-60	DARK (BLUISH) CLAY
60-65	1/2 DARK CLAY- 1/2 ORANGE SAND
65-85	MEDIUM TO VERY COARSE ORANGE SAND
85-90	ORANGE SAND W/ STRINGER OF BLUE CLAY
90-95	LIGHT BROWN CLAYEY SAND
95-110	LIGHT BROWN CLAYEY SAND, SOME ORANGE SAND
110-120	ORANGE SAND W/ ≈ 20% LIGHT COLORED CLAY

DRILL TIME LOG	
8:00	DRILLER'S SET UP
11:20	@ 120': RAINING HARD, LIGHTNING
11:40	RAIN QUIT, BACK TO DRILLING
12:00	MOVING TO NTH-6

WELL: NTH-6
DATE: 5/5/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-10	VERY FINE TO FINE LIGHT COLORED CLAYEY SAND
10-15	VERY FINE TO FINE LIGHT COLORED CLAYEY SAND; LENSE OF DARKER CLAYEY SAND
15-20	VERY FINE TO FINE LIGHT COLORED CLAYEY SAND; 18-20 DARK CLAY - CARBONACEOUS
20-25	DARK CLAY - CARBONACEOUS - SHALEY
25-30	DARK CLAY, ≈ 30% FINE SAND
30-35	DARK CLAY, LESS SAND
35-60	DARK CARBONACEOUS CLAY
60-65	4' DARK CLAY; 1' ORANGE CLAYEY SAND
65-80	ORANGE CLAYEY SAND

DRILL TIME LOG	
12:06	SETTING UP
13:45	DONE - GETTING READY TO MOVE

TABLE A.1-17. LITHOLOGIC LOG FOR NTH-7 & NTH-8.

WELL: NTH-7
DATE: 5/10/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-20	BROWN SANDY CLAY
20-25	DARK, BLUISH CLAY & BROWN SANDY CLAY
25-75	DARK, BLUISH CLAY
75-80	1' CLAY; 4' MEDIUM TO COARSE PINKISH SAND
80-95	MEDIUM TO COARSE PINKISH SAND
95-125	FINE TO VERY COARSE ORANGE SAND

DRILL TIME LOG

7:40	DRILLER'S SETTING UP
11:40	DONE - @ 130', TROUBLE W/ RETURN MOVING

WELL: NTH-8
DATE: 5/10/93
DRILLER: NUNN
ENGINEER: TGM

DEPTH	DESCRIPTION
0-15	LIGHT BROWN SANDY CLAY
15-30	WHITE SILTY SAND
30-50	LIGHT BROWN SANDY CLAY
50-95	BLUISH GREEN CLAY
95-100	1' CLAY AS ABOVE; 4' MEDIUM TO VERY COARSE TAN COLORED SAND

A.2 TEST HOLE GEOPHYSICAL LOGS

The geophysical logs for the test holes are presented in Section A.2 of Appendix A. Geophysical logs were developed for one test hole drilled in the No. 3 pond area, ten test holes on the No. 4 tailings area, and five test holes drilled in the No. 5 tailings area. One of the No. 5 test holes, NS-2, was drilled on the northeast side of the No. 5 dam. Geophysical logs for test holes OP-1 through OP-16 in the ore pad area are also presented in this section. Five geophysical logs (LGW) from the low grade ore pile on the west side of the No. 3 tailings were developed to define radiological conditions in this area. Concluding the section are two geophysical logs that were developed on the South overburden pile.

These geophysical logs present a natural gamma log, resistivity and SP. Resistivity and SP logs were not measured above the water level in the drill hole. The gamma log is very useful in the tailings in defining the lenses of slimes and sand layers. Depth in feet is presented on the left-hand scale of the geophysical log. The gamma log is generally presented on the left side of the log with increasing gamma values to the right. The resistivity log is typically presented on the right side of the graphs as a solid line, while the SP is presented as a dashed line. Gamma activities of less than 6,000 CPS and greater than 1,000 CPS are typically indicative of the tailings sand. Gamma values greater than 6,000 CPS indicate a tailings slime. Gamma values from the test holes are also very useful in defining depths of contaminated materials. For example, the log for test hole OP-6, which is presented in Figure A.2-19, shows that the ore stock pile pad in this region has elevated gamma values to a depth of 8′-9′. The material in this zone exceeds the site clean-up standard for RA-226 as demonstrated by the gamma log.

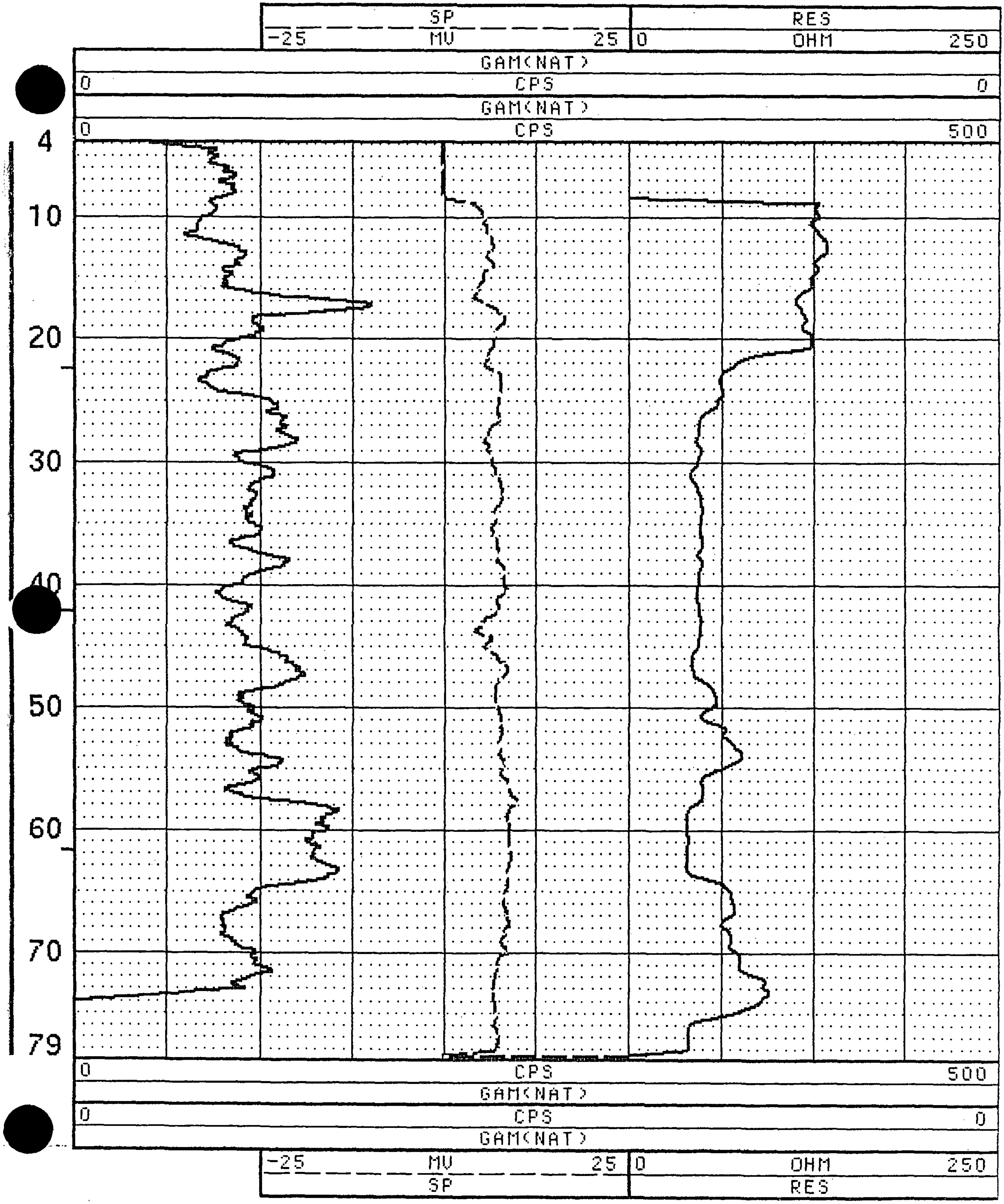


FIGURE A.2-1. GEOPHYSICAL LOG FOR TW3-1.

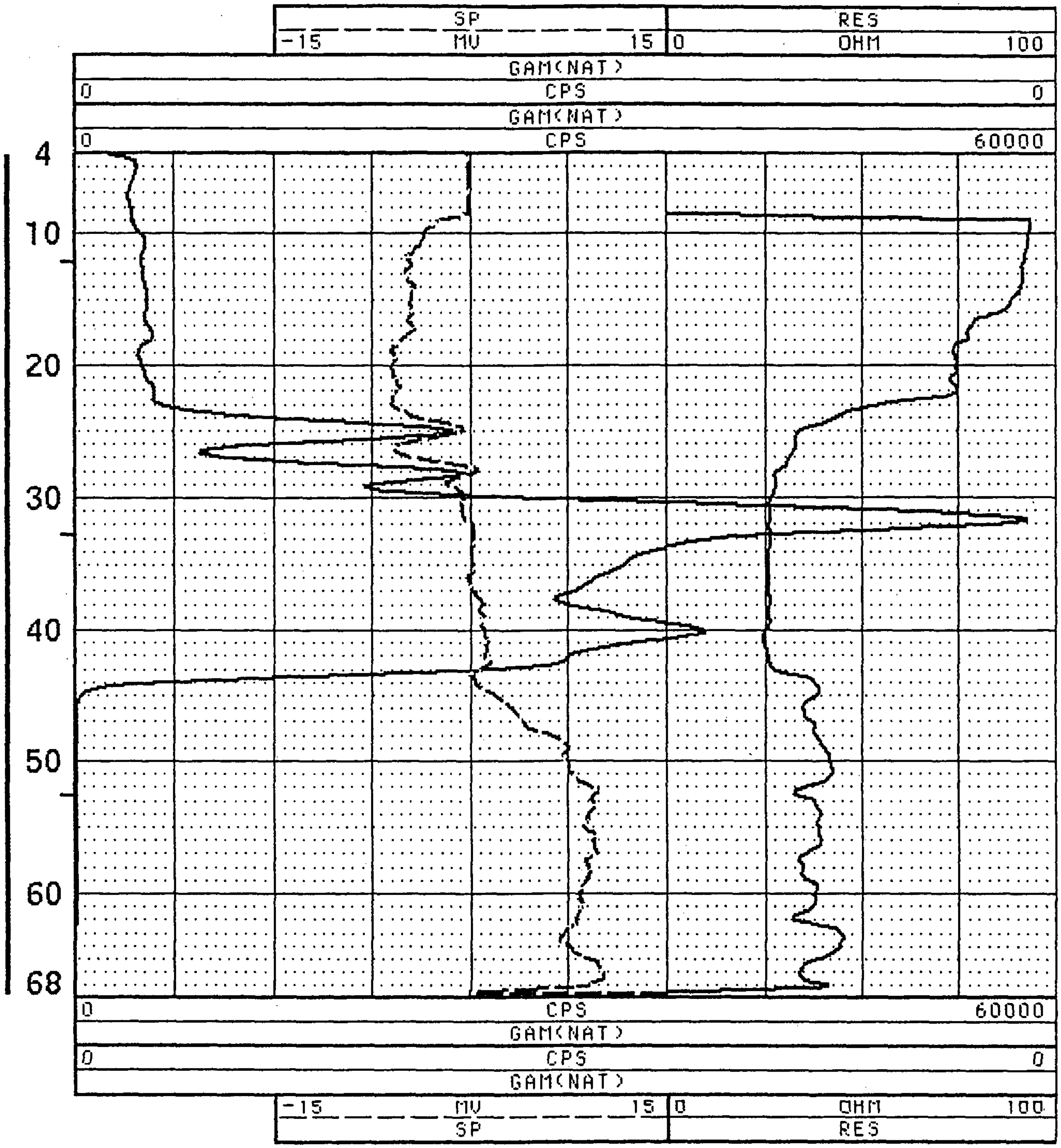


FIGURE A.2-2. GEOPHYSICAL LOG FOR TW4-1B.

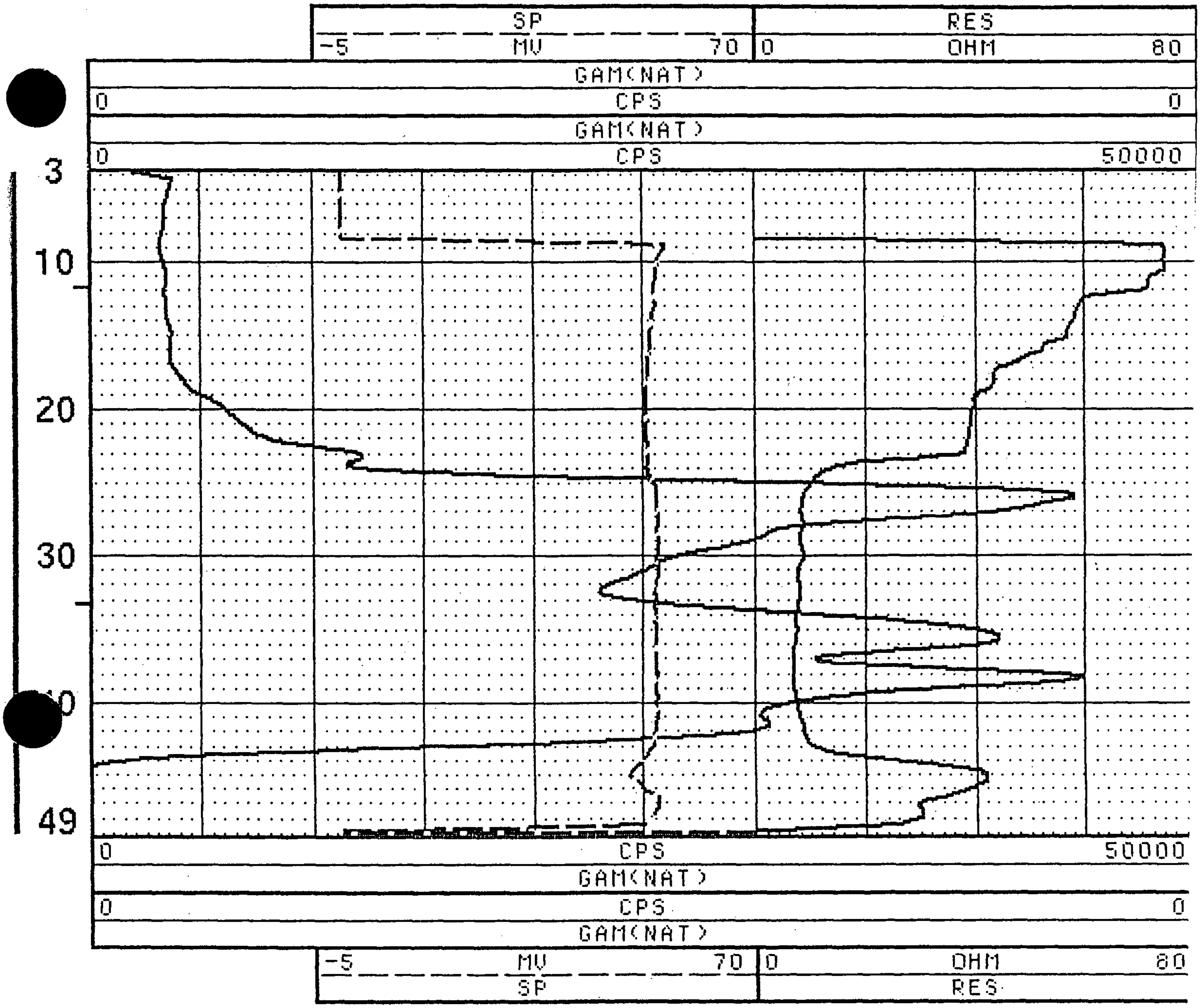


FIGURE A.2-3. GEOPHYSICAL LOG FOR TW4-1C.

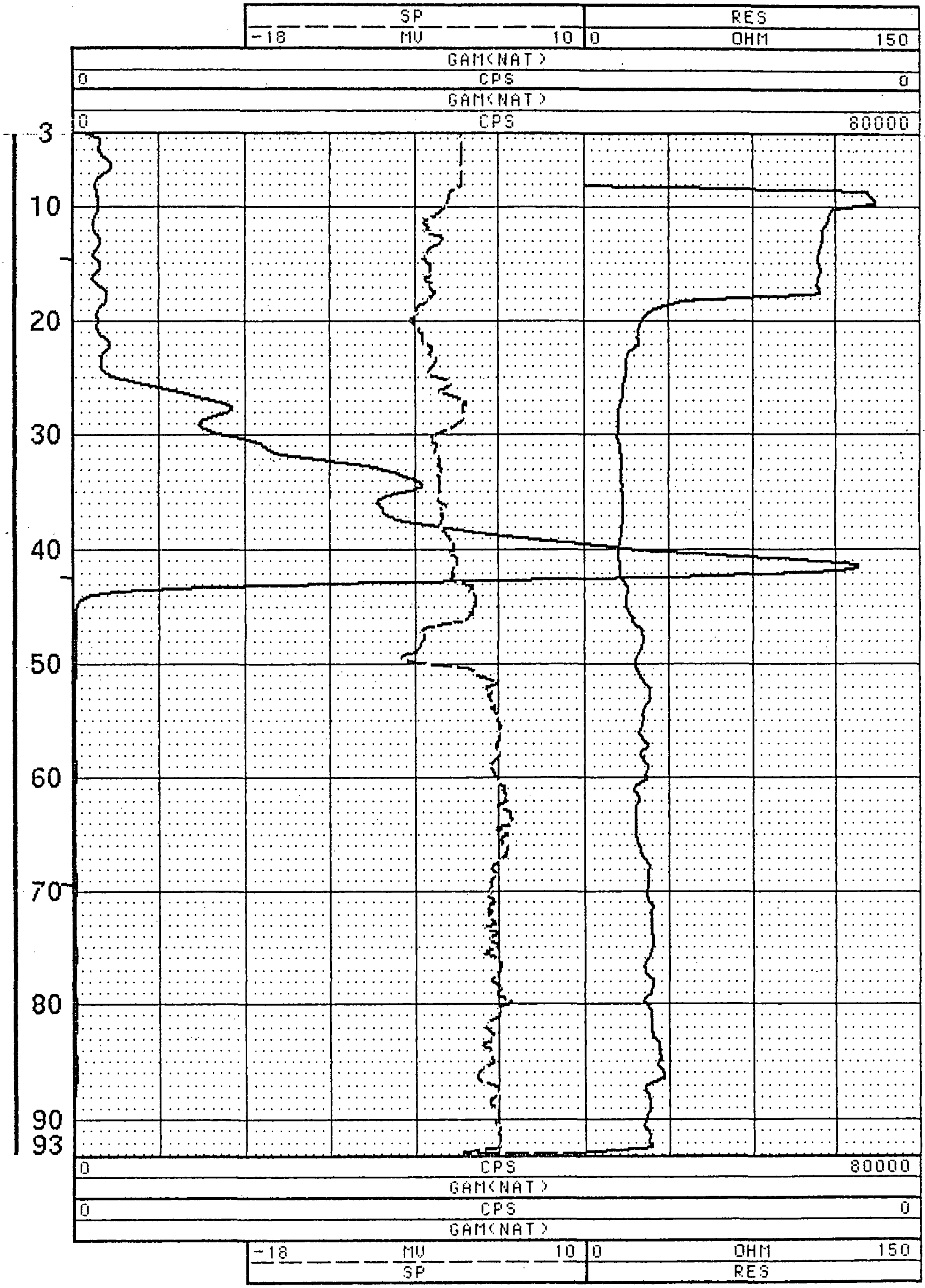


FIGURE A.2-4. GEOPHYSICAL LOG FOR TW4-2B.

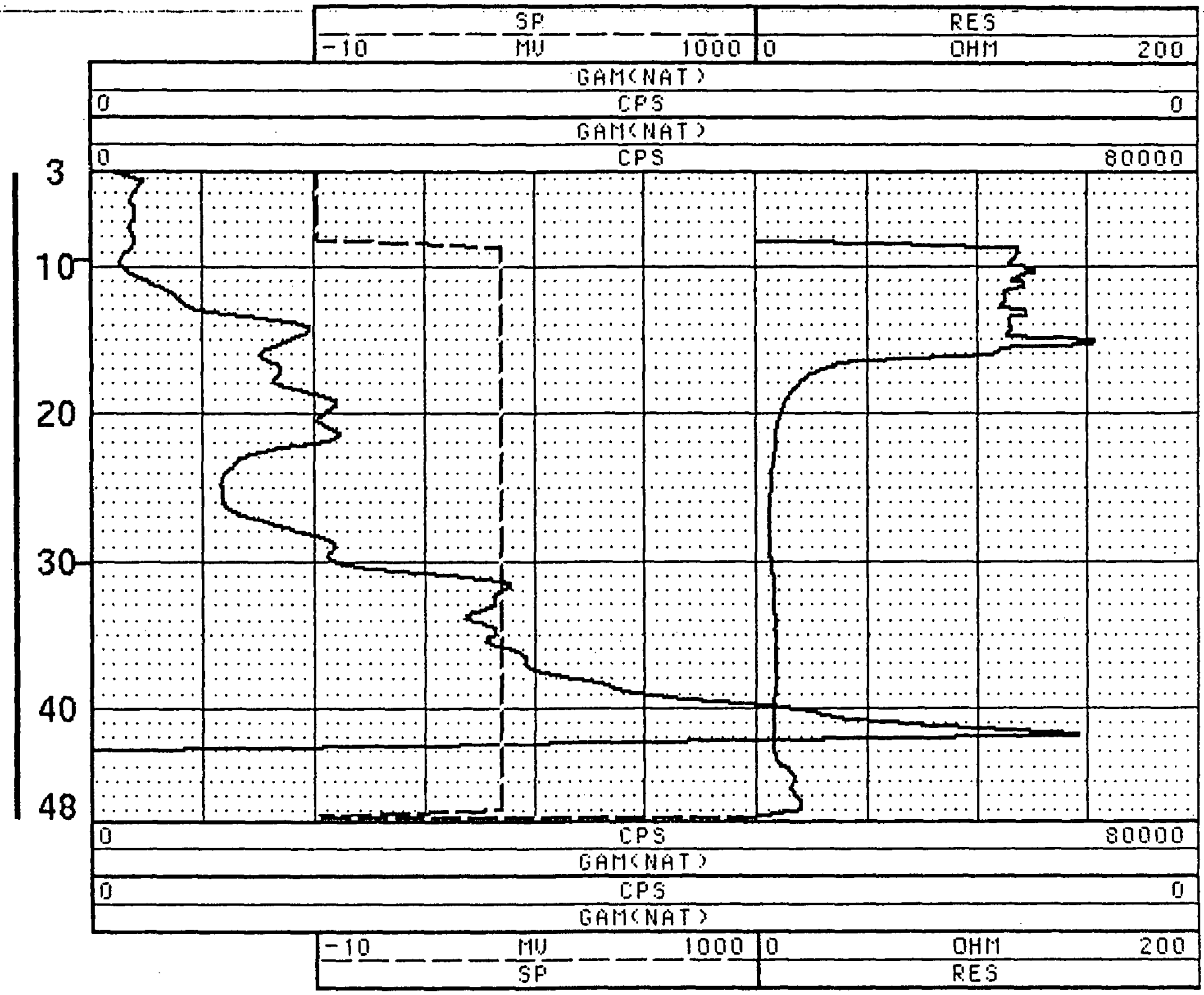


FIGURE A.2-5. GEPHYSICAL LOG FOR TW4-2C.

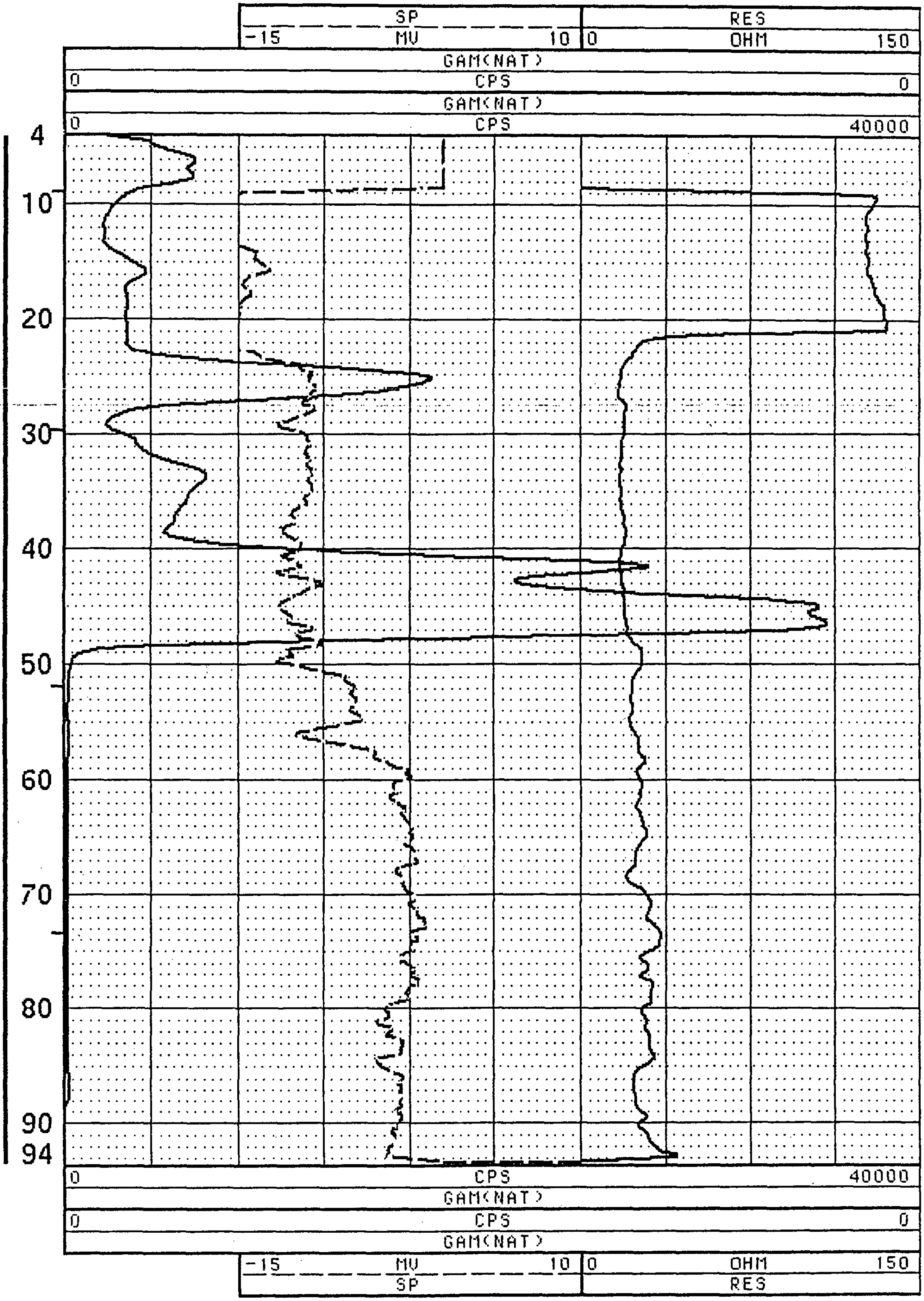


FIGURE A.2-6. GEOPHYSICAL LOG FOR TW4-3B.

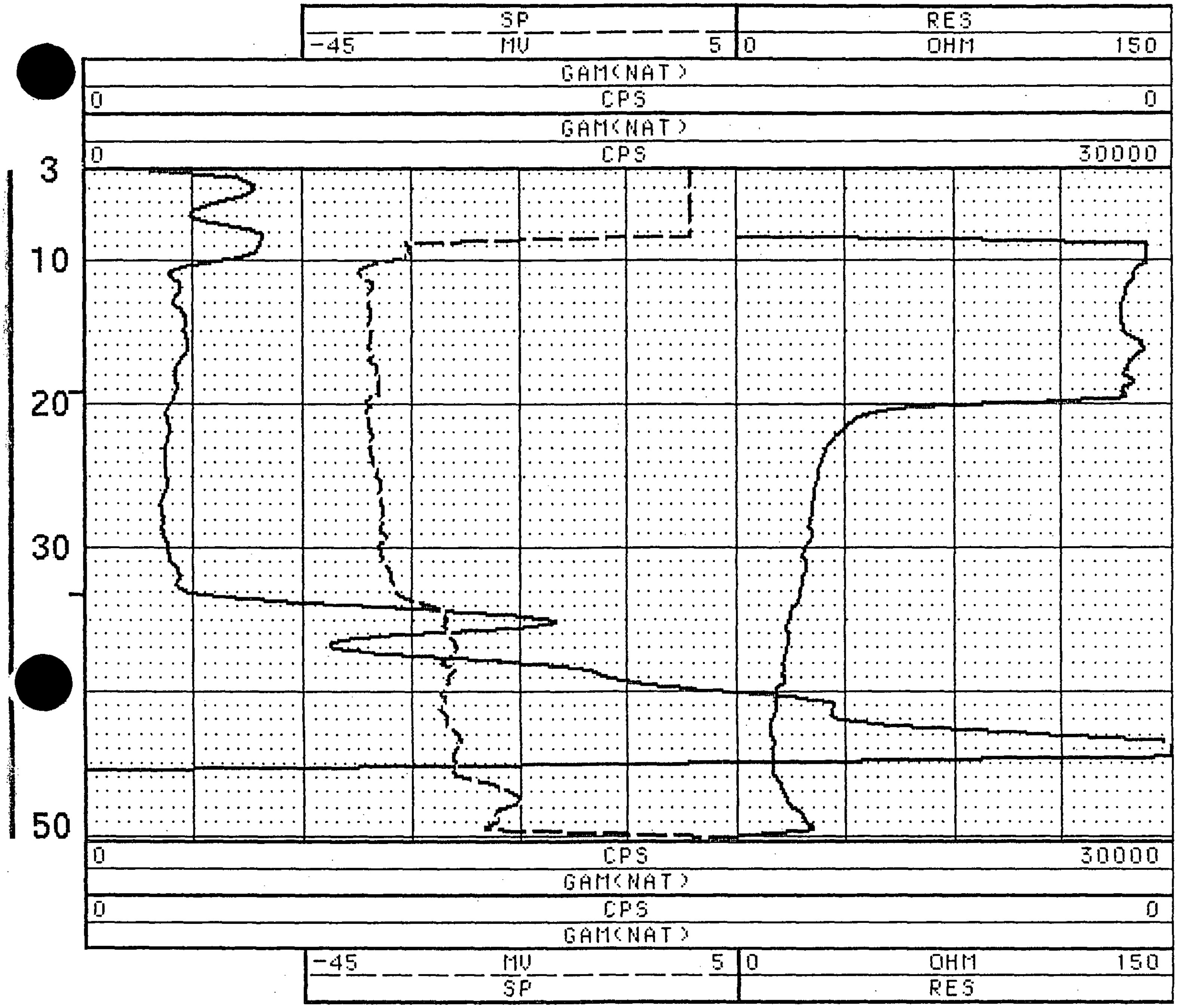


FIGURE A.2-7. GEOPHYSICAL LOG FOR TW4-3C.

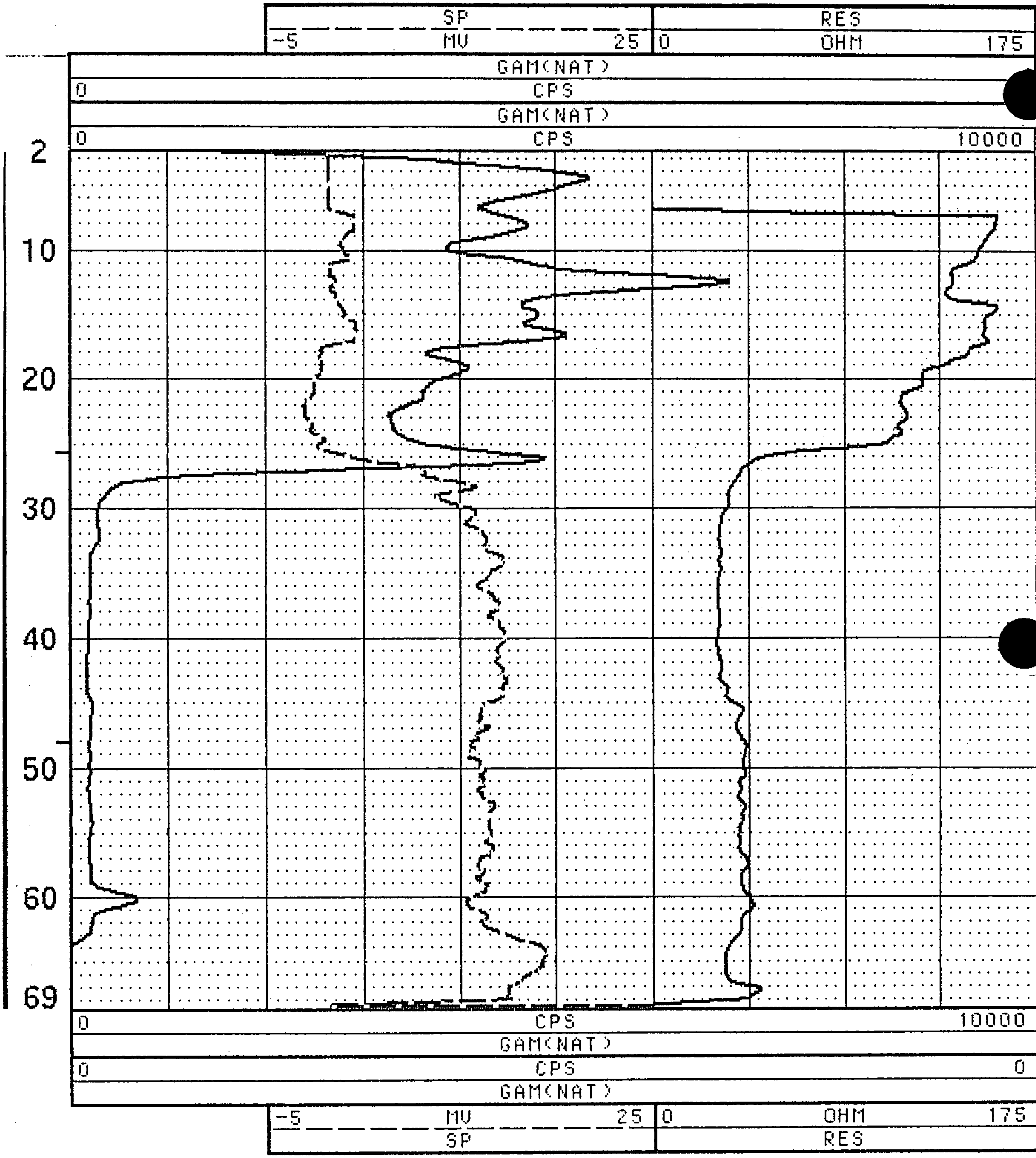


FIGURE A.2-8. GEOPHYSICAL LOG FOR TW4-4B.

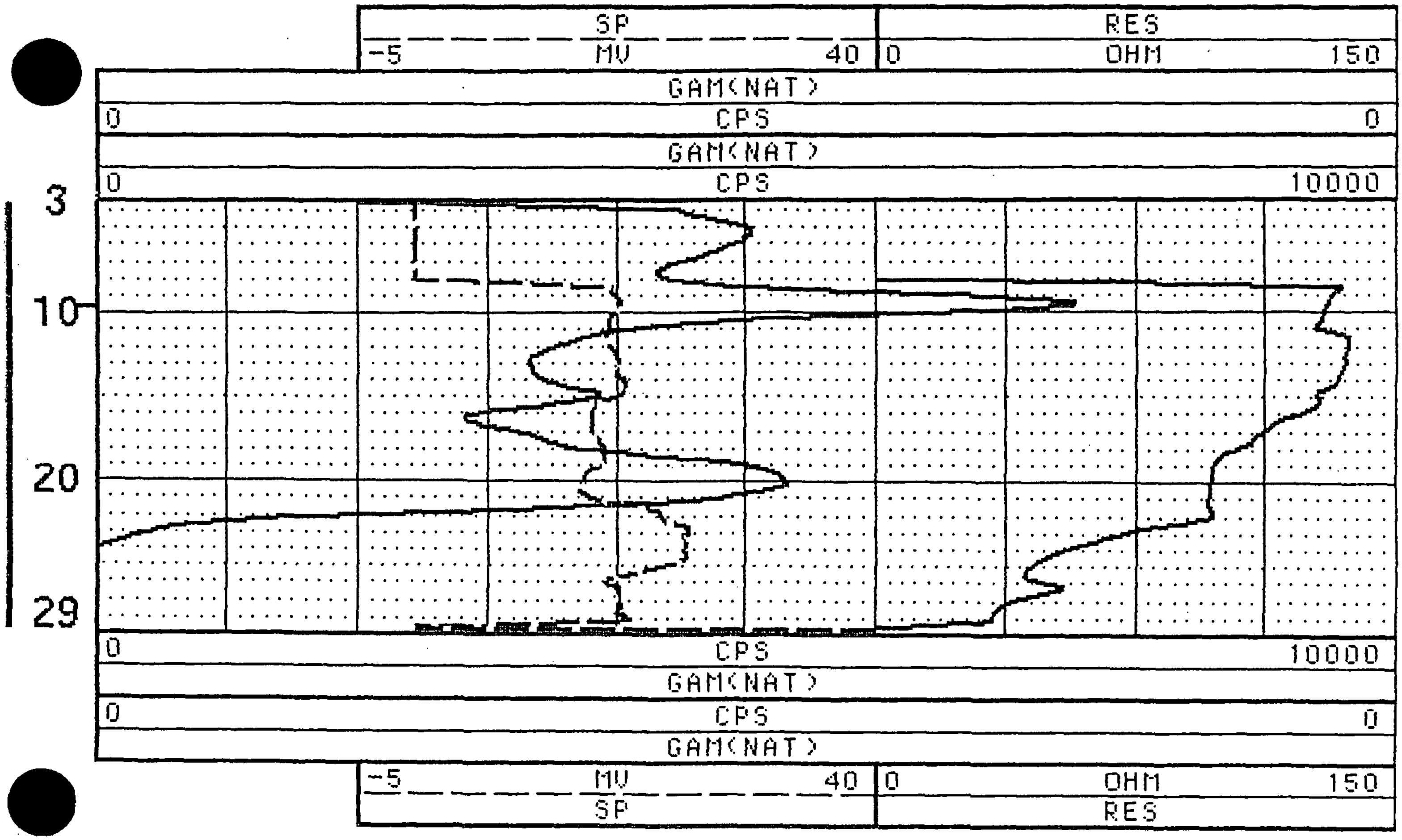


FIGURE A.2-9. GEOPHYSICAL LOG FOR TW4-4C.

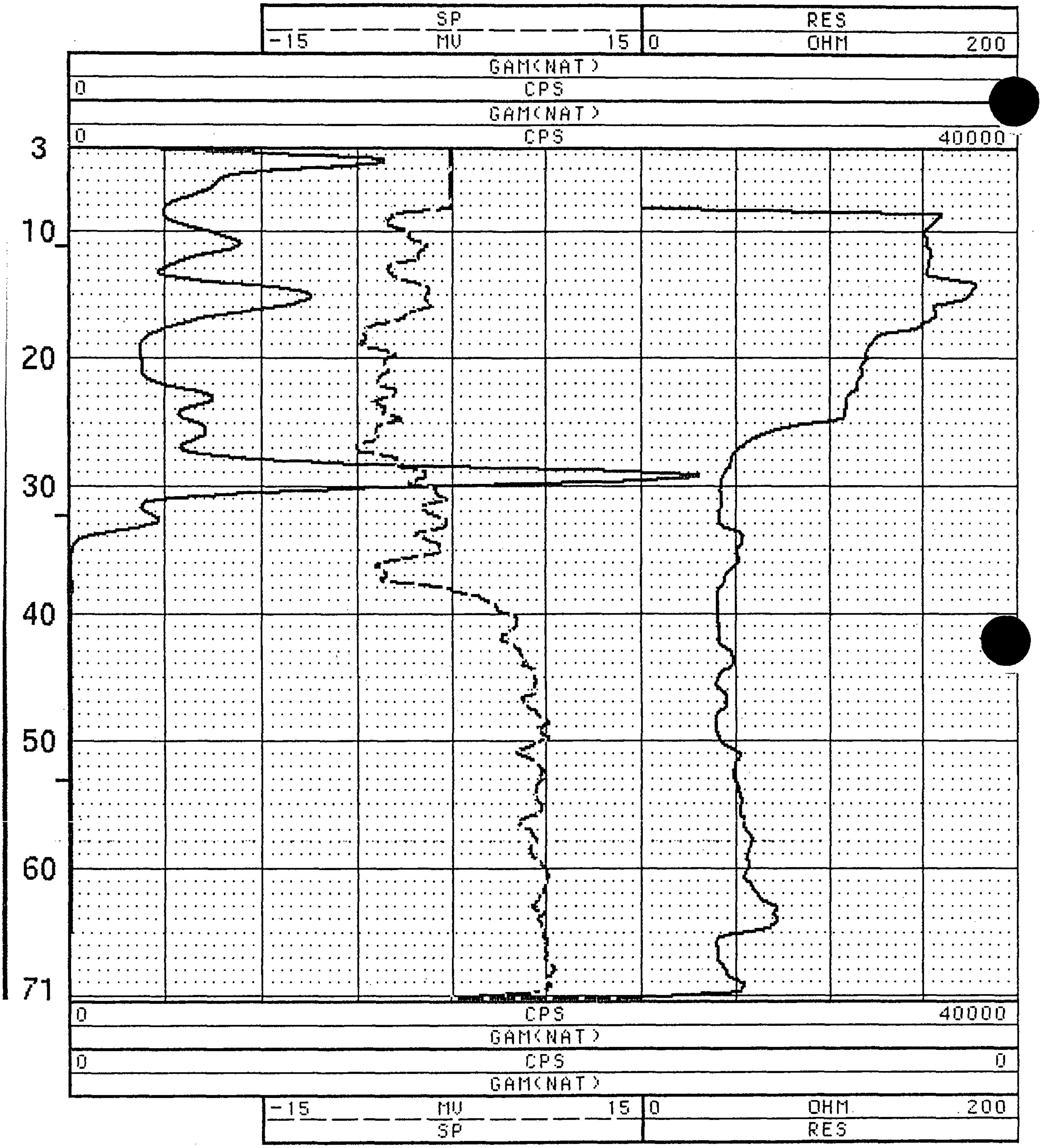


FIGURE A.2-10. GEOPHYSICAL LOG FOR TW4-5B.

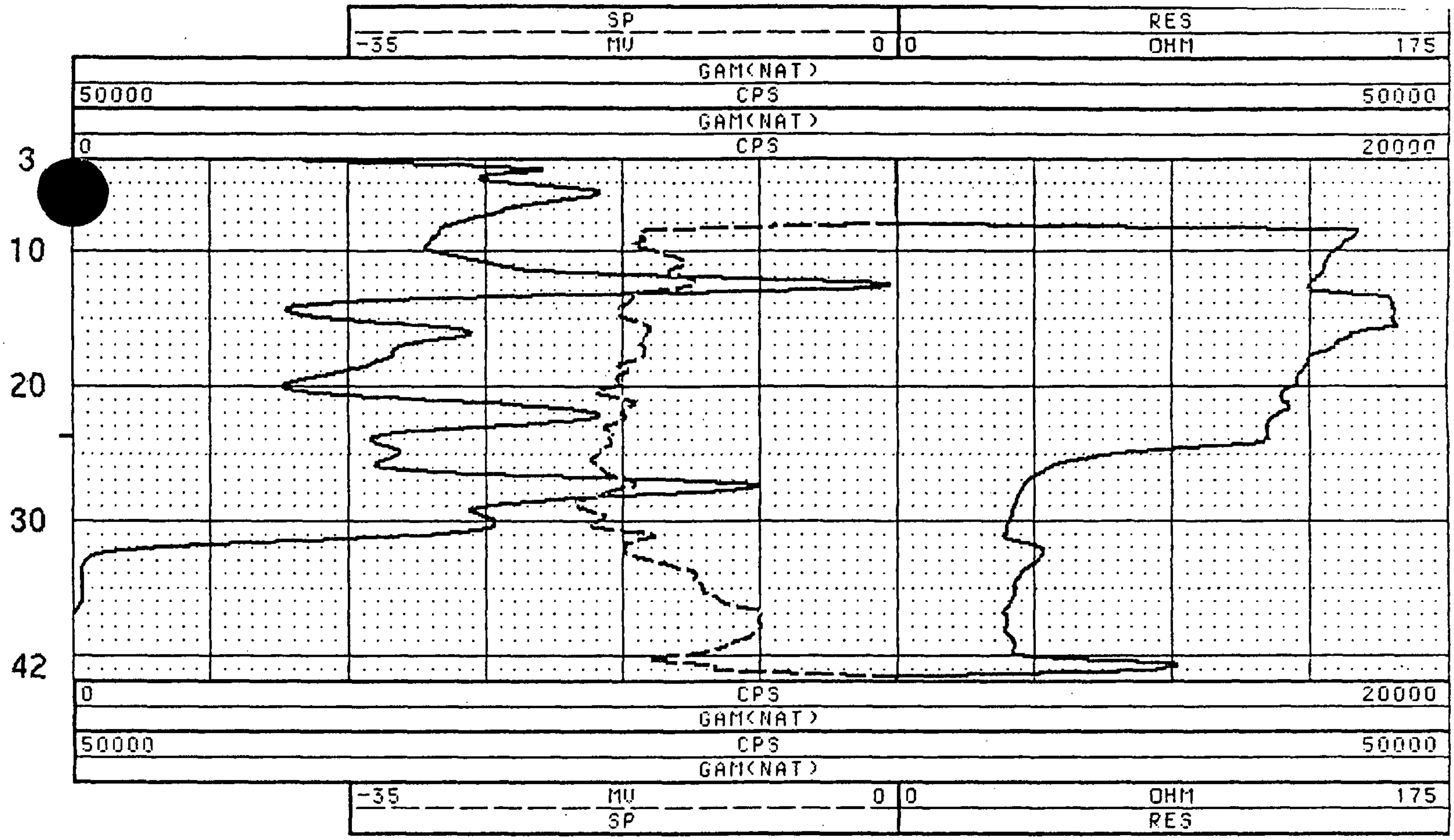


FIGURE A.2-11. GEOPHYSICAL LOG FOR TW4-5C.

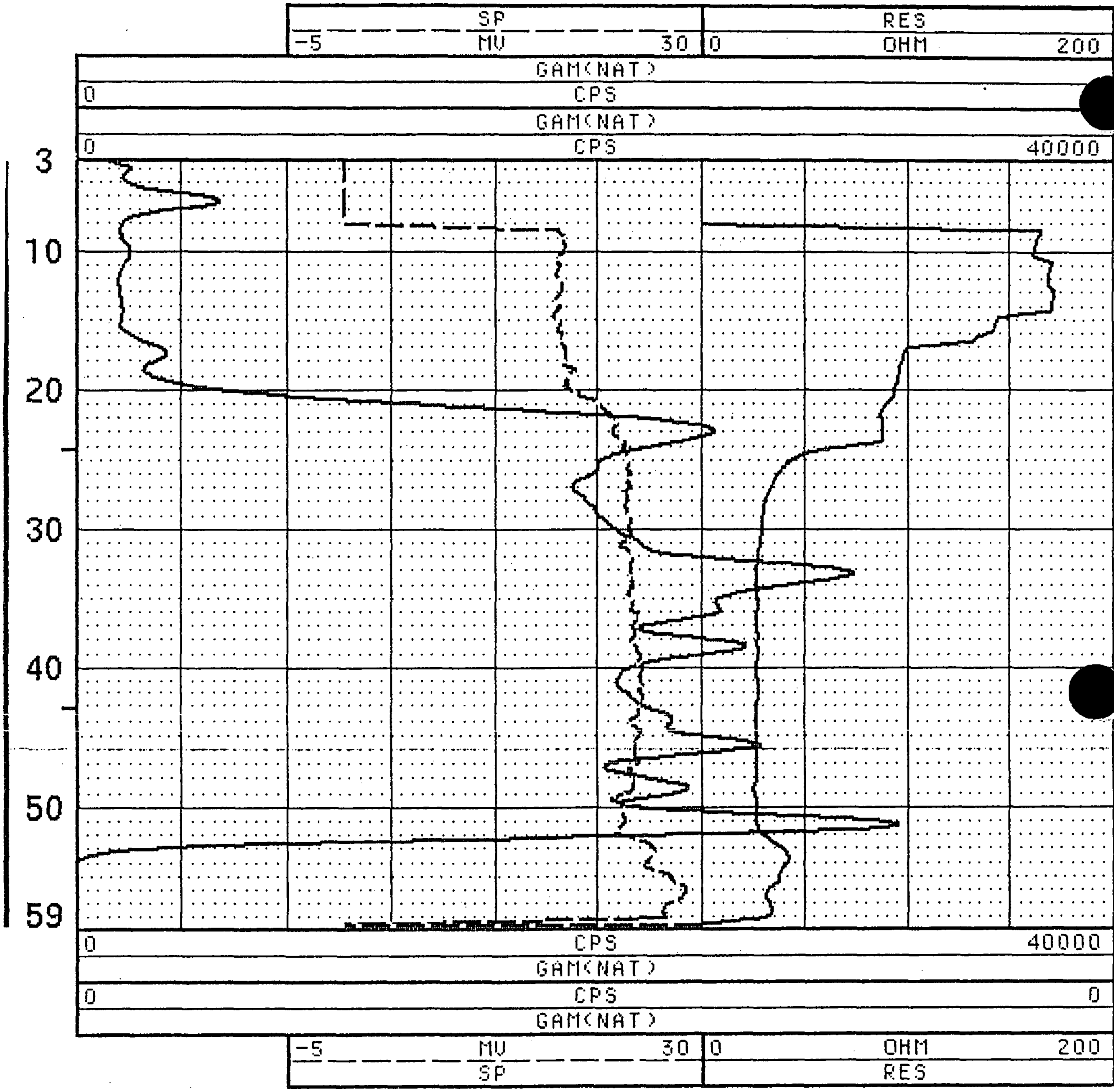


FIGURE A.2-12. GEOPHYSICAL LOG FOR TW5-1C.

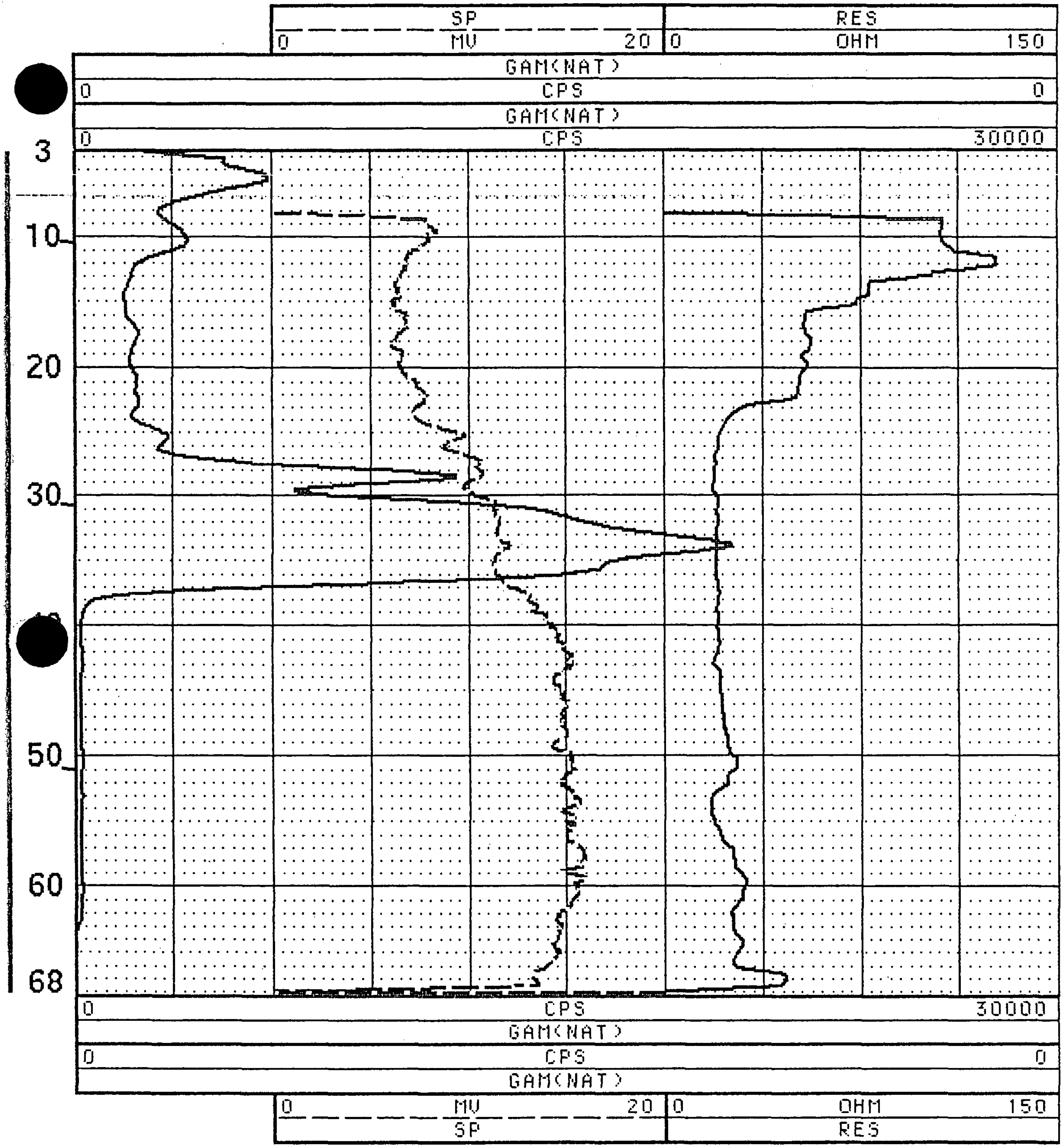


FIGURE A.2-13. GEOPHYSICAL LOG FOR TW5-2B.

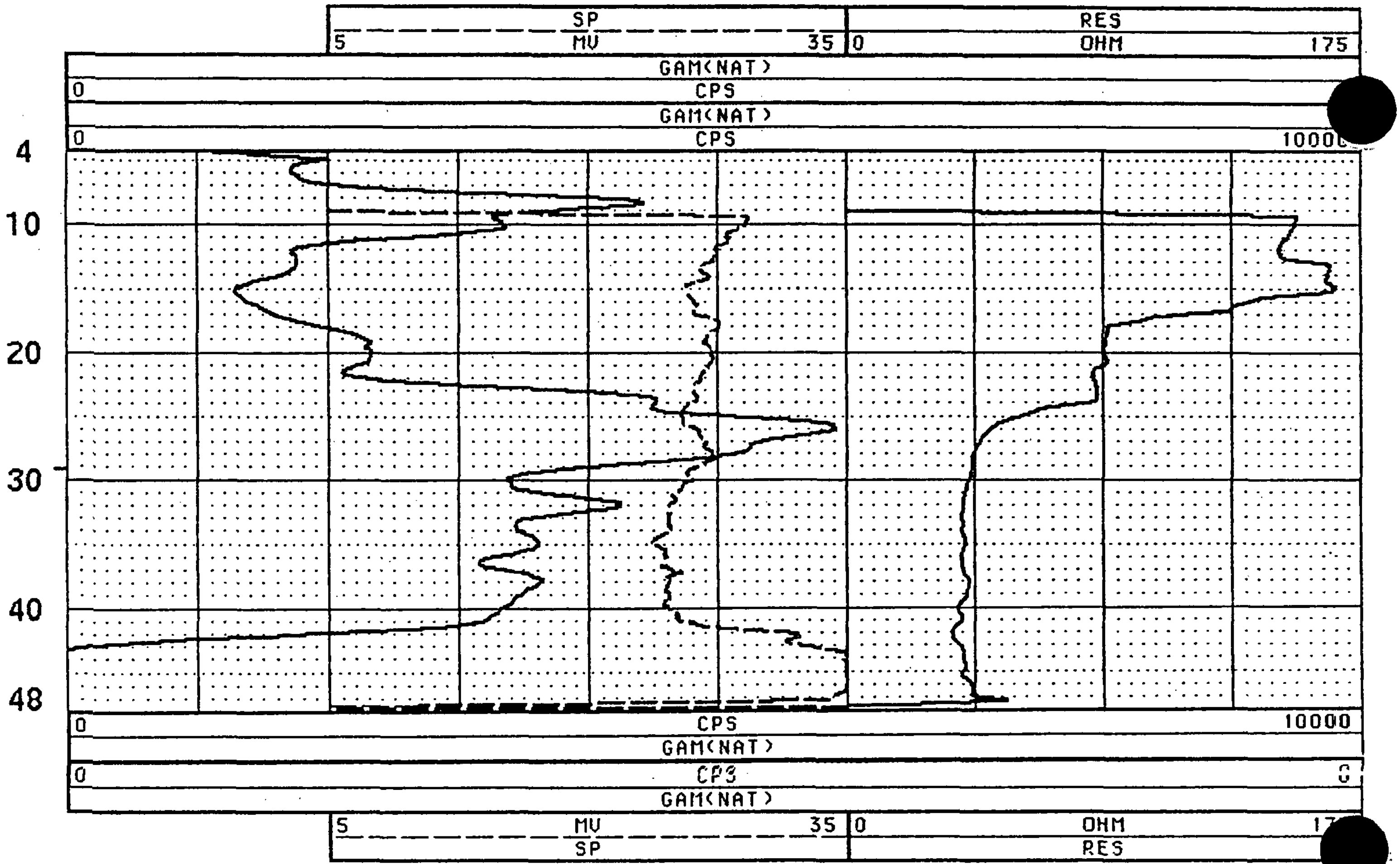


FIGURE A.2-14 GEOPHYSICAL LOG FOR TW5-3.

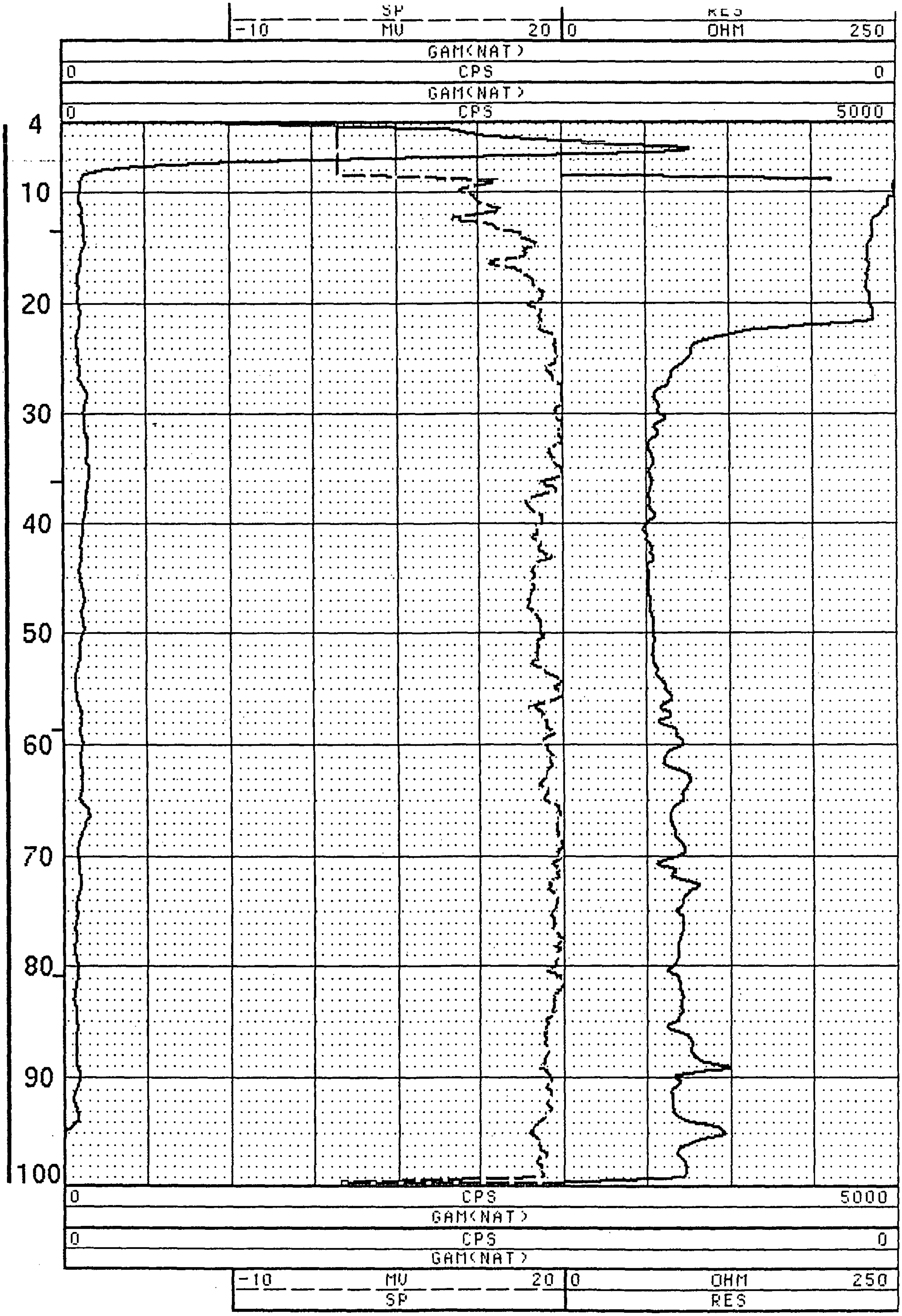


FIGURE A.2-15. GEOPHYSICAL LOG FOR NS-1.

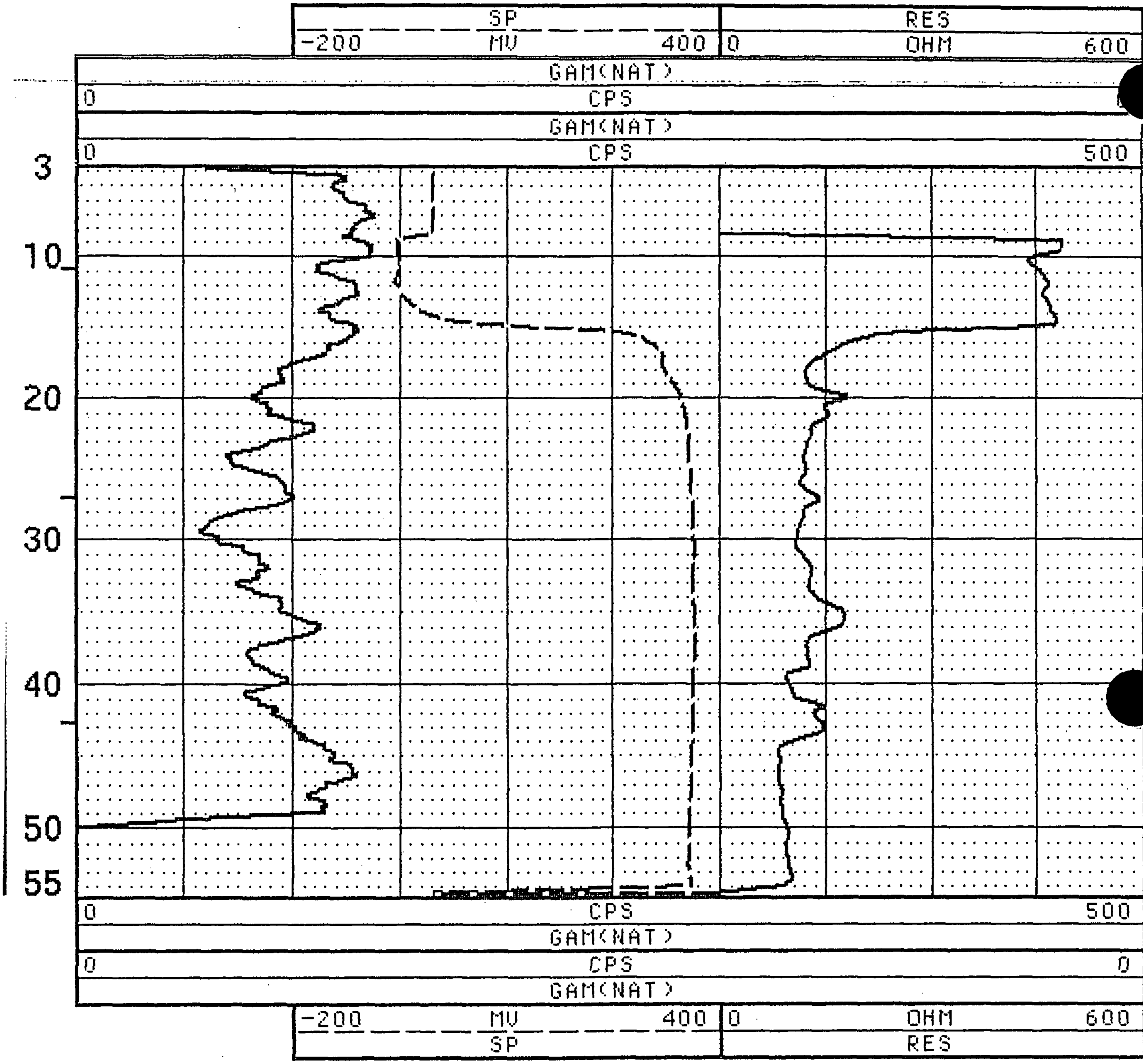
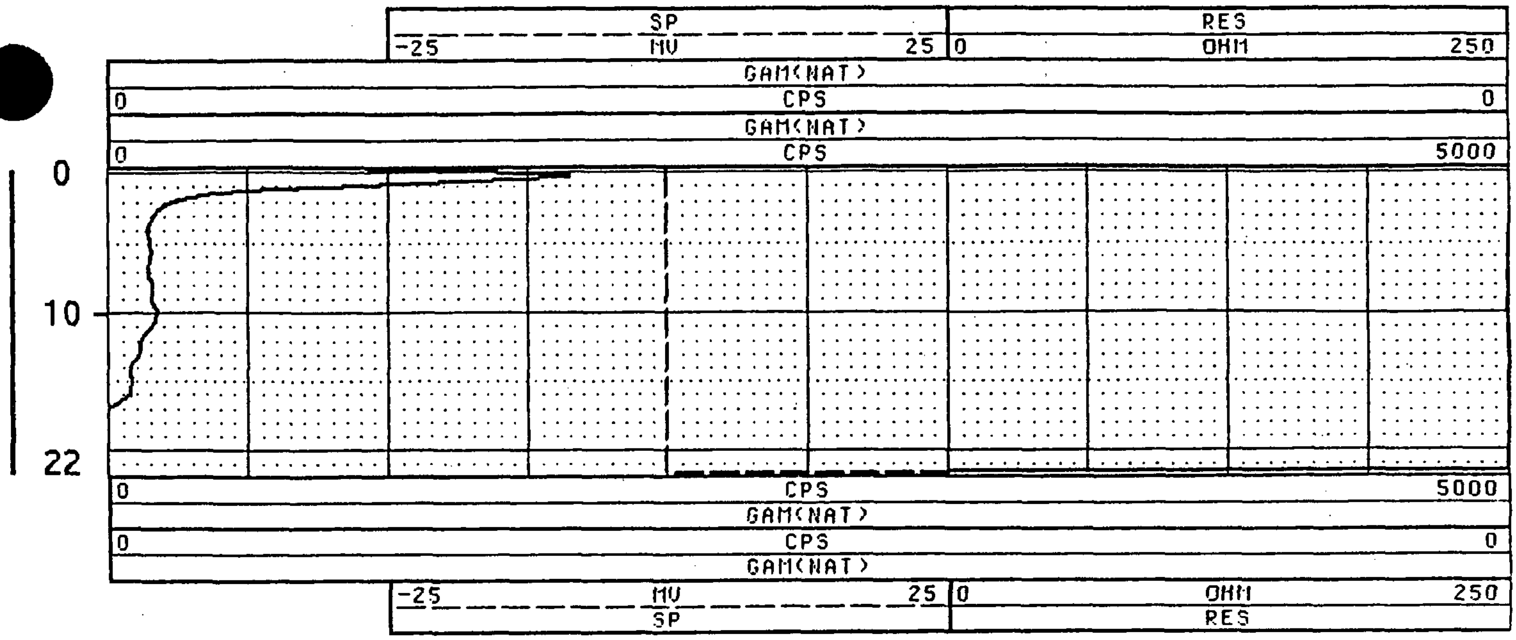


FIGURE A.2-16. GEOPHYSICAL LOG FOR NS-2.

OP-1



OP-2

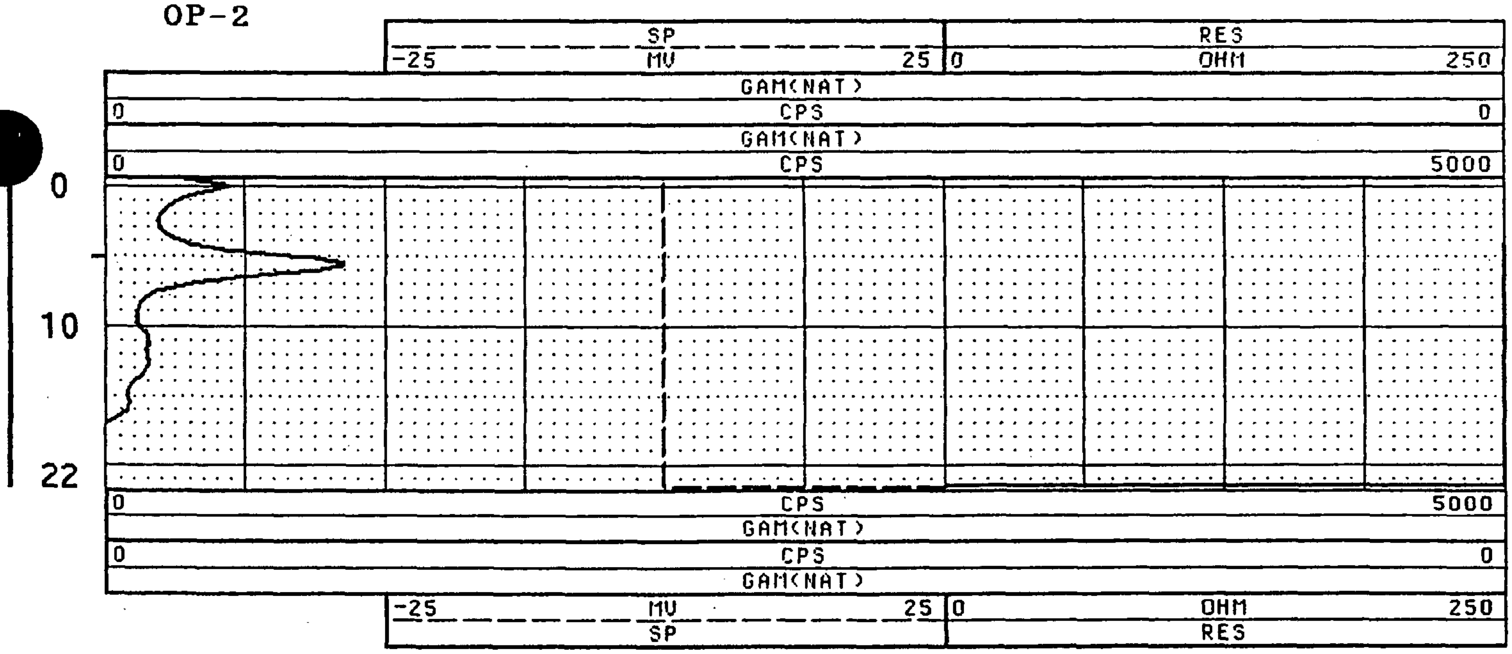
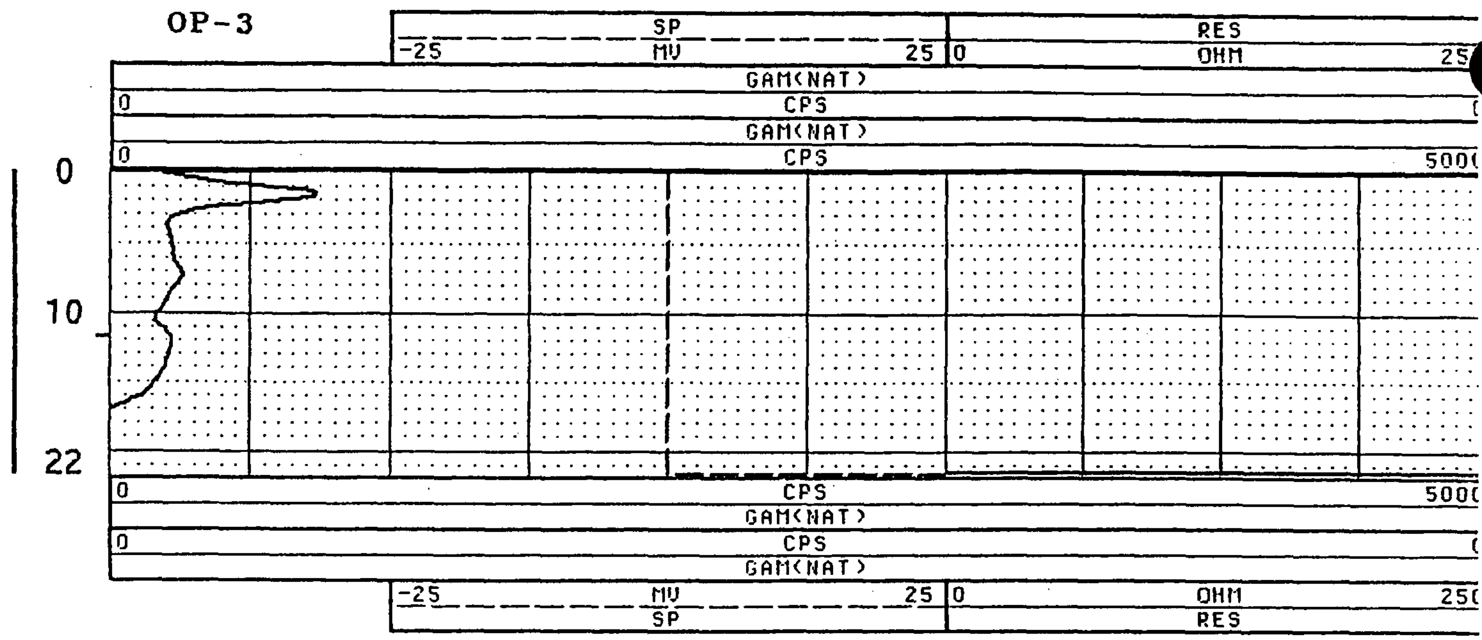


FIGURE A.2-17. GEOPHYSICAL LOGS FOR OP-1 & OP-2.



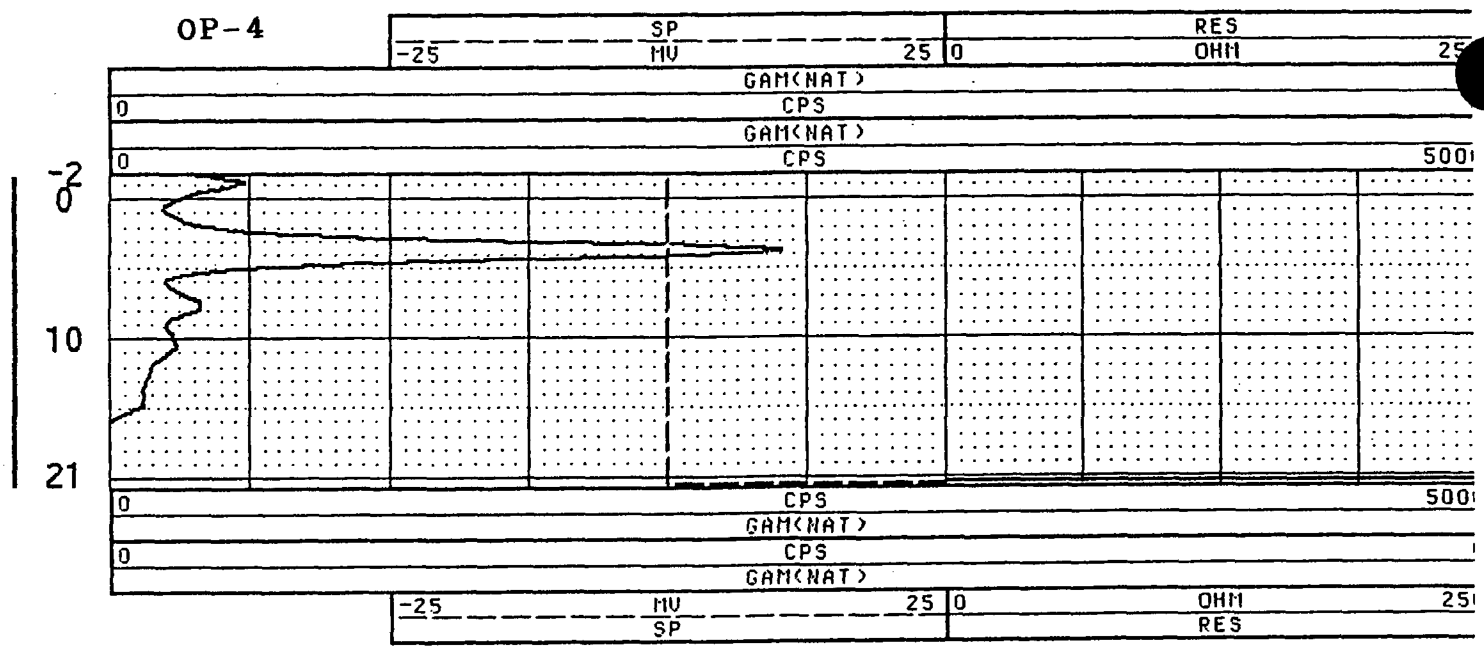
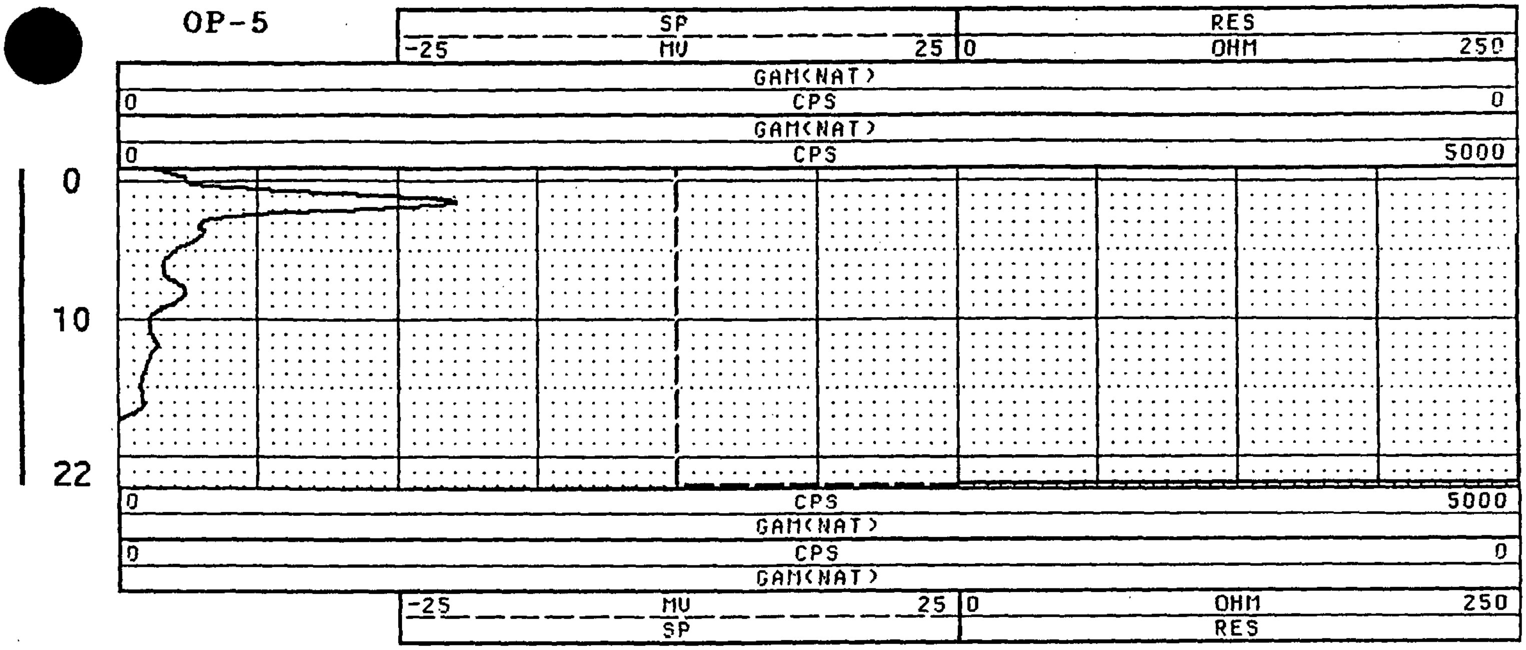


FIGURE A.2-18. GEOPHYSICAL LOGS FOR OP-3 & OP-4.



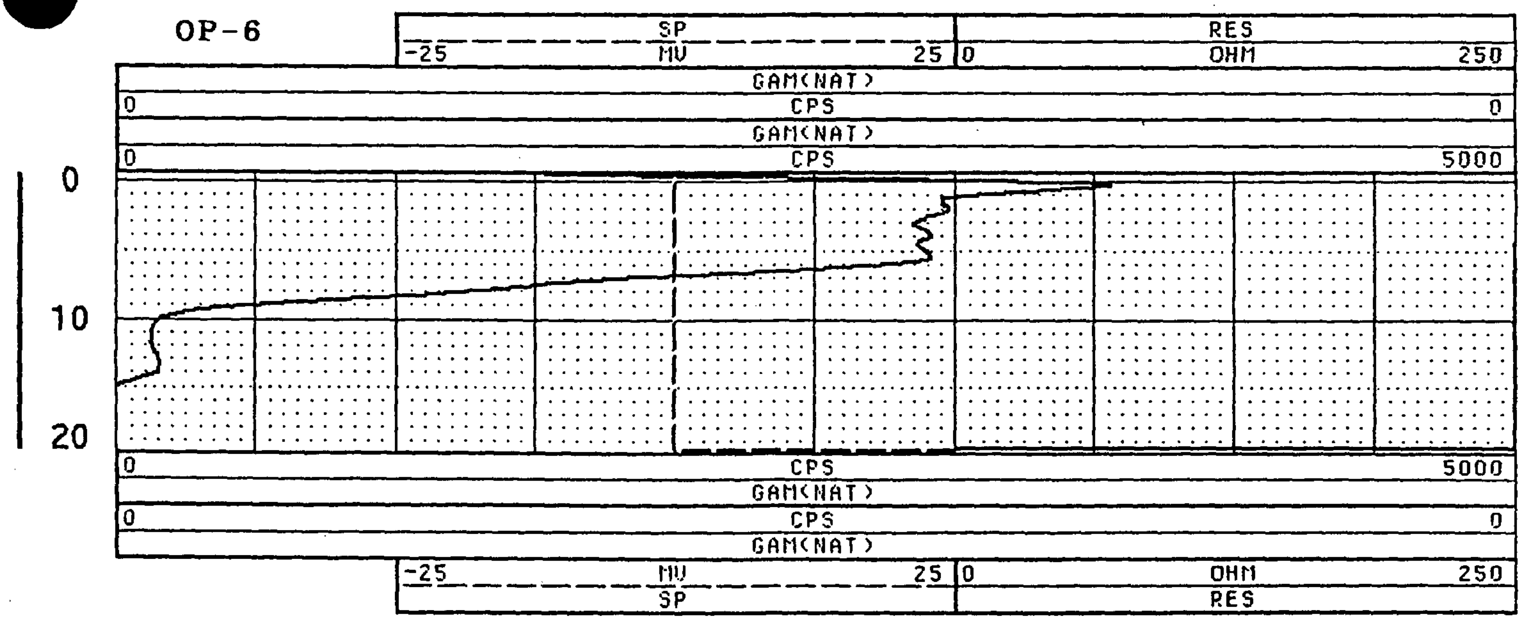
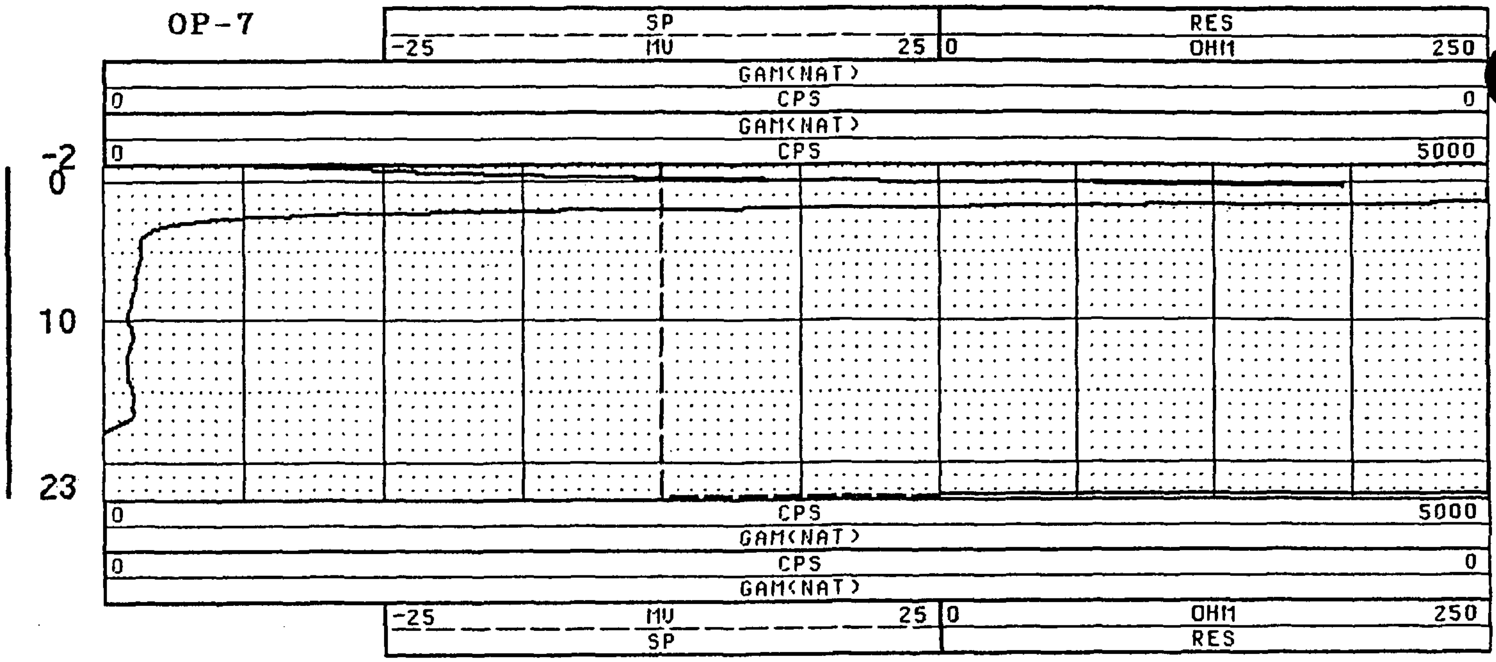


FIGURE A.2-19. GEOPHYSICAL LOGS FOR OP-5 & OP-6.



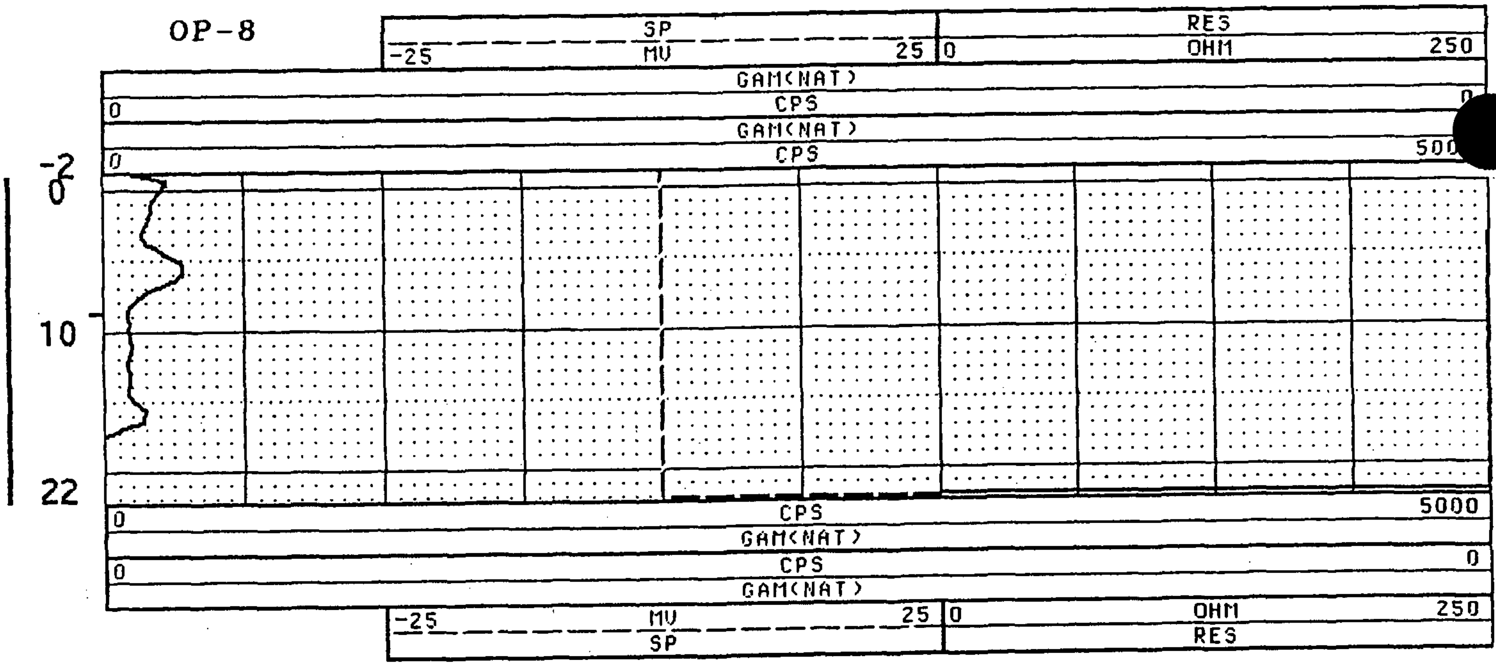
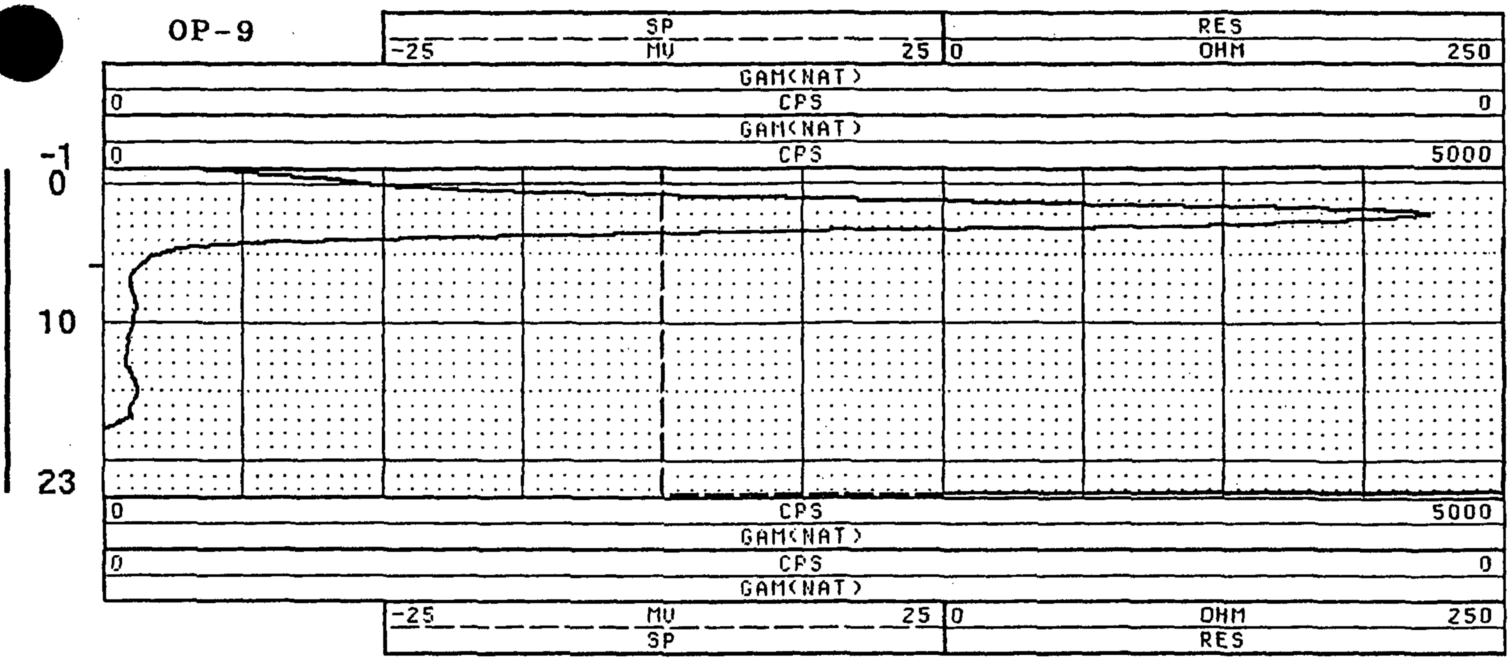


FIGURE A.2-20. GEOPHYSICAL LOGS FOR OP-7 & OP-8.



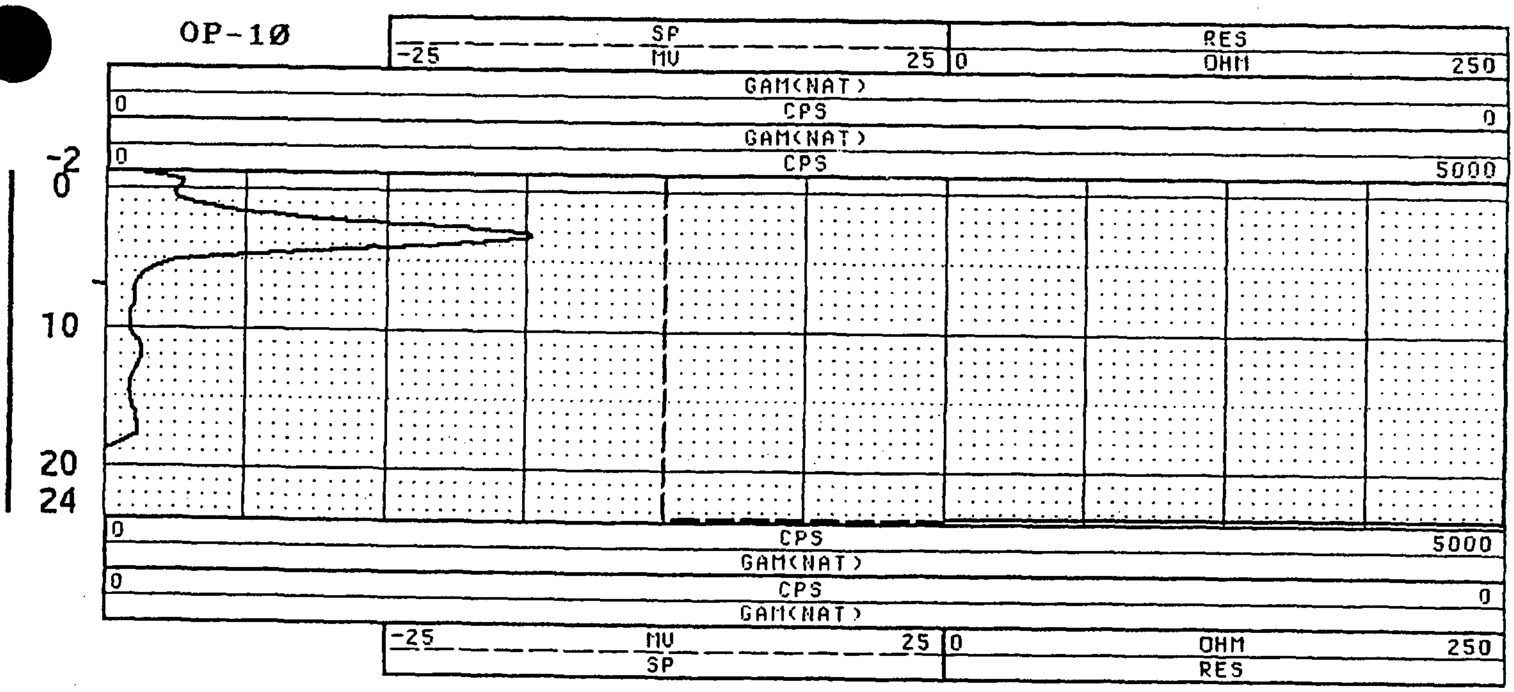
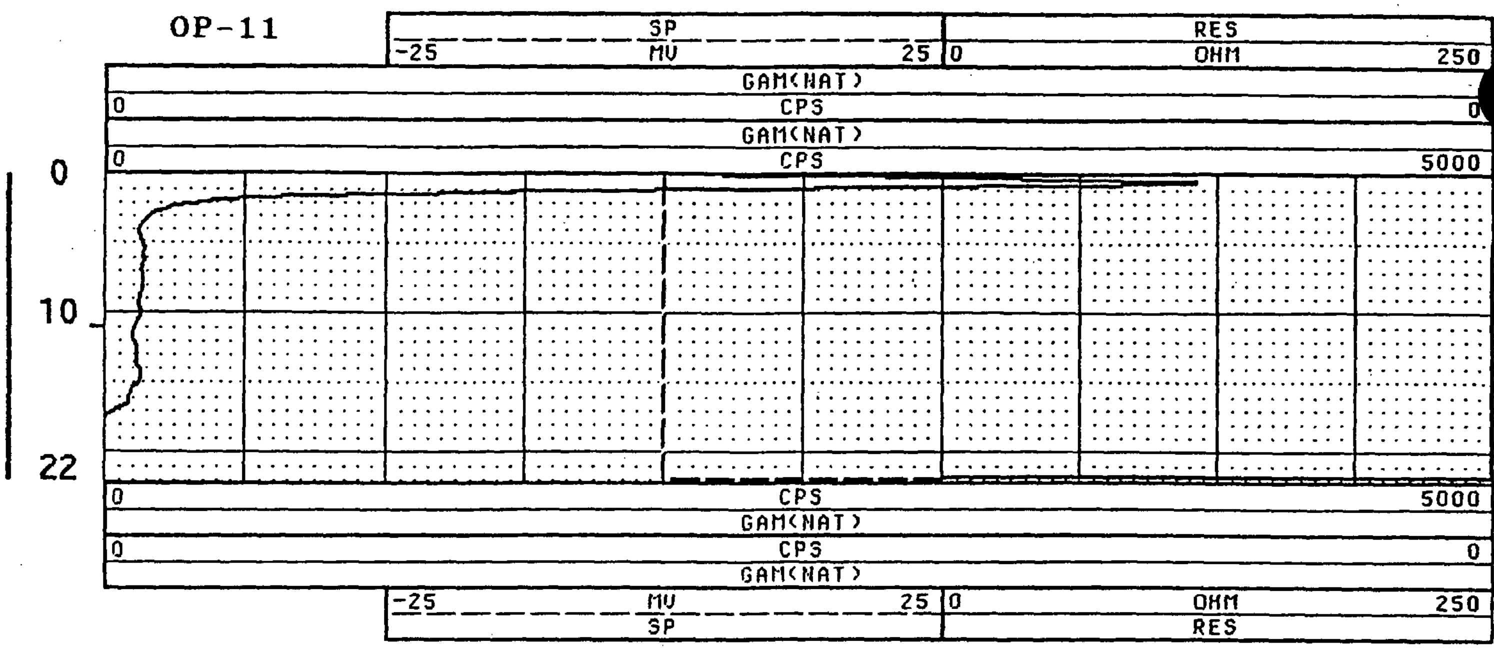


FIGURE A.2-21. GEOPHYSICAL LOGS FOR OP-9 & OP-10.



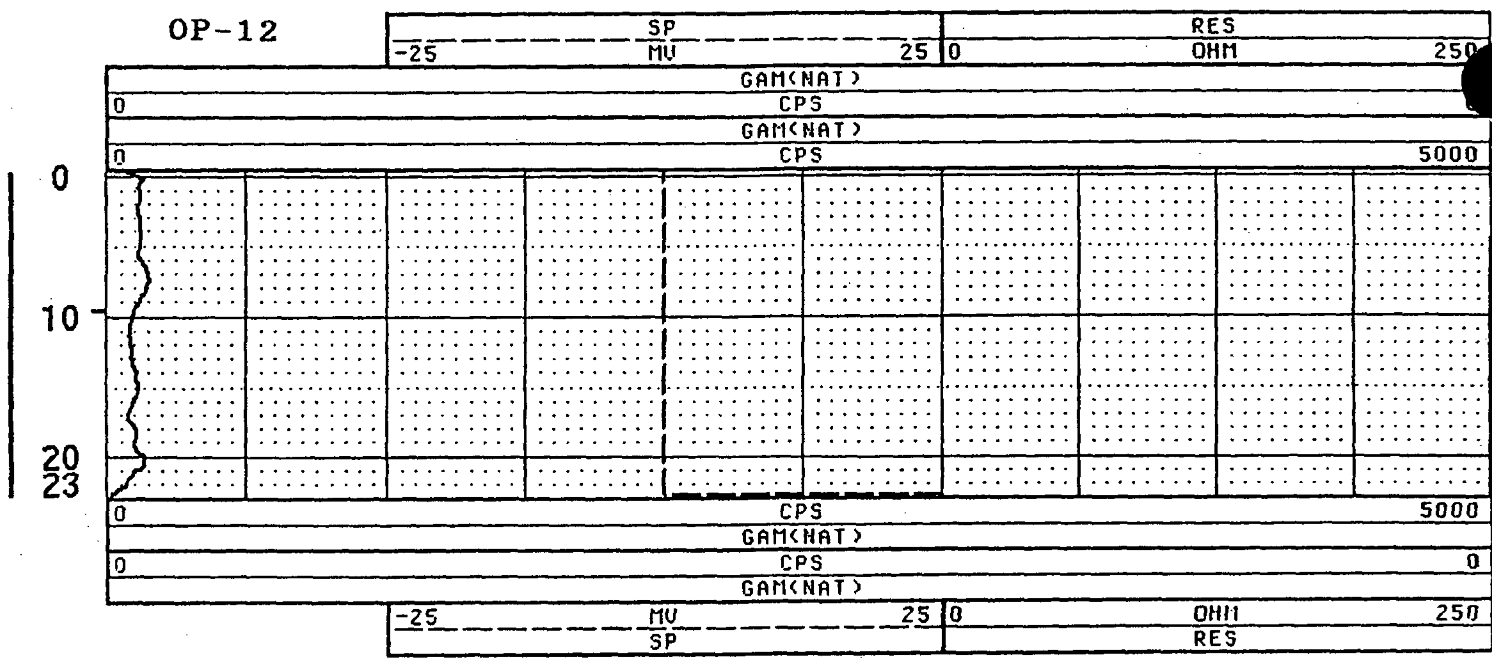
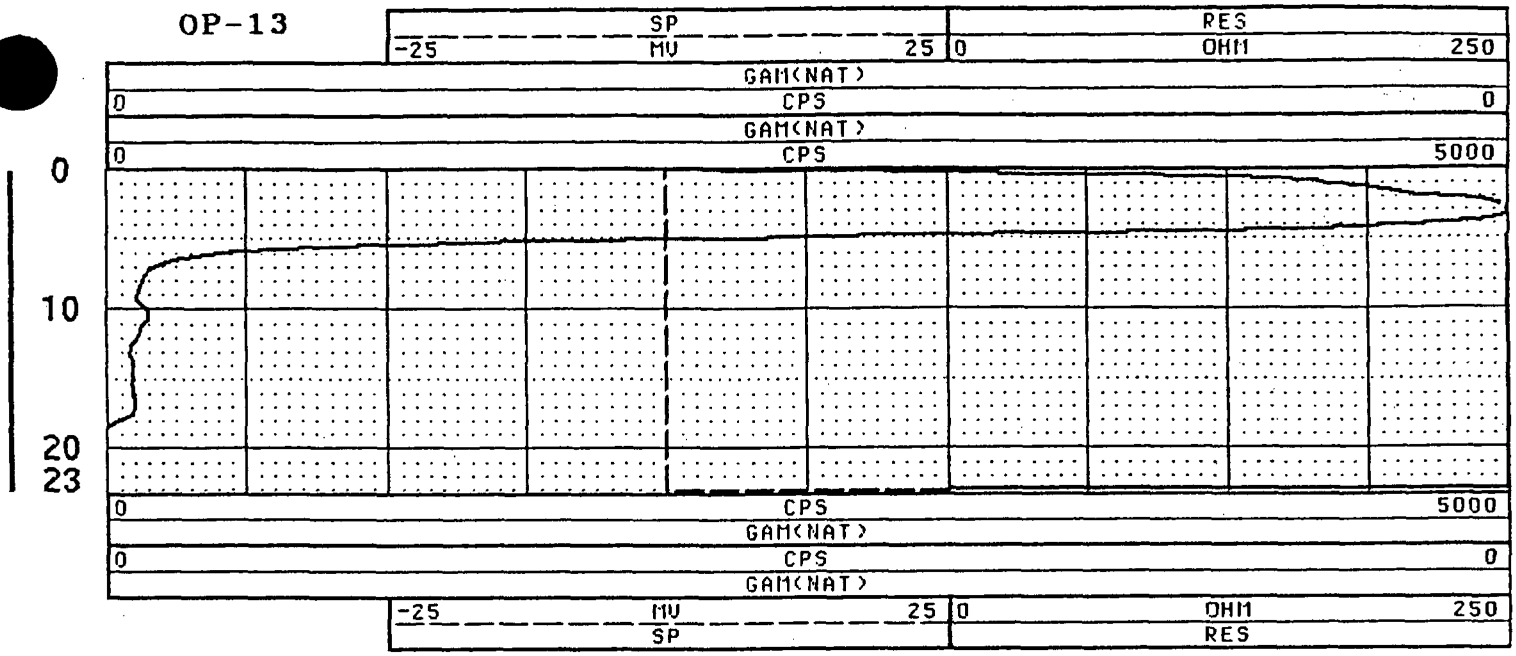


FIGURE A.2-22. GEOPHYSICAL LOGS FOR OP-11 & OP-12.

OP-13



OP-14

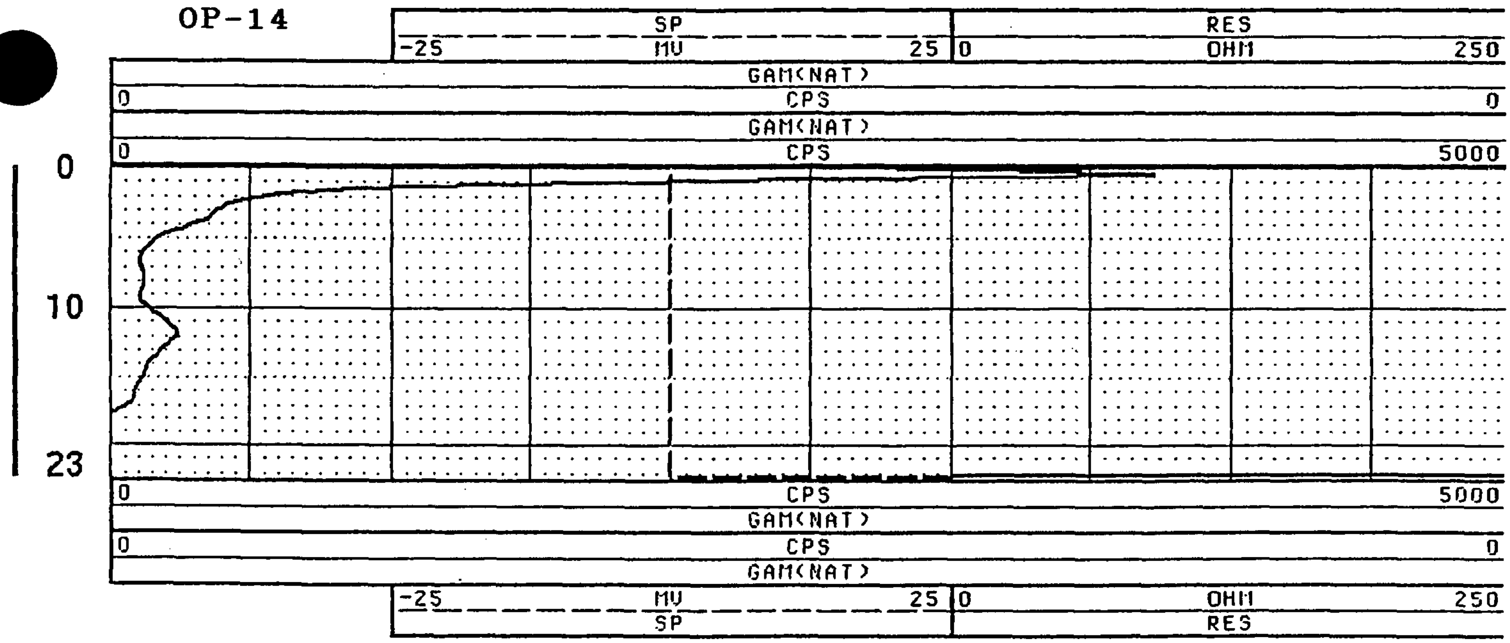
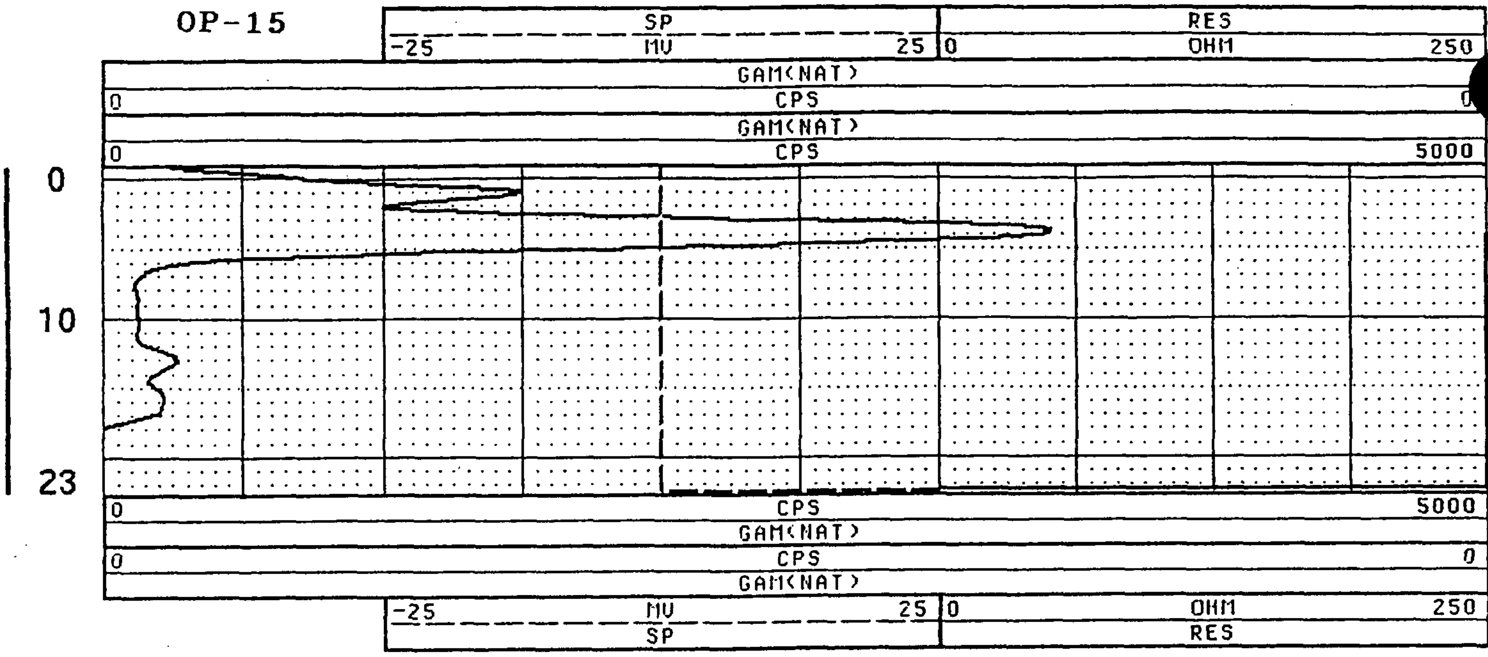


FIGURE A.2-23. GEOPHYSICAL LOGS FOR OP-13 & OP-14.



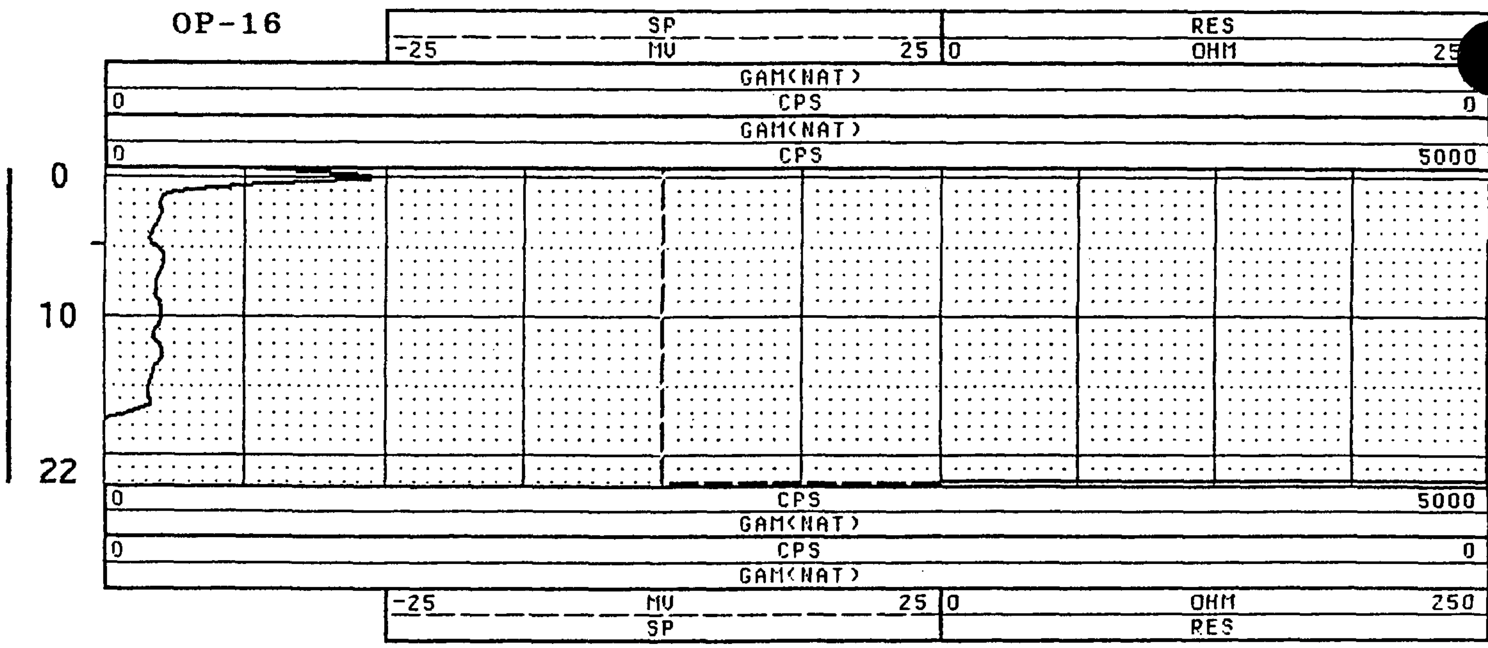


FIGURE A.2-24. GEOPHYSICAL LOGS FOR OP-15 & OP-16.

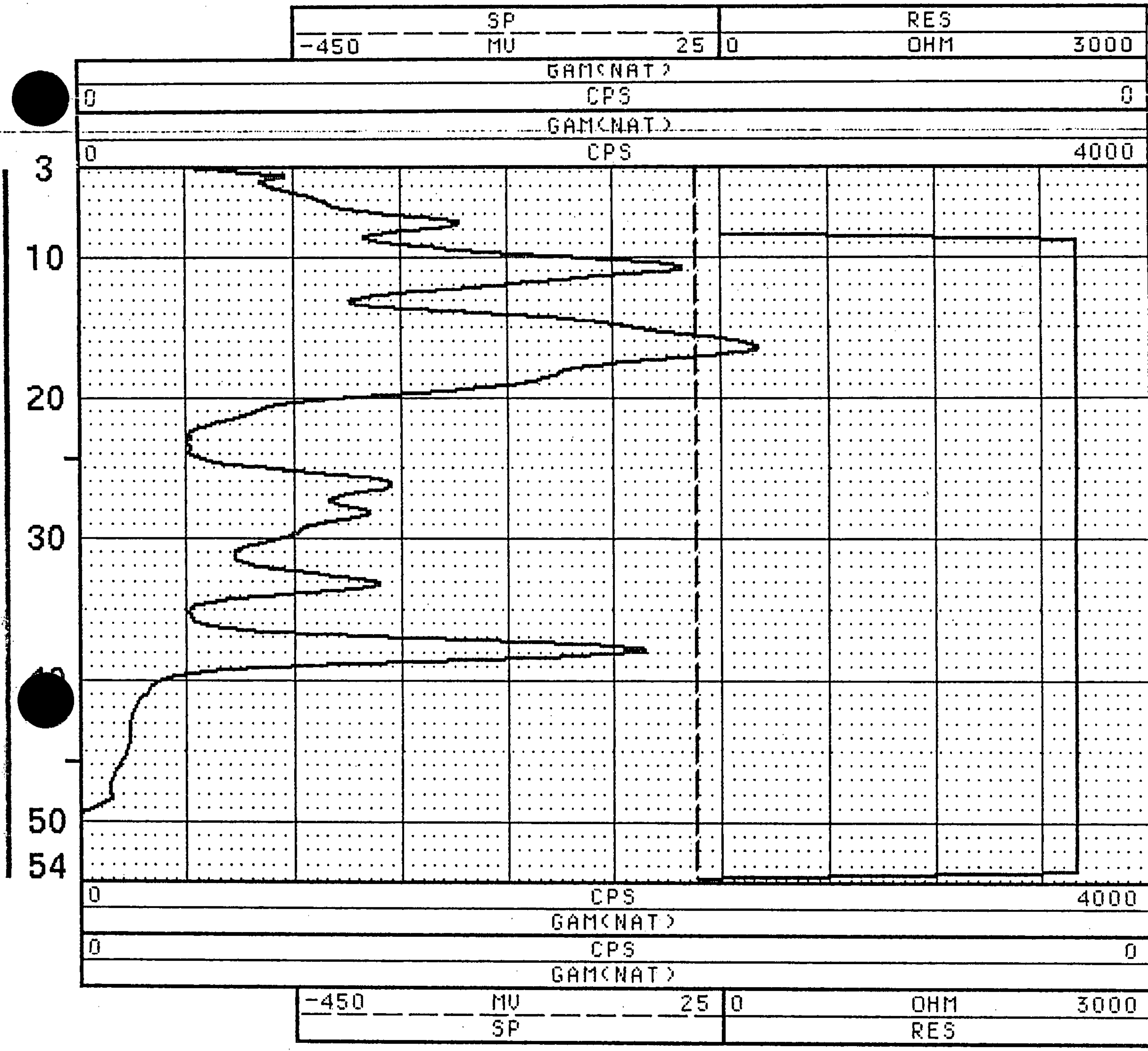


FIGURE A.2-25. GEOPHYSICAL LOG FOR LGW-1.

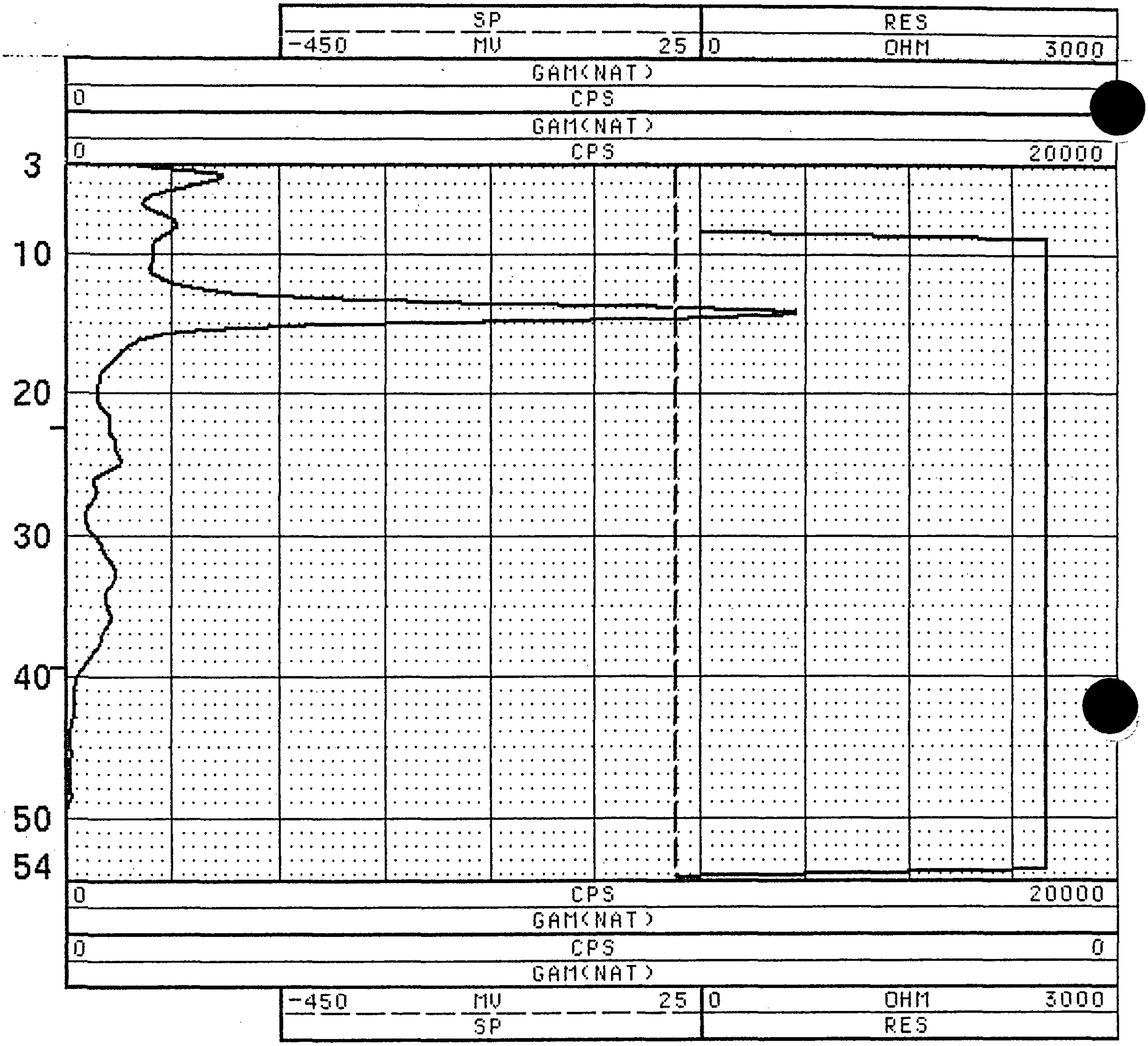


FIGURE A.2-26. GEOPHYSICAL LOG FOR LGW-2.

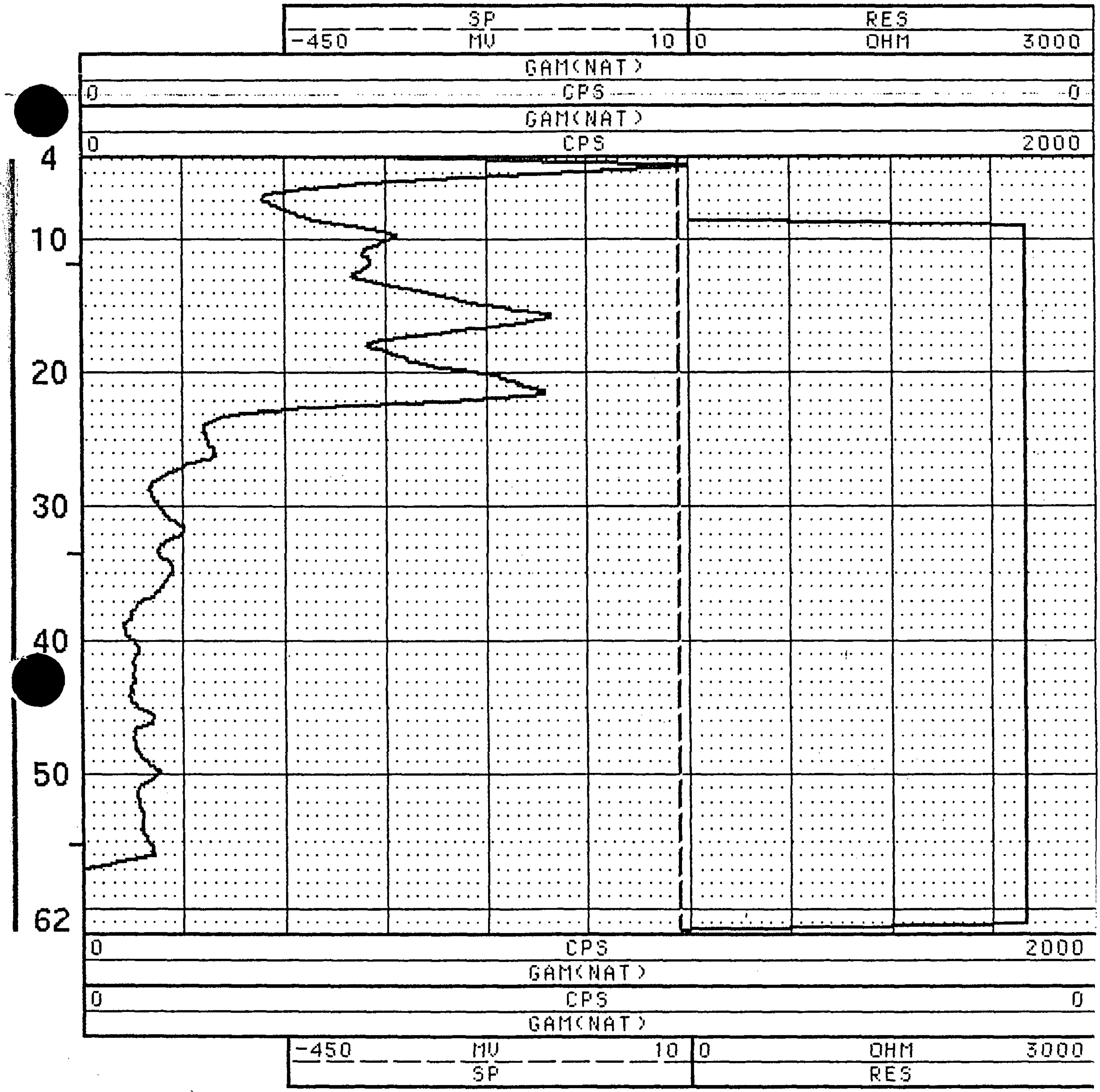


FIGURE A.2-27. GEOPHYSICAL LOG FOR LGW-3.

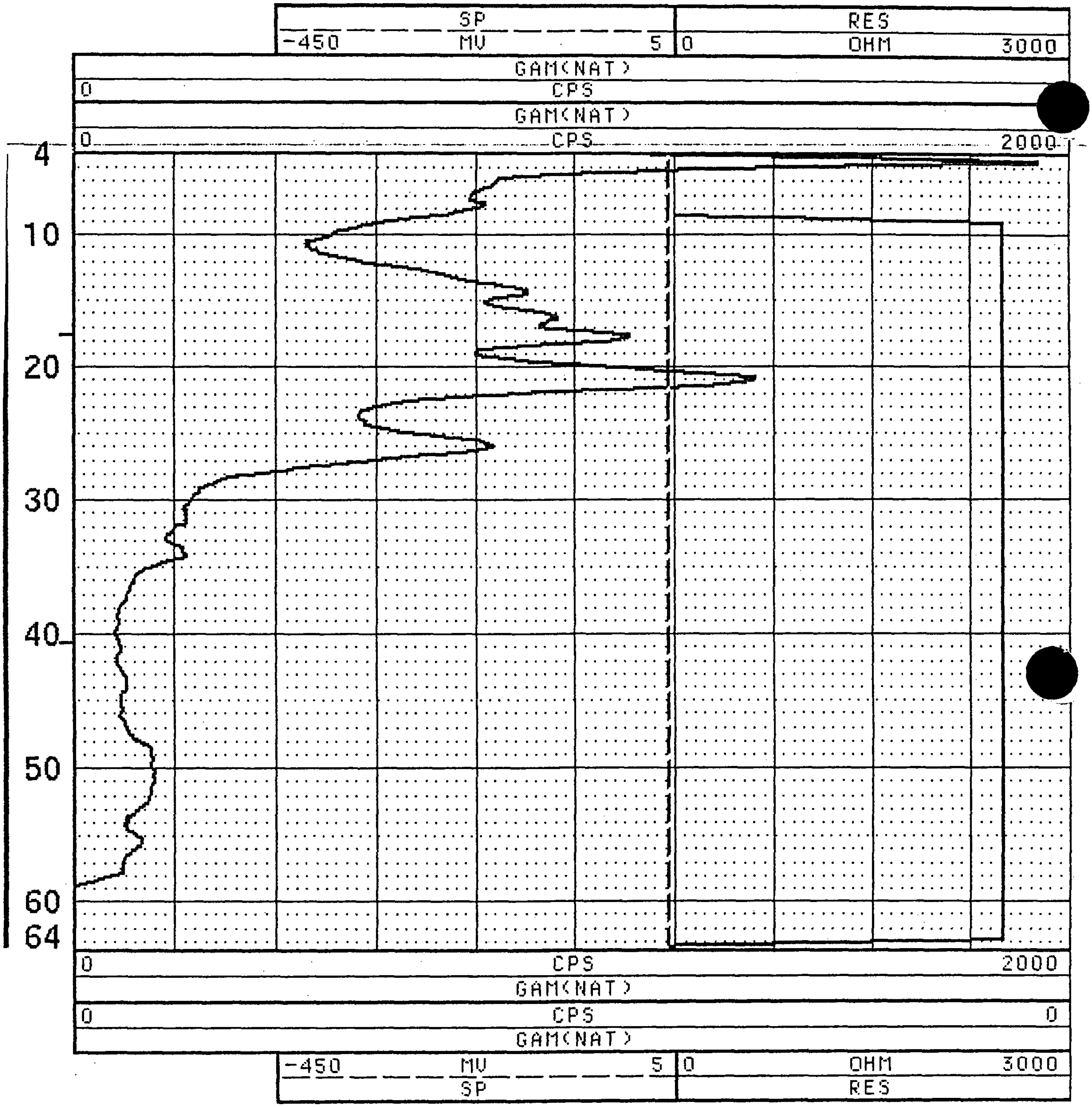


FIGURE A.2-28. GEOPHYSICAL LOG FOR LGW-4.

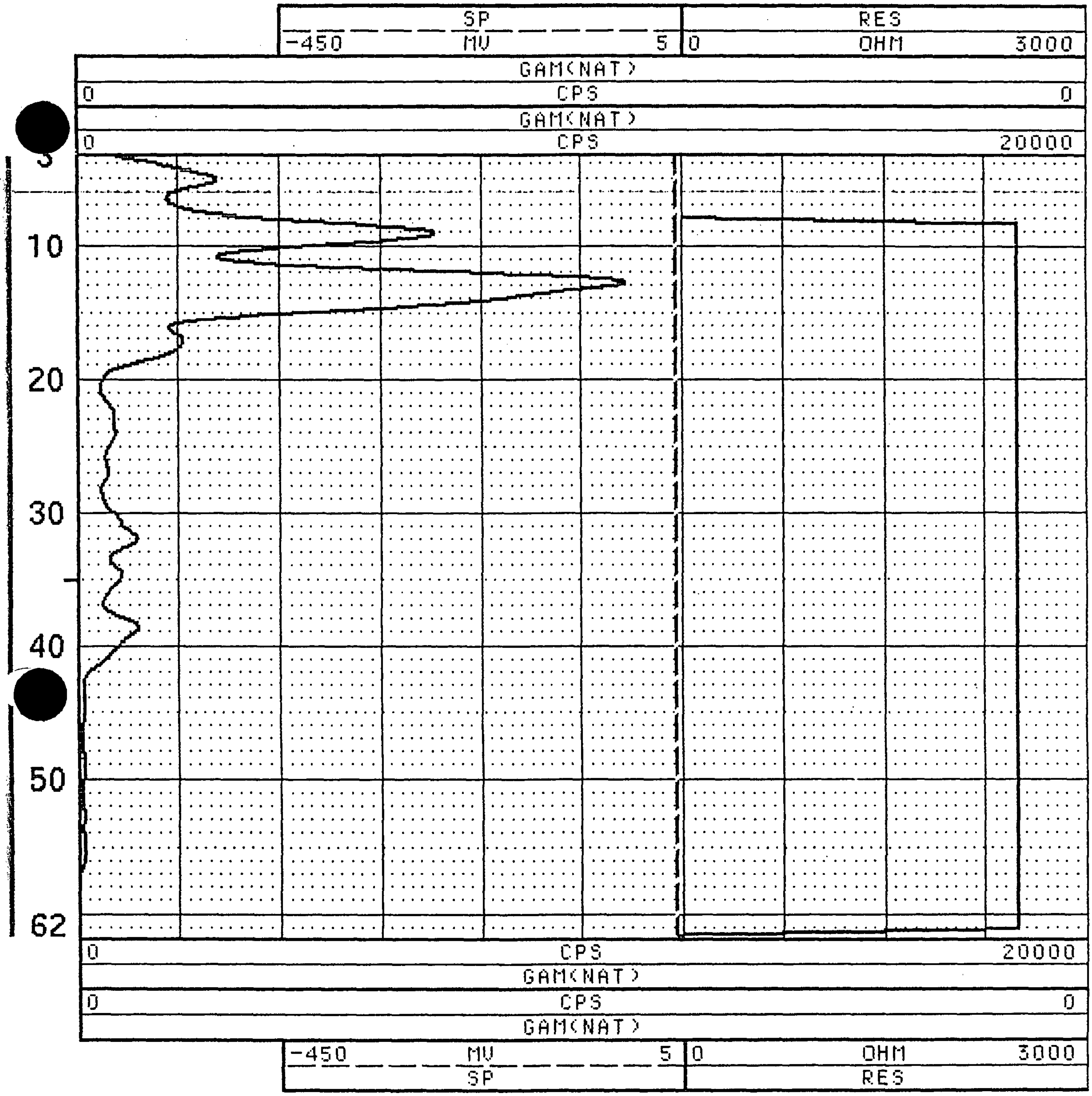


FIGURE A.2-29. GEOPHYSICAL LOG FOR LGW-5.

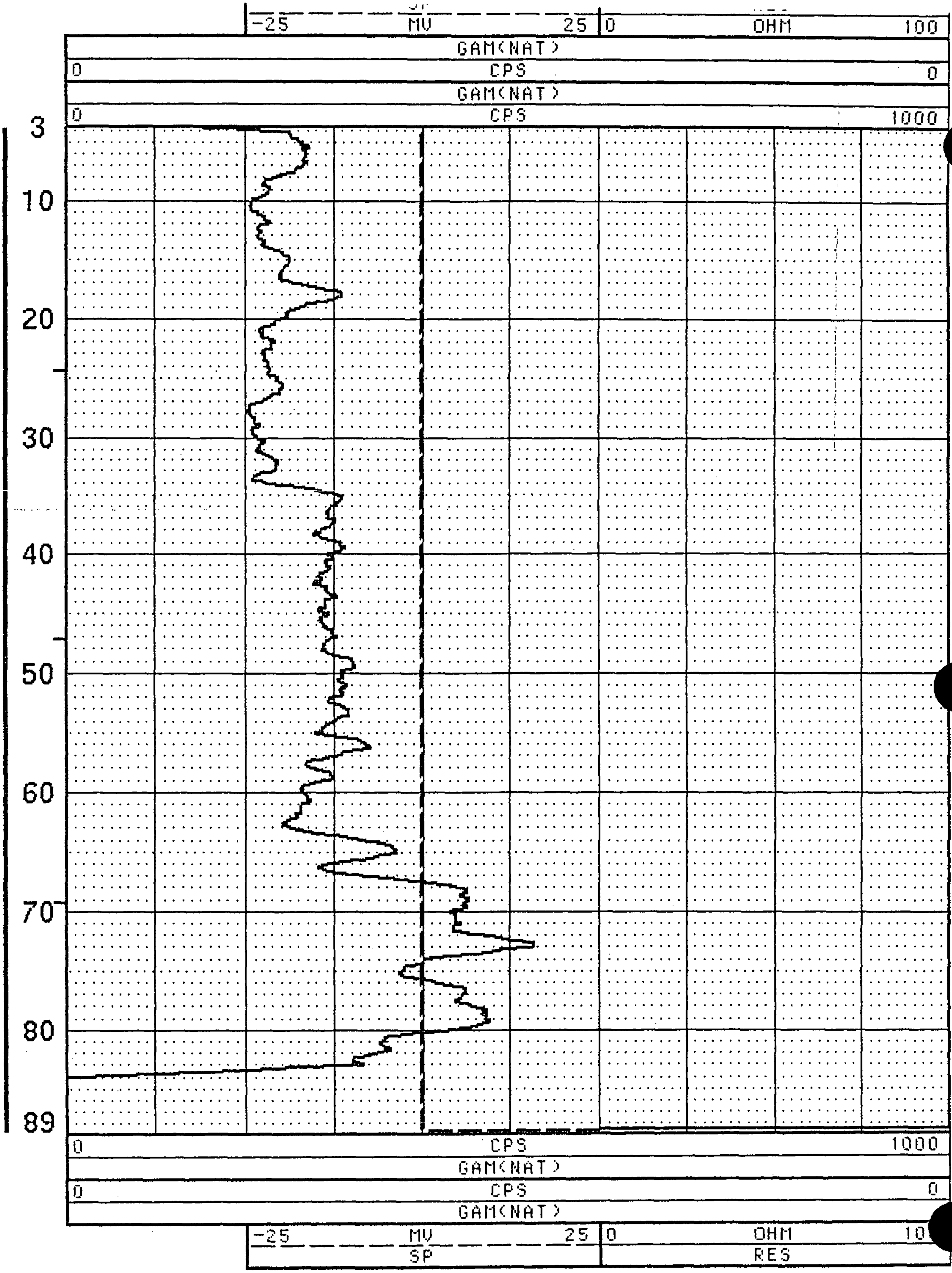


FIGURE A.2-30. GEOPHYSICAL LOG FOR STH-1A.

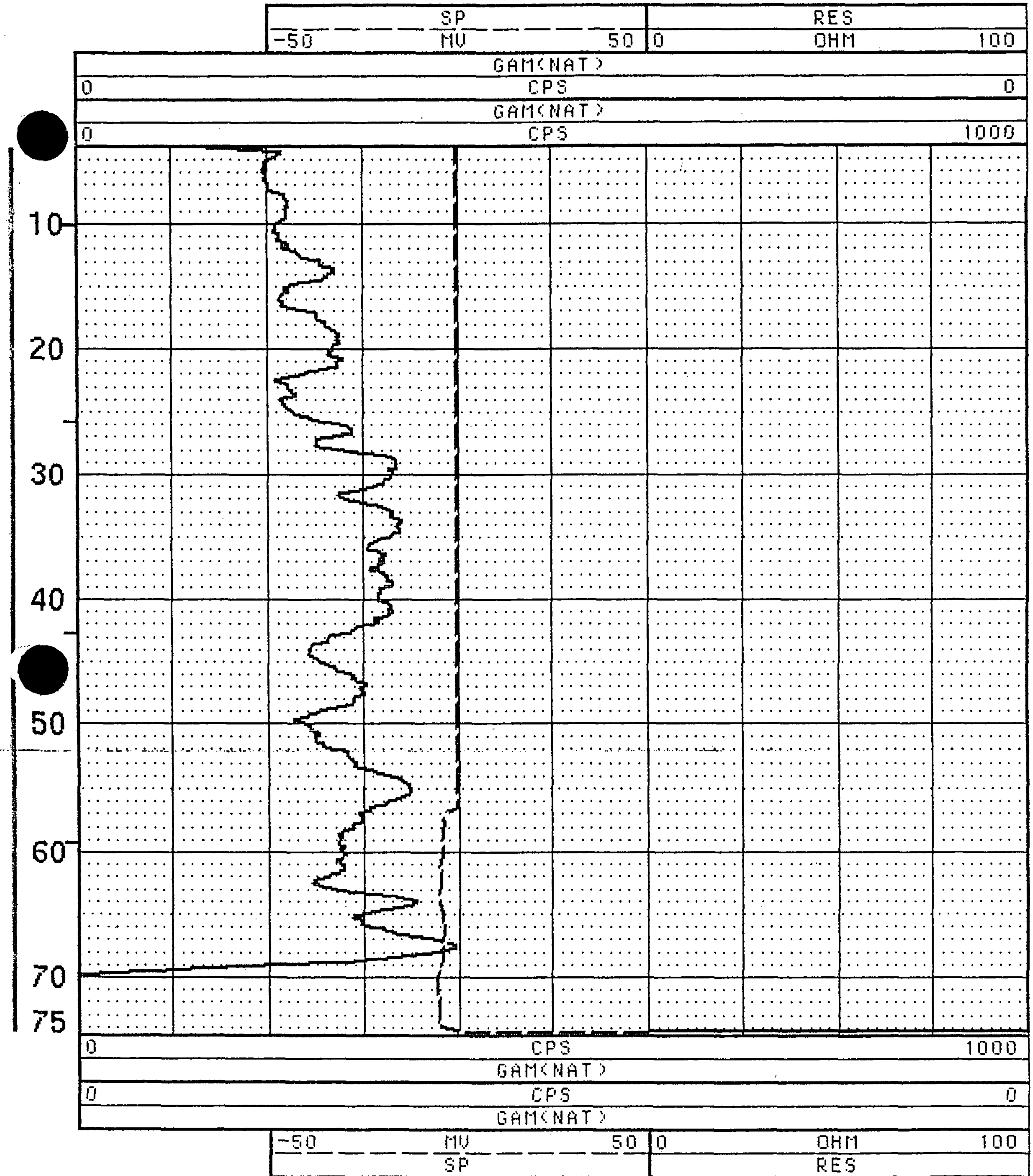


FIGURE A.2-31. GEOPHYSICAL LOG FOR STH-3.

A.3 TEST HOLE PREDICTED RADIUM-226 CONCENTRATIONS

This section presents the predicted radium concentrations from the gamma downhole logs for the test holes. These profiles were prepared by converting gamma log values to Ra-226 values using the relationships described in Section 2.4. A predicted radium concentration for each of the geophysical logs was developed.

These figures present the clean-up standard of 8 pCi/gm as a vertical dashed line on the graphs. Therefore, it is easy to see the levels that exceed the estimated concentrations greater than 8 pCi/gm. As an example, Figure A.3-22 shows that the radium concentration of the upper portion of OP-6 is greater than 8 pCi/gm, while the level below 9′ is less than this concentration.

Section A.1 of Appendix A presents the lithologic logs for the test holes. Section A.2 presents the geophysical logs for the test holes that were used to develop the estimated radium-226 concentrations.

The estimated radium concentrations in the tailings vary considerably, with higher values in the slimes than in the sandy portion of the tailings. The radium concentration is generally lower in the upper portion of the tailings and higher toward the base of the tailings.

The estimated radium concentration in the bottom of test hole TW4-2C is large and does not define the base of the elevated radium levels. A paired deeper test hole exists at most of the tailings sites and should be used to define the lower depth of elevated concentration. Figure A.3-4 shows that the elevated concentrations extend to a depth of 42 feet at well TW4-2B.

Appendix D presents the laboratory radium values that were measured from the test hole materials.

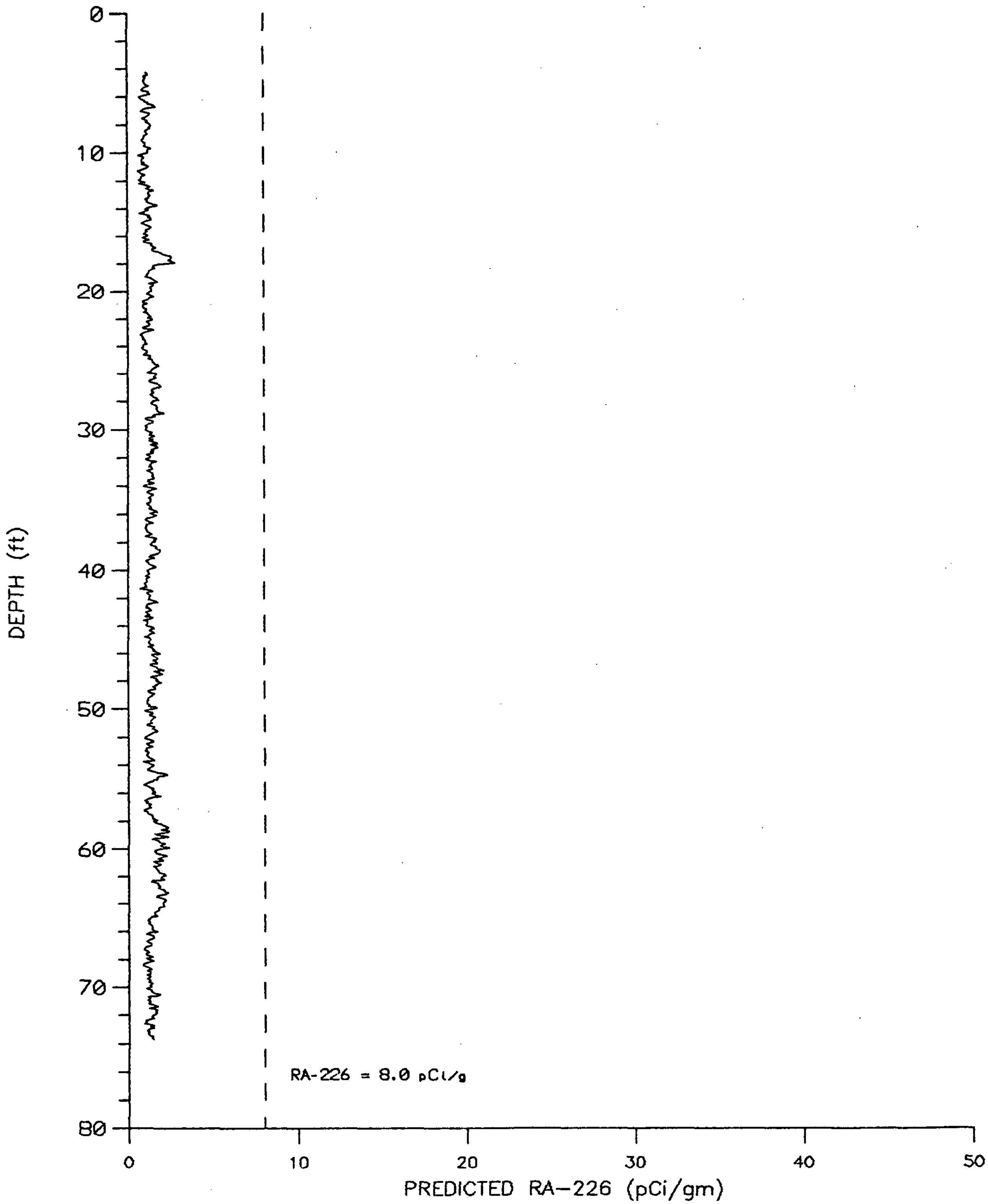


FIGURE A.3-1. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW3-1.

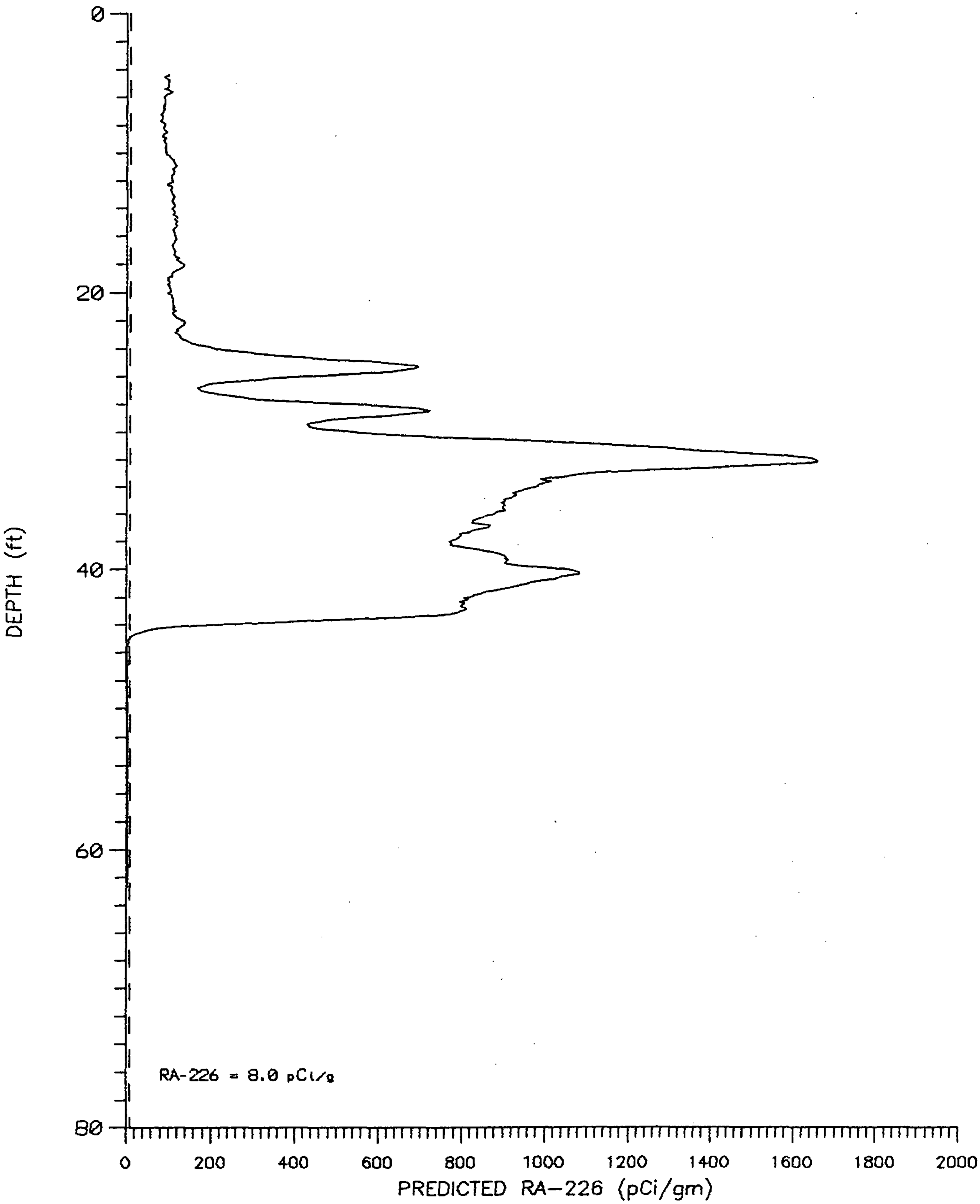


FIGURE A.3-2. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW4-1B.

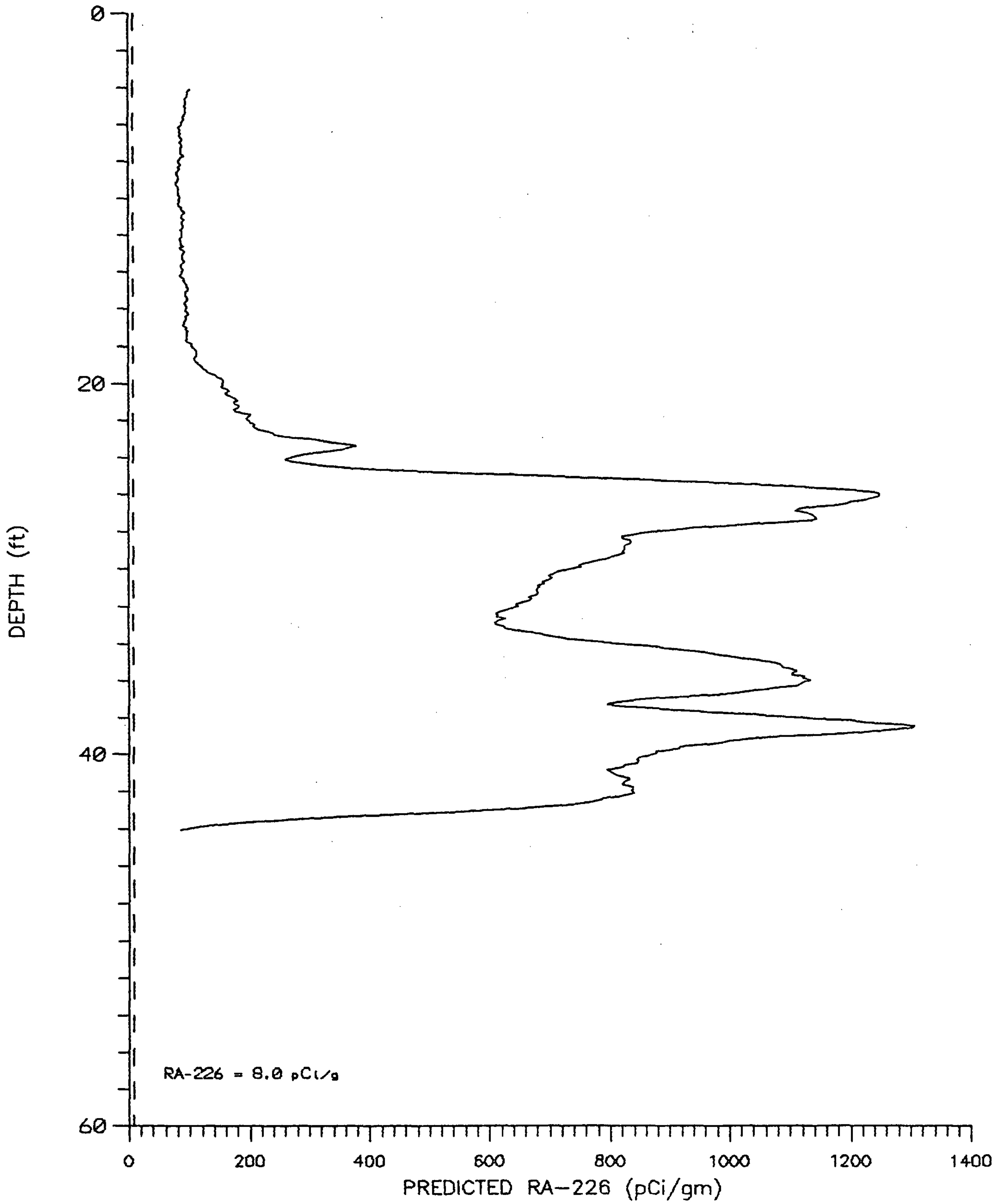


FIGURE A.3-3. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW4-1C.

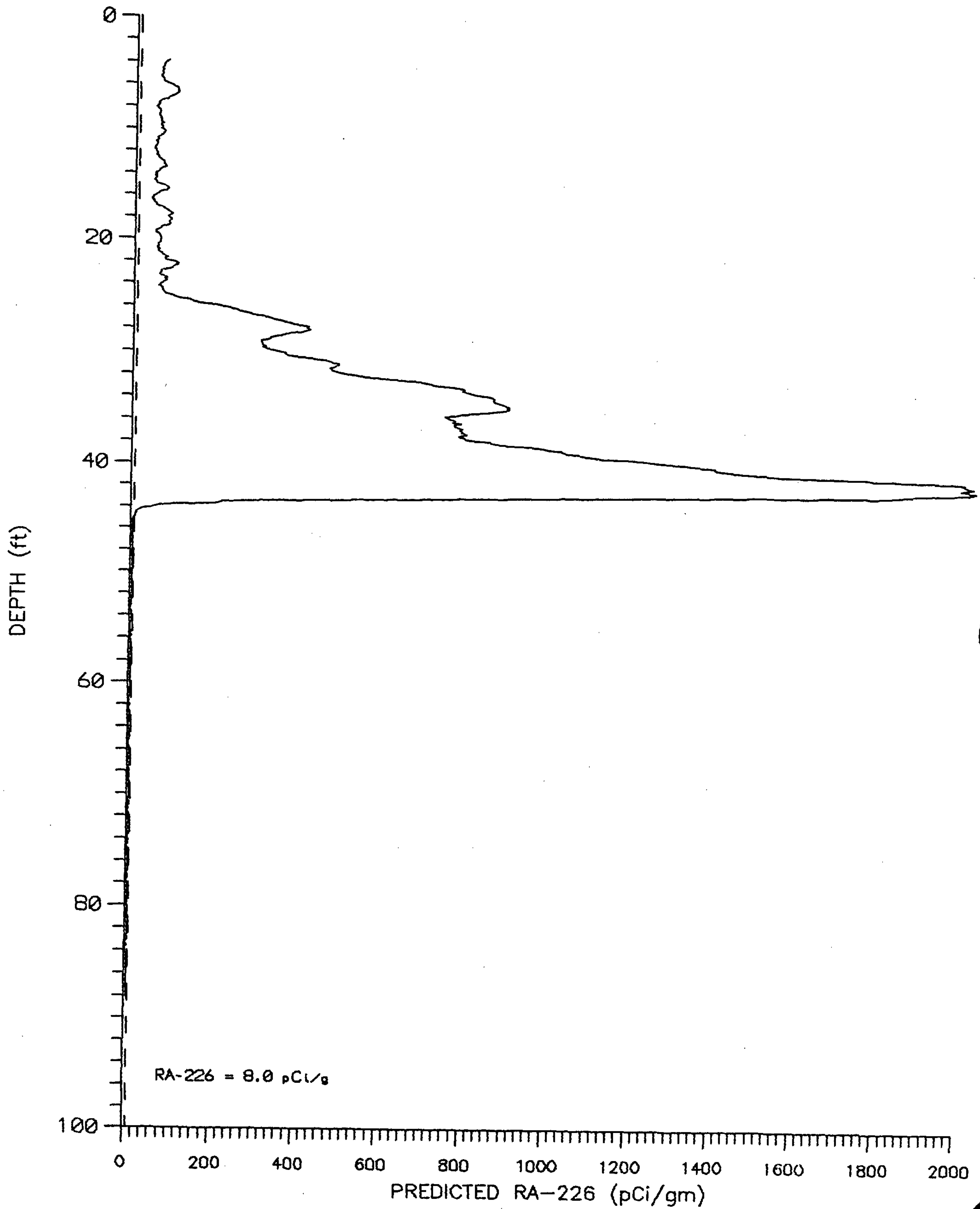


FIGURE A.3-4. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW4-2B.

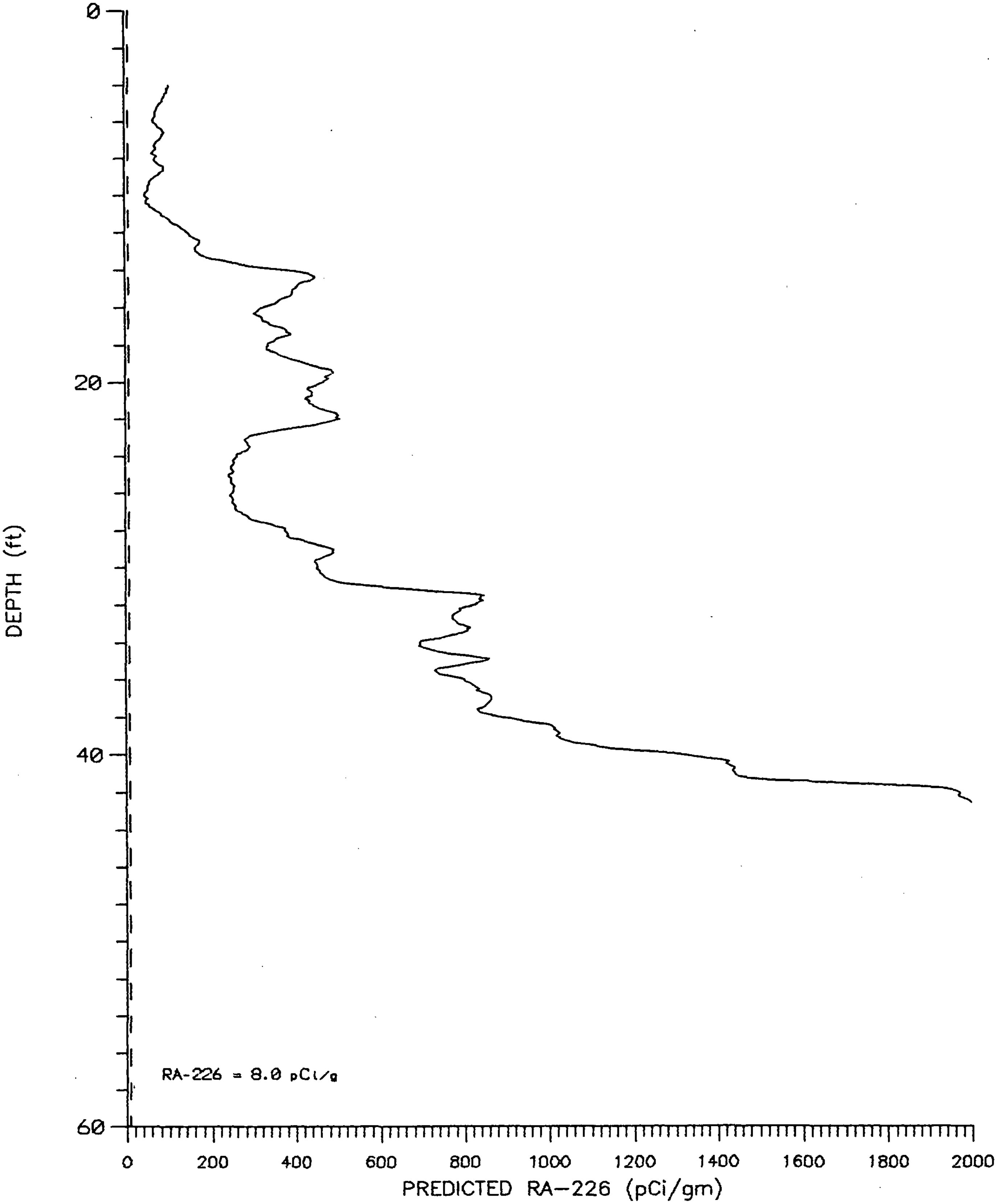


FIGURE A.3-5. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW4-2C.

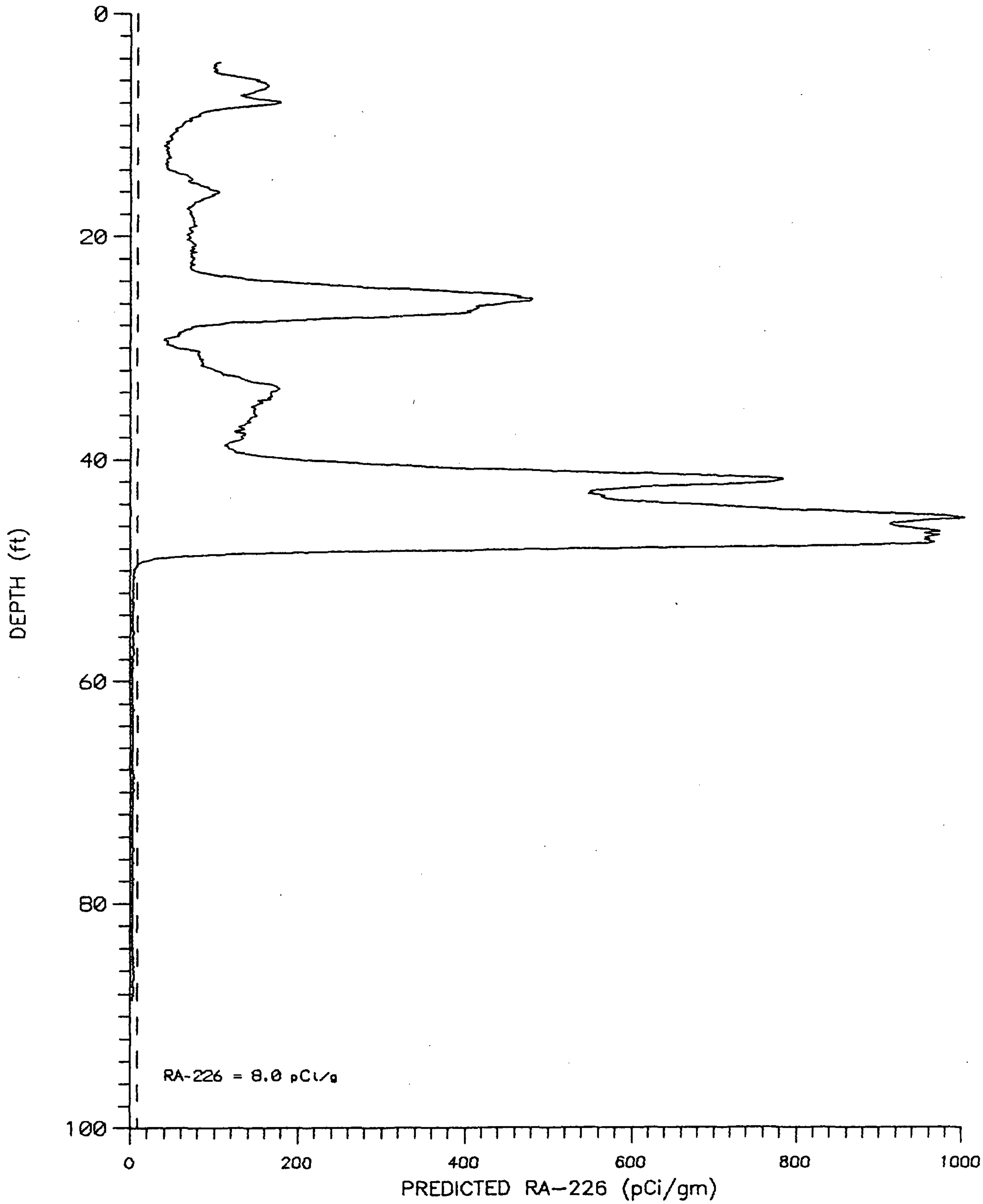


FIGURE A.3-6. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW4-3B.

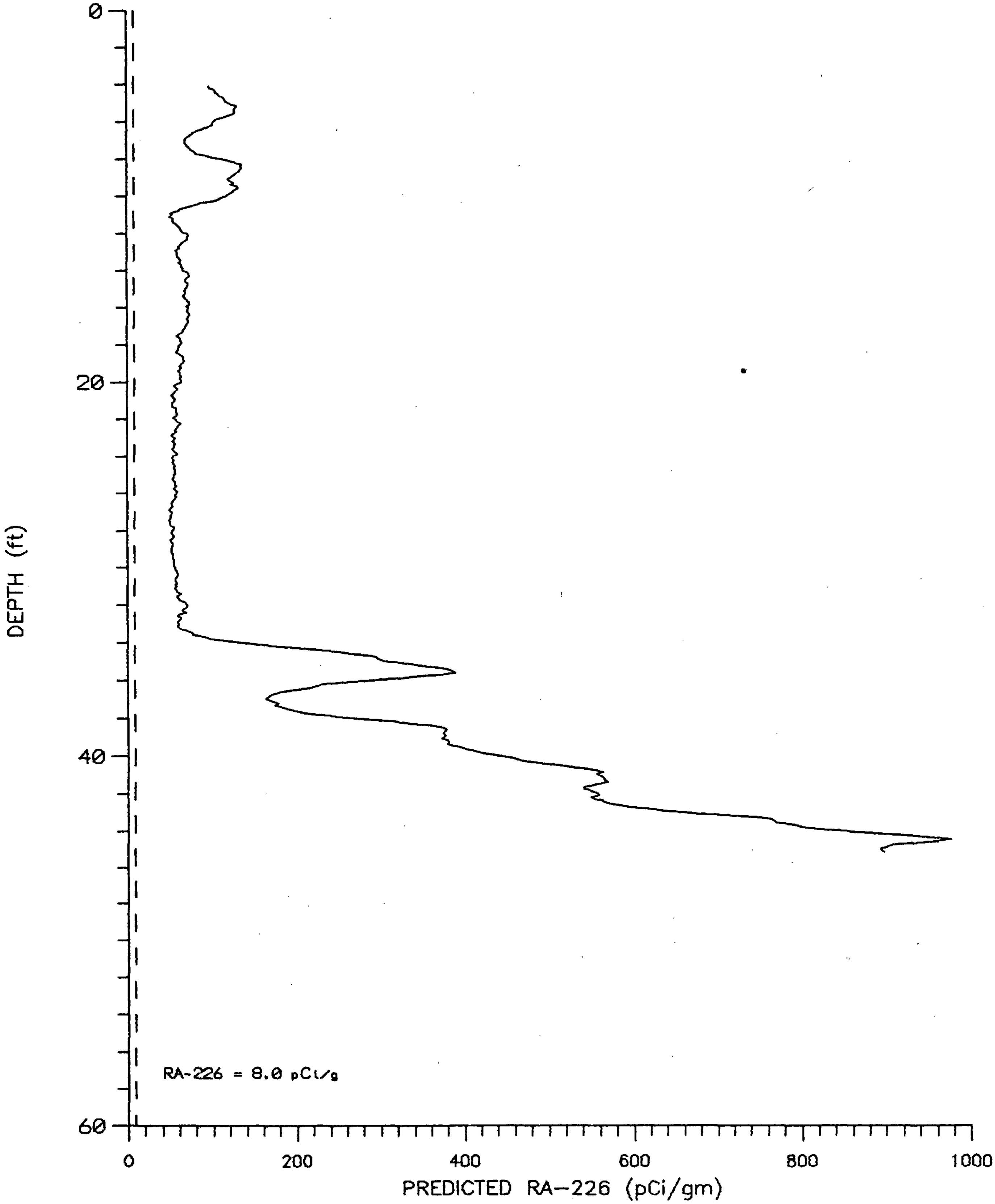


FIGURE A.3-7. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW4-3C.

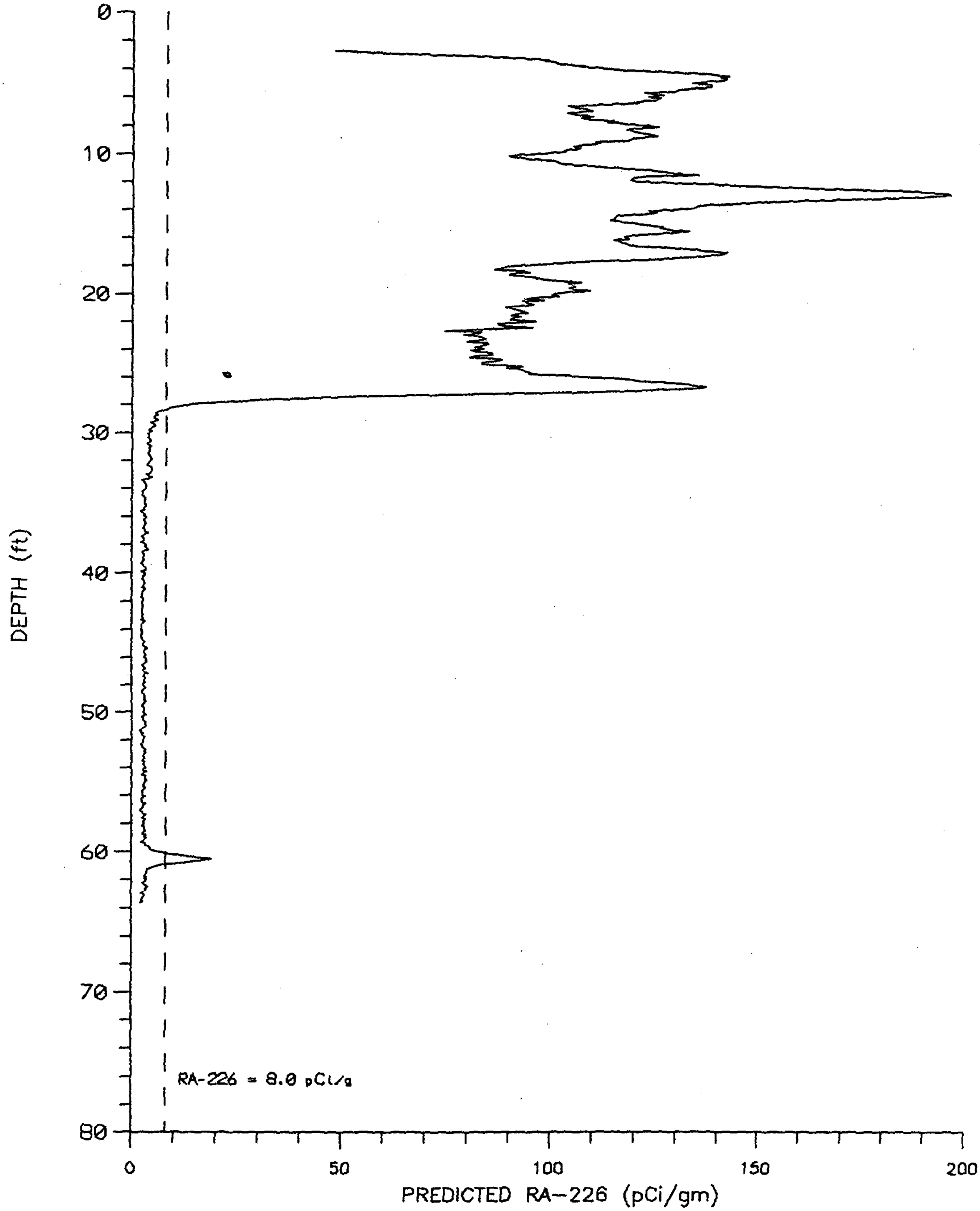


FIGURE A.3-8. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW4-4B.

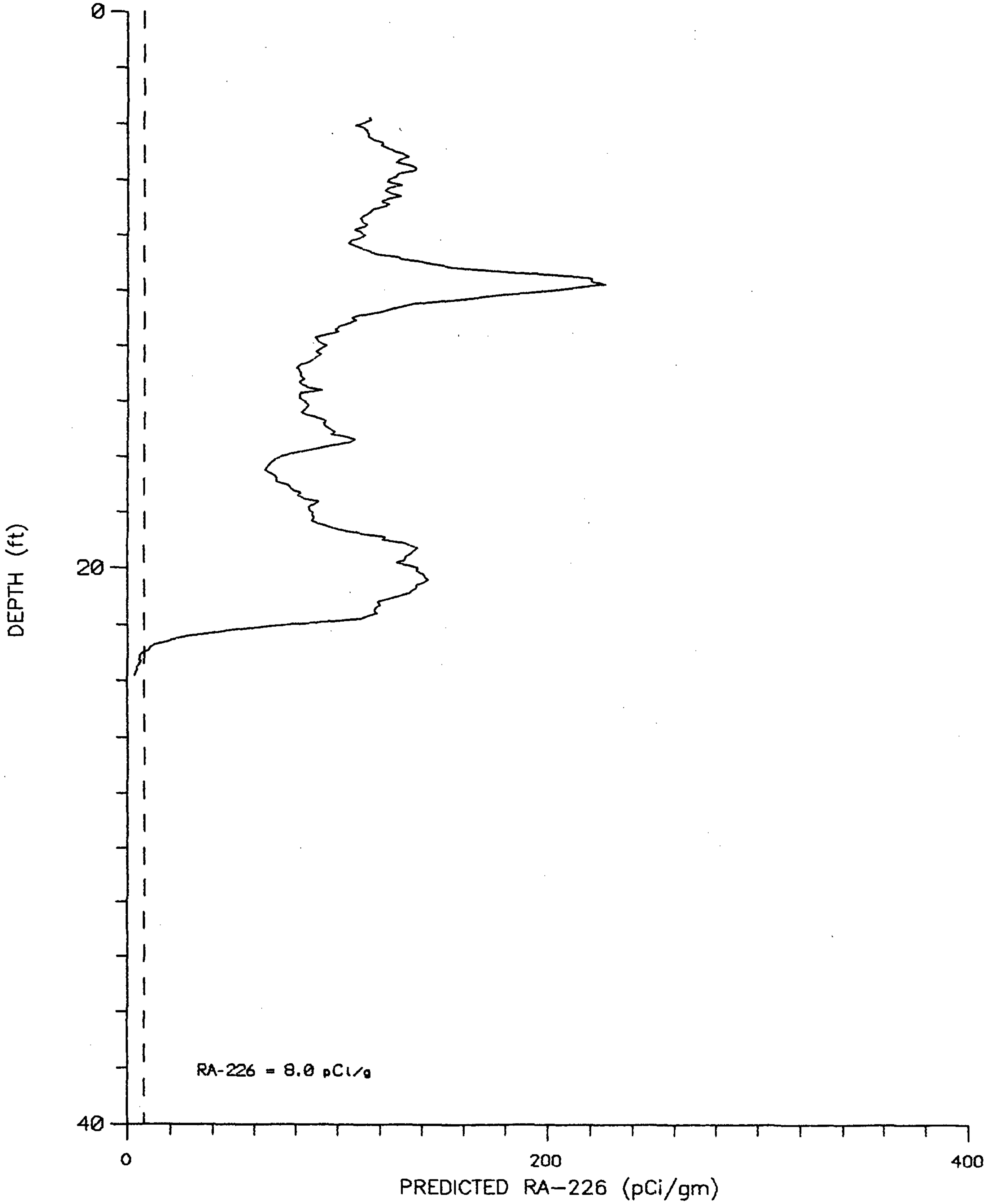


FIGURE A.3-9. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW4-4C.

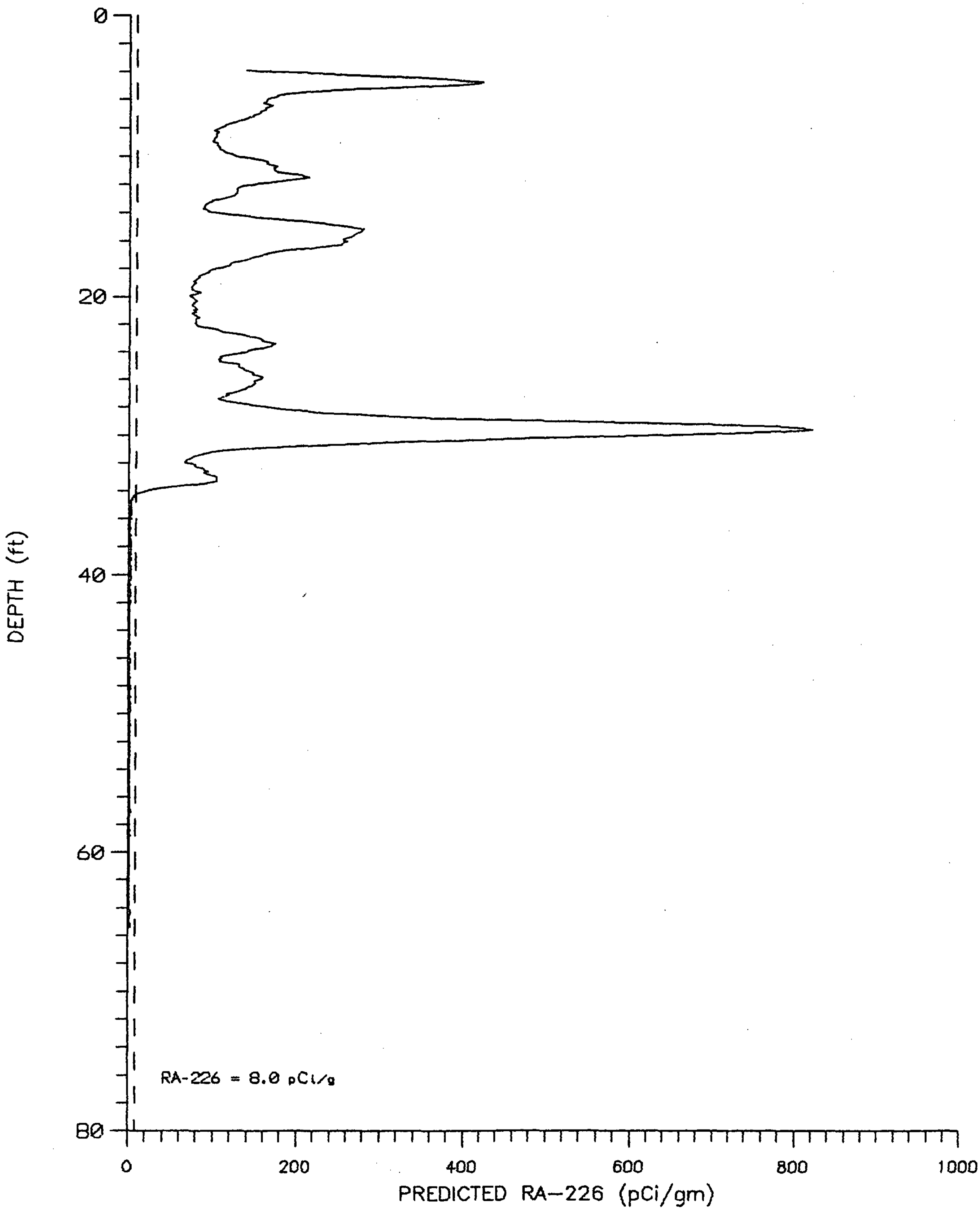


FIGURE A.3-10. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW4-5B.

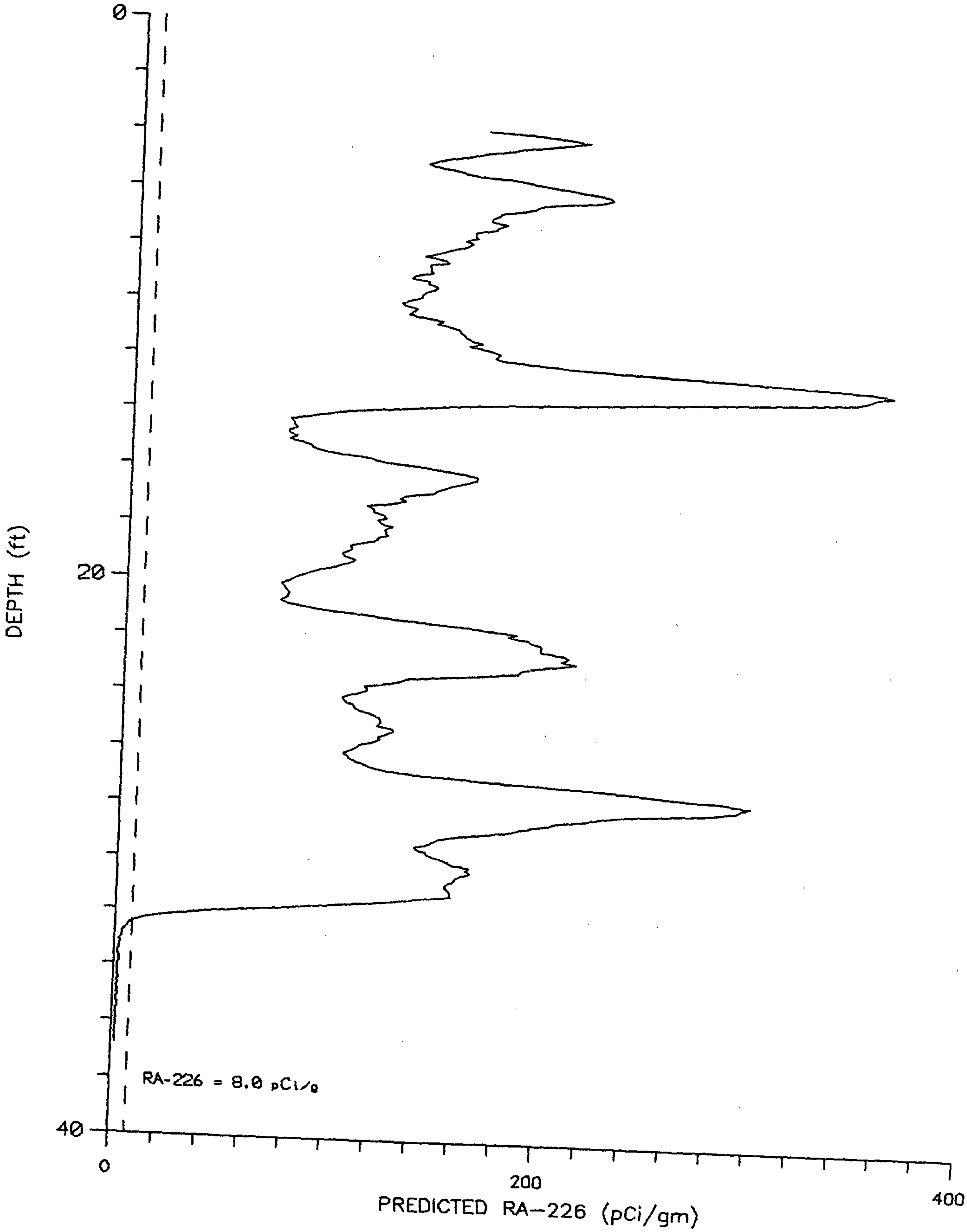


FIGURE A.3-11. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW4-5C.

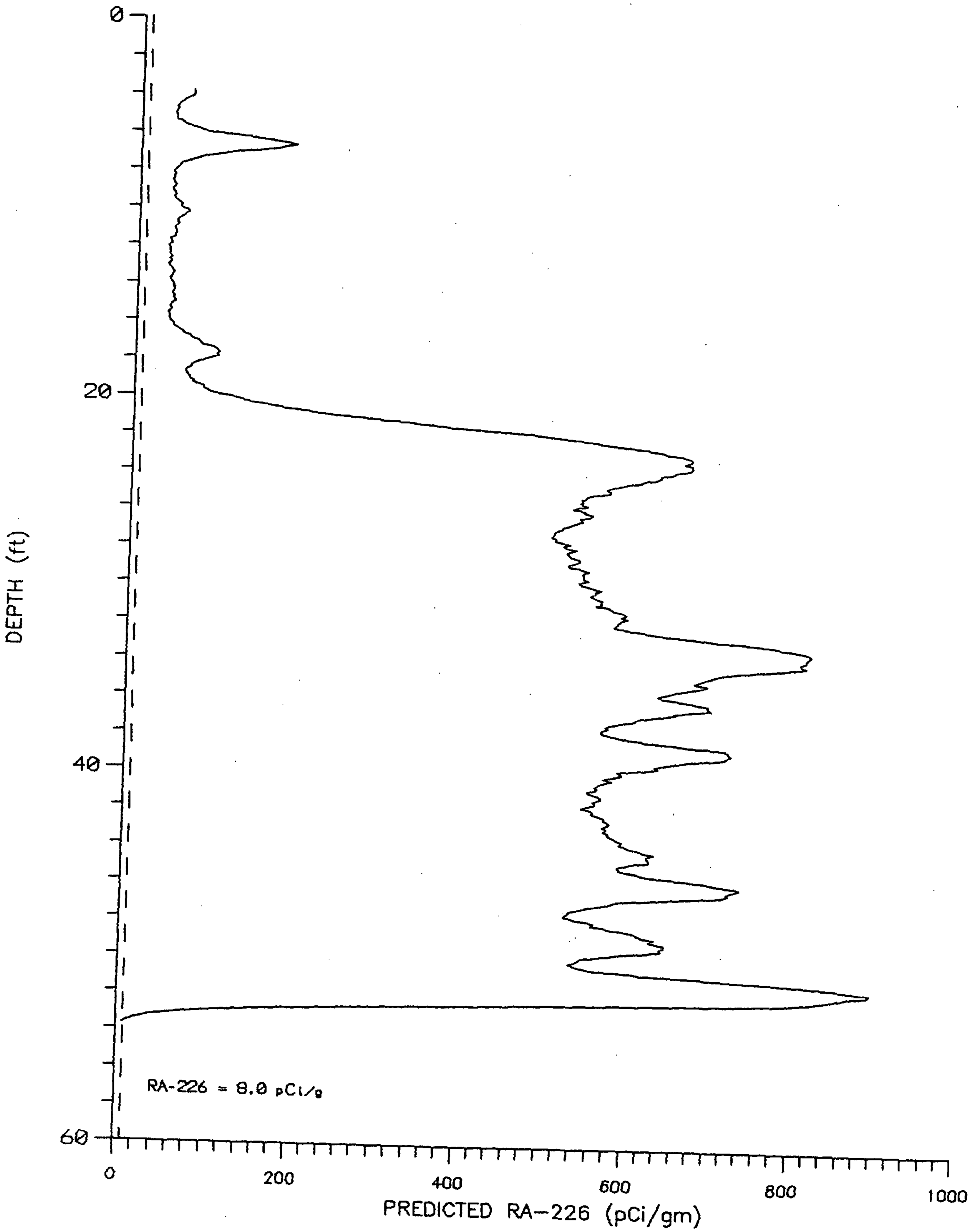


FIGURE A.3-12. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW5-1C.

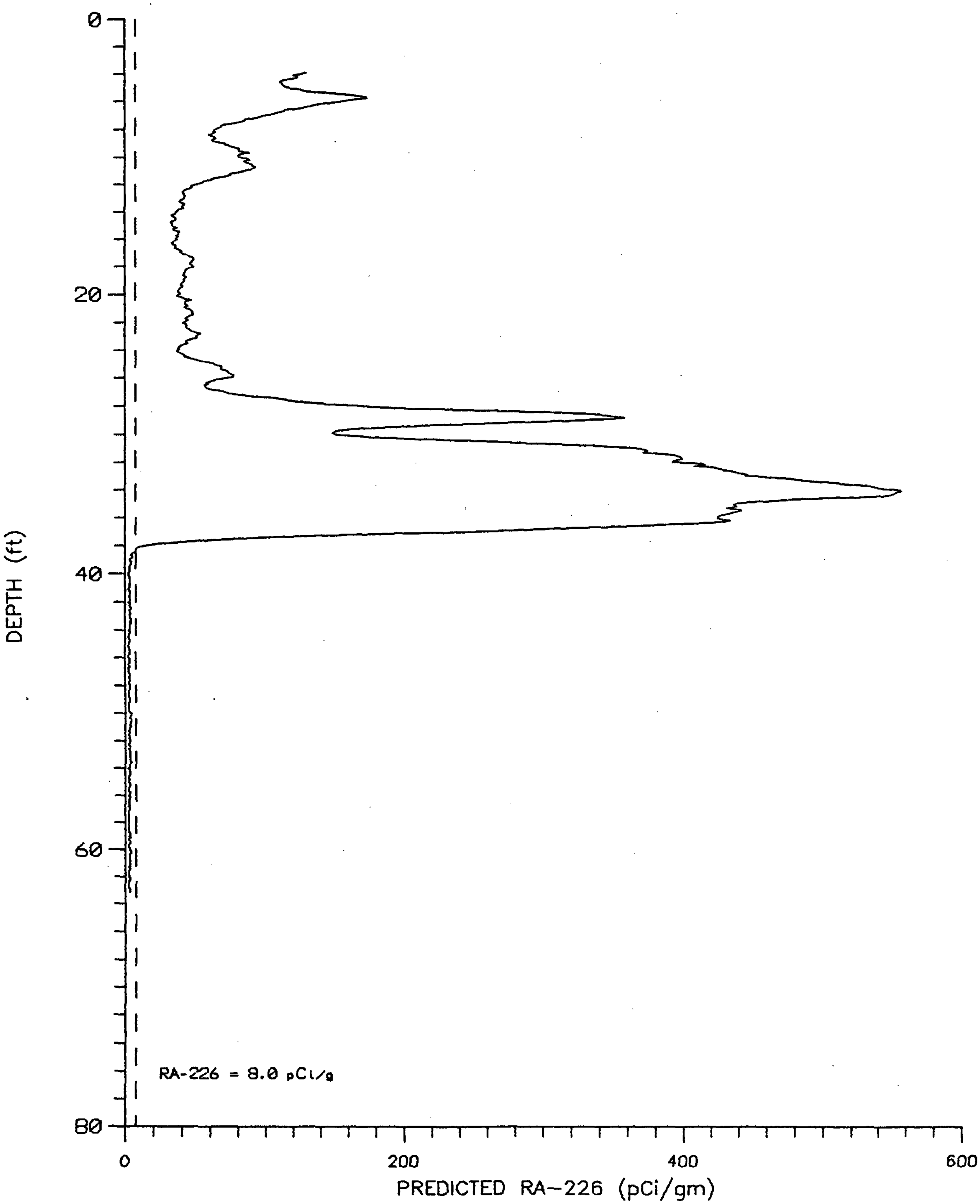


FIGURE A.3-13. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW5-2B.

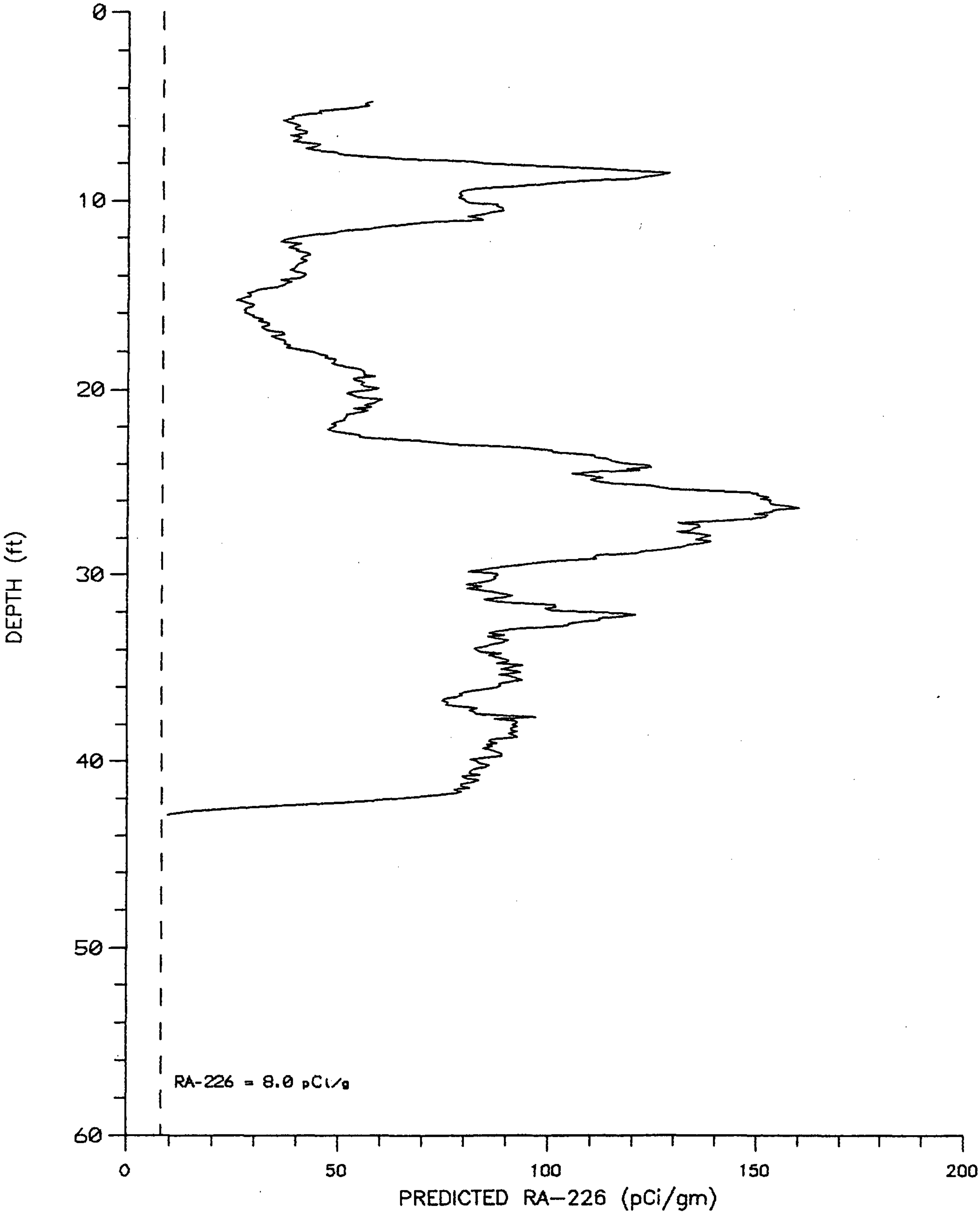


FIGURE A.3-14. PREDICTED RA-226 (pCi/g) IN TEST HOLE TW5-3.

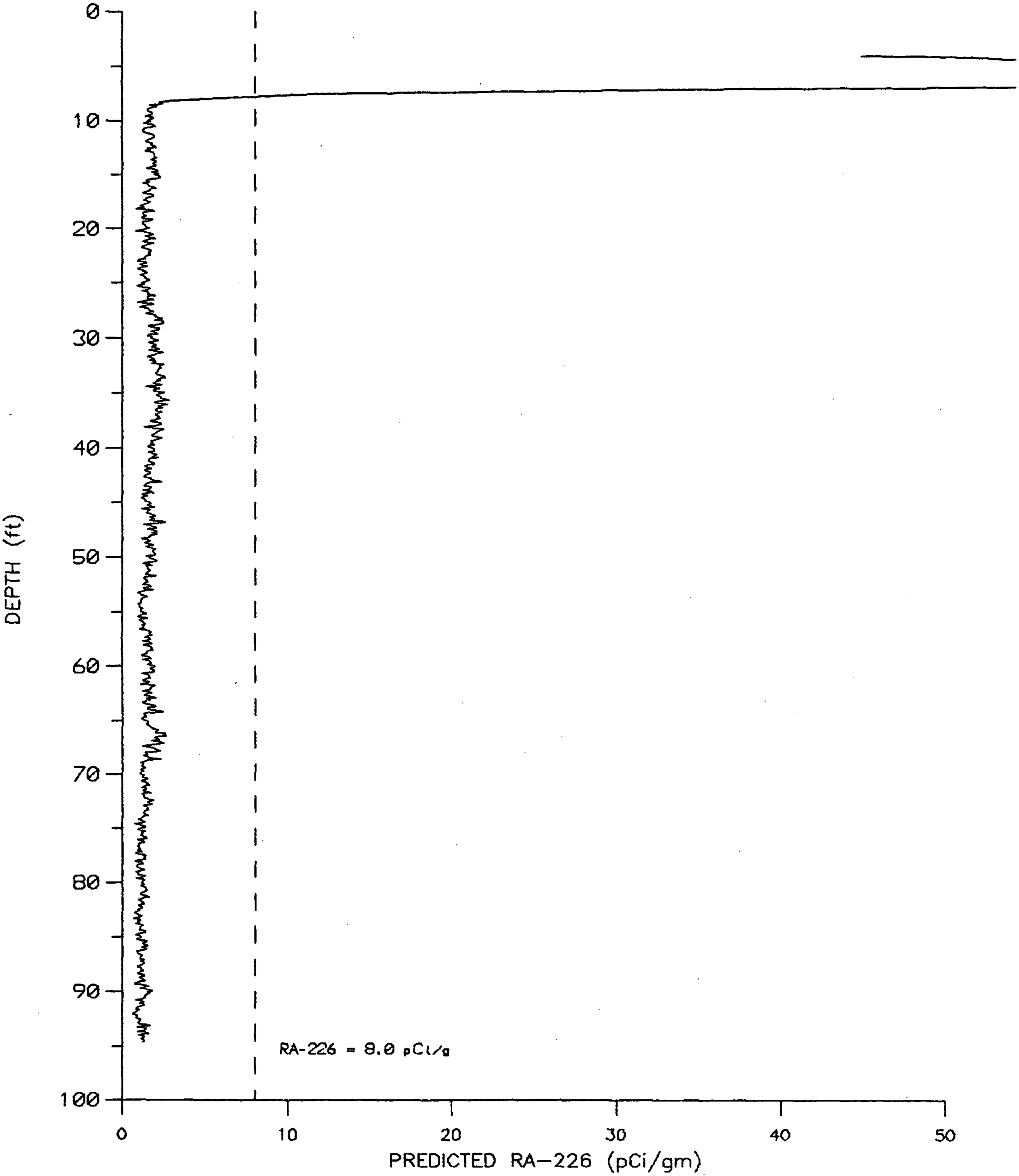


FIGURE A.3-15. PREDICTED RA-226 (pCi/g) IN TEST HOLE NS-1.

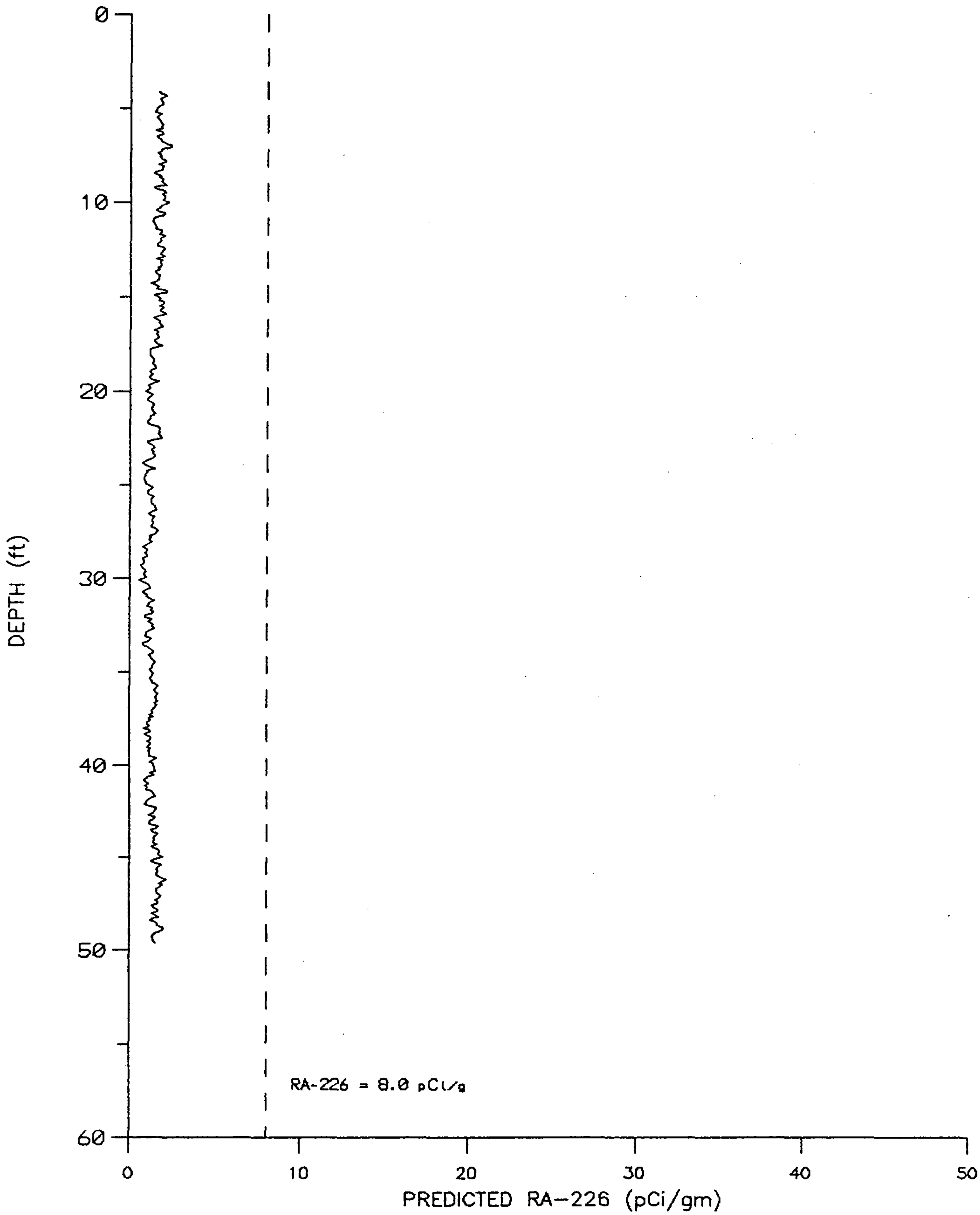


FIGURE A.3-16. PREDICTED RA-226 (pCi/g) IN TEST HOLE NS-2.

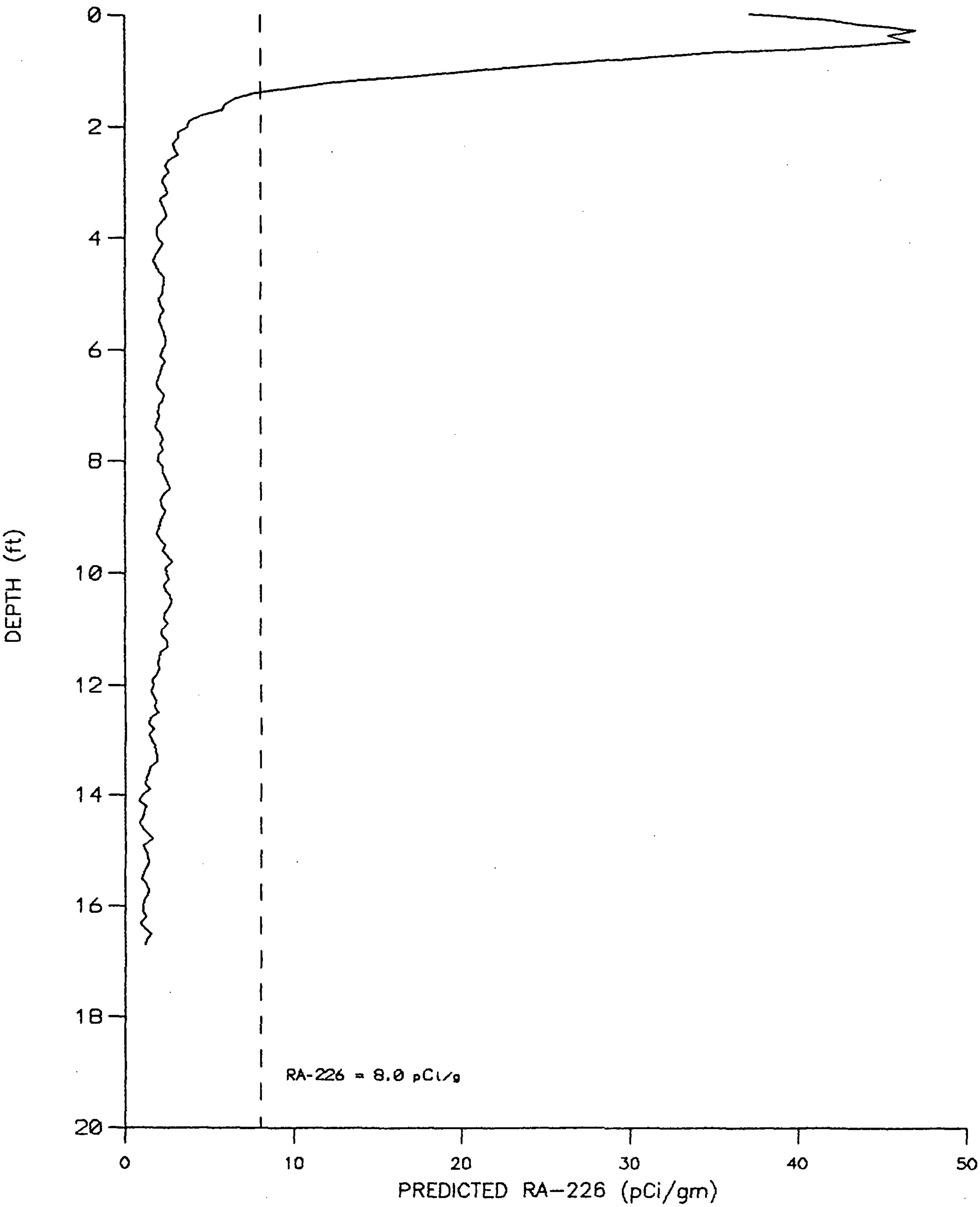


FIGURE A.3-17. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-1.

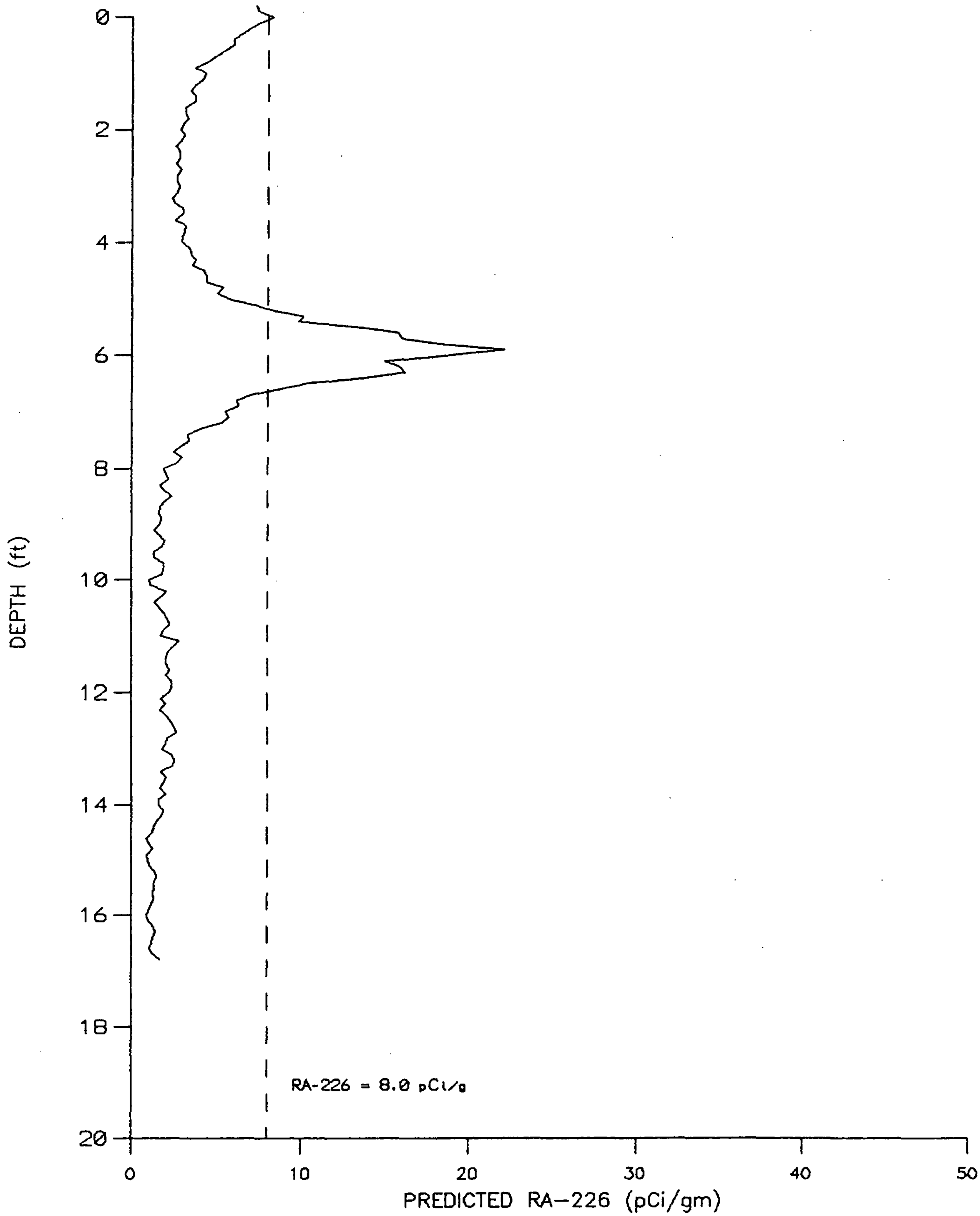


FIGURE A.3-18. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-2.

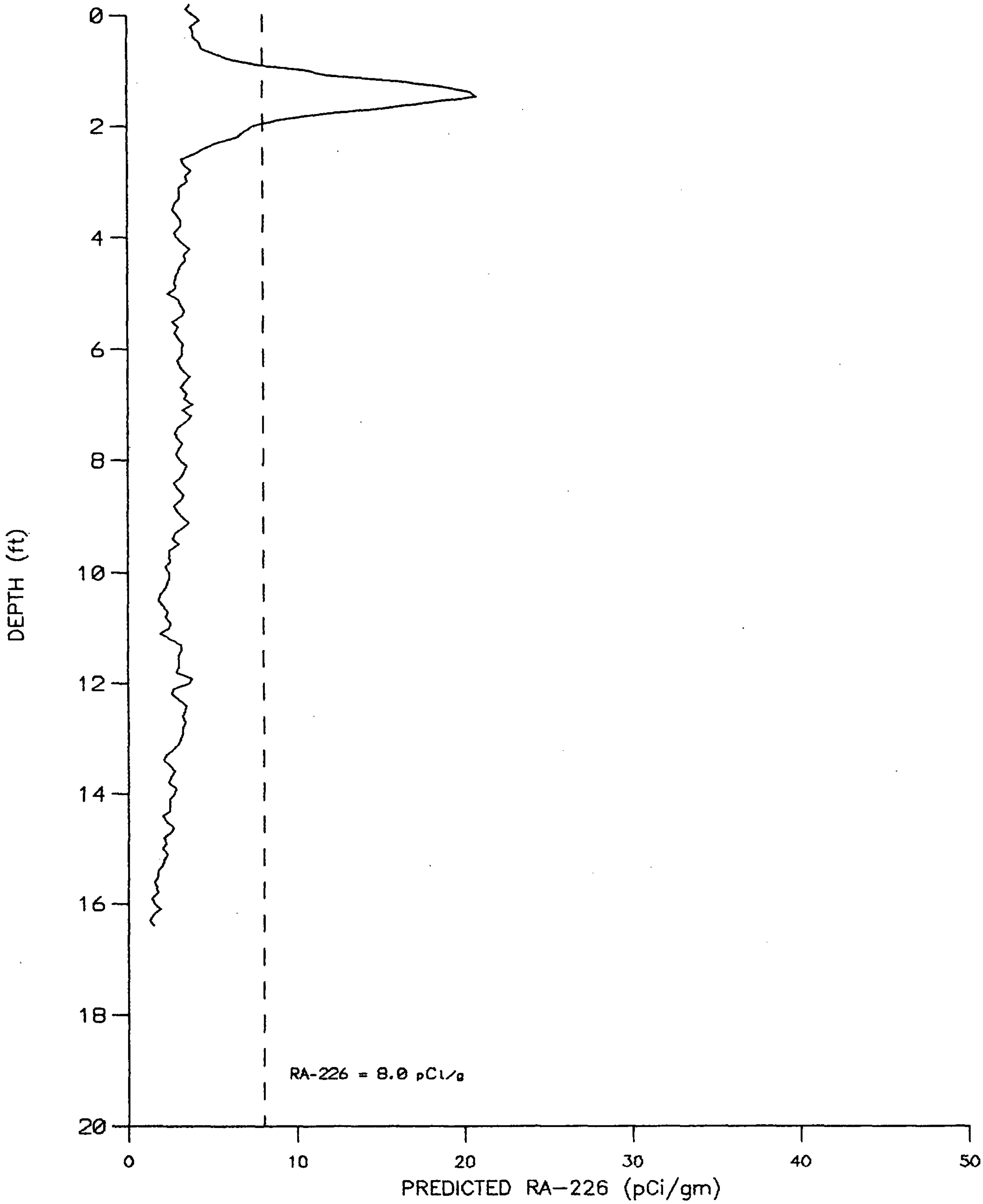


FIGURE A.3-19. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-3.

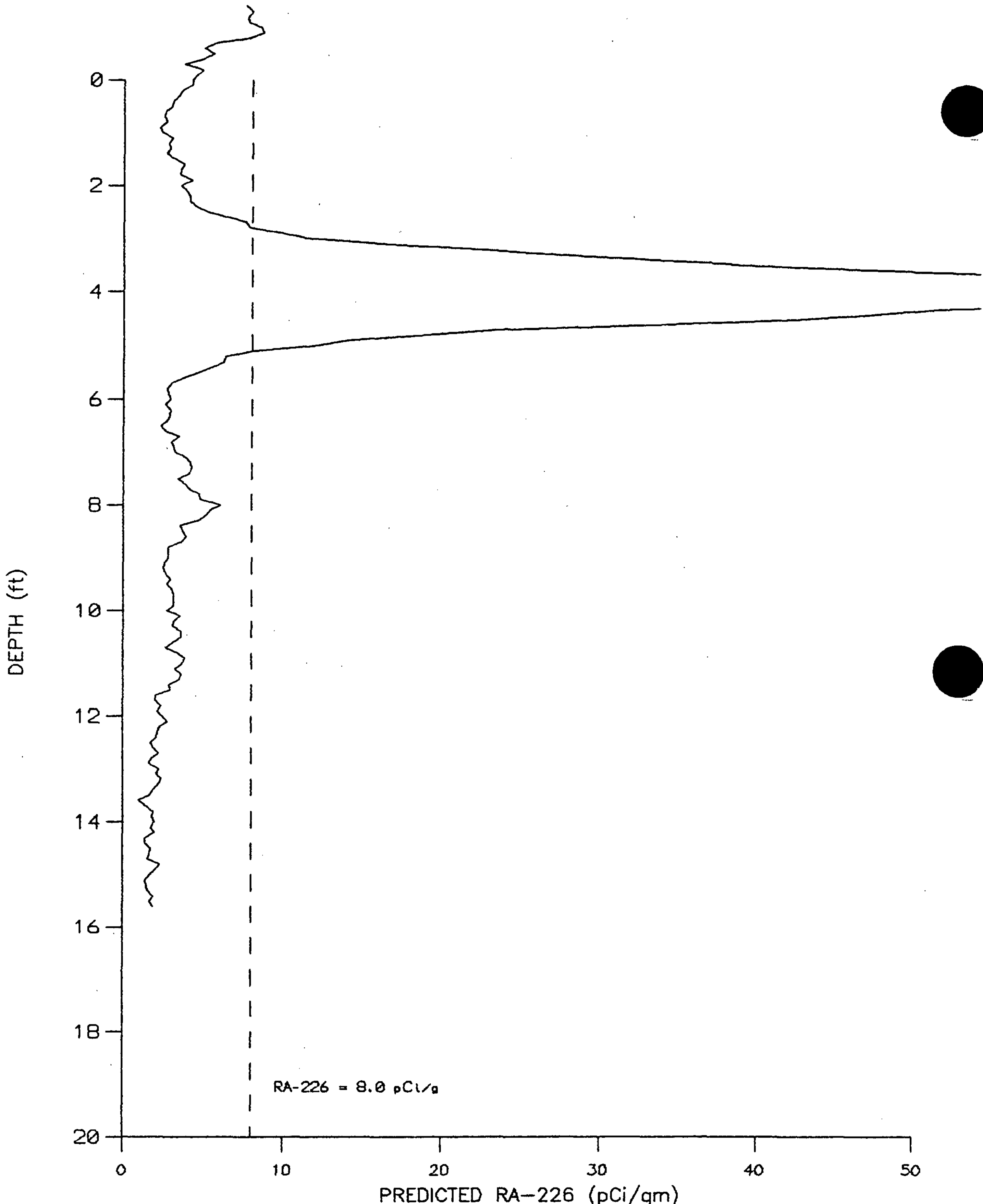


FIGURE A.3-20. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-4.

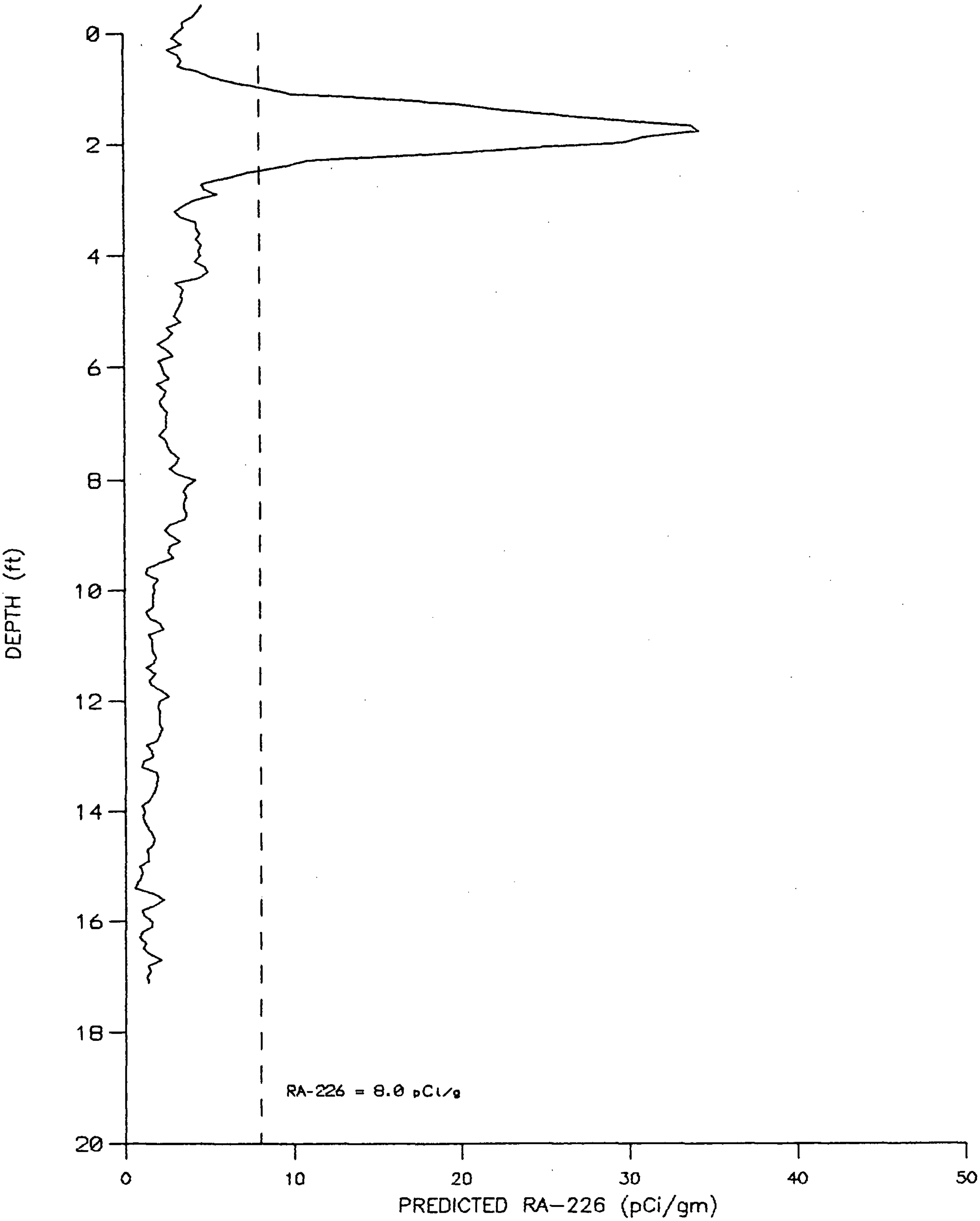


FIGURE A.3-21. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-5.

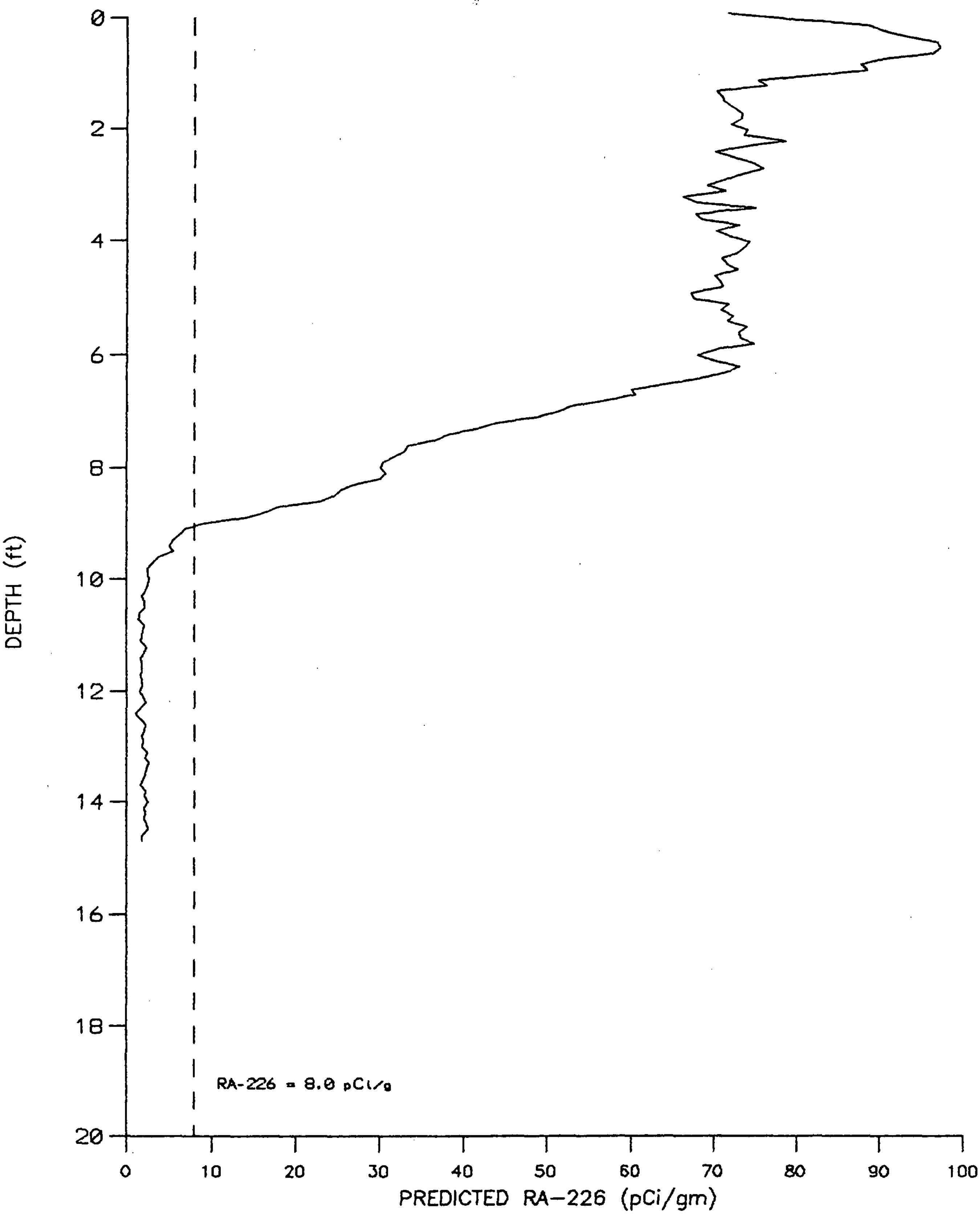


FIGURE A.3-22. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-6.

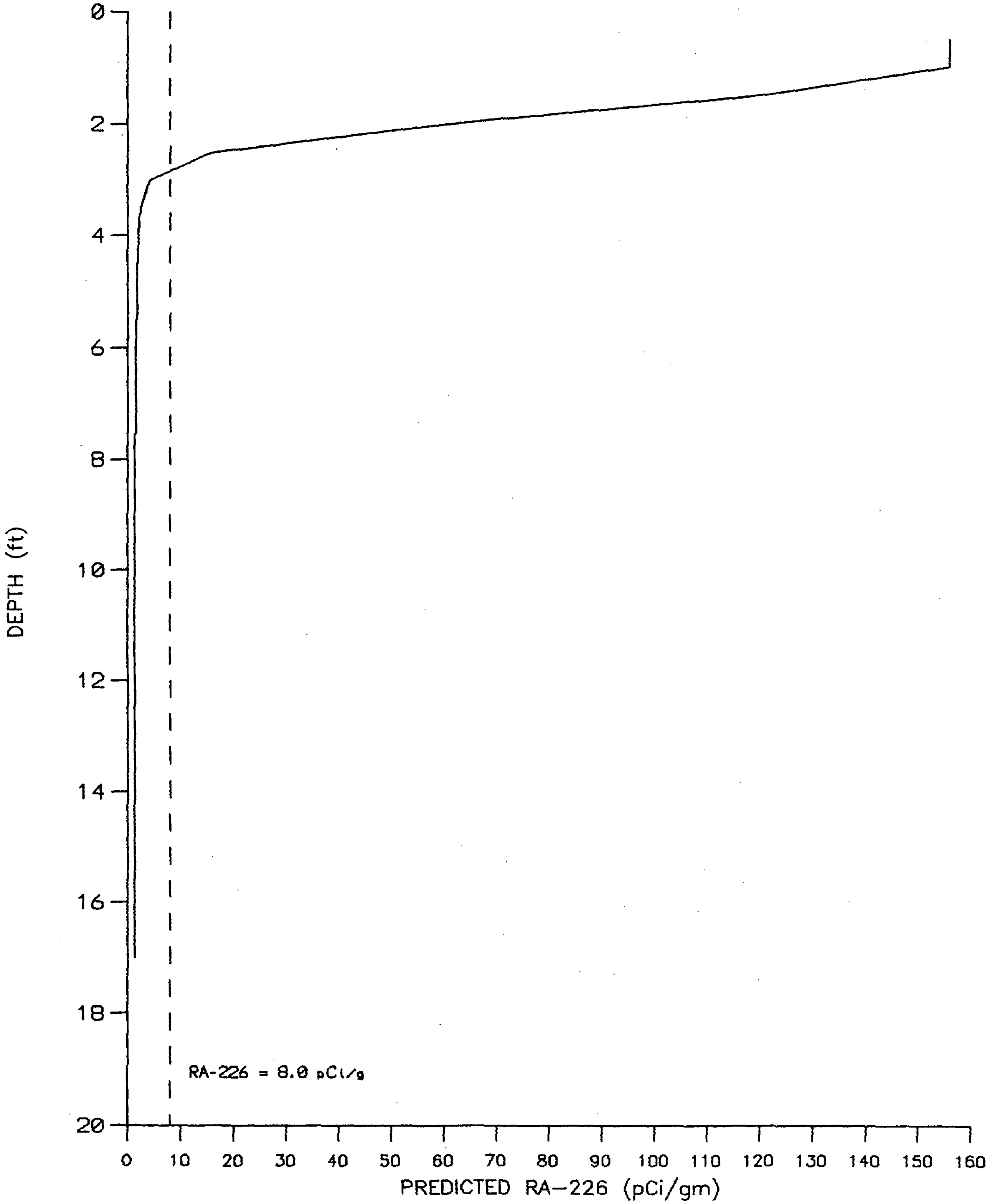


FIGURE A.3-23. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-7.

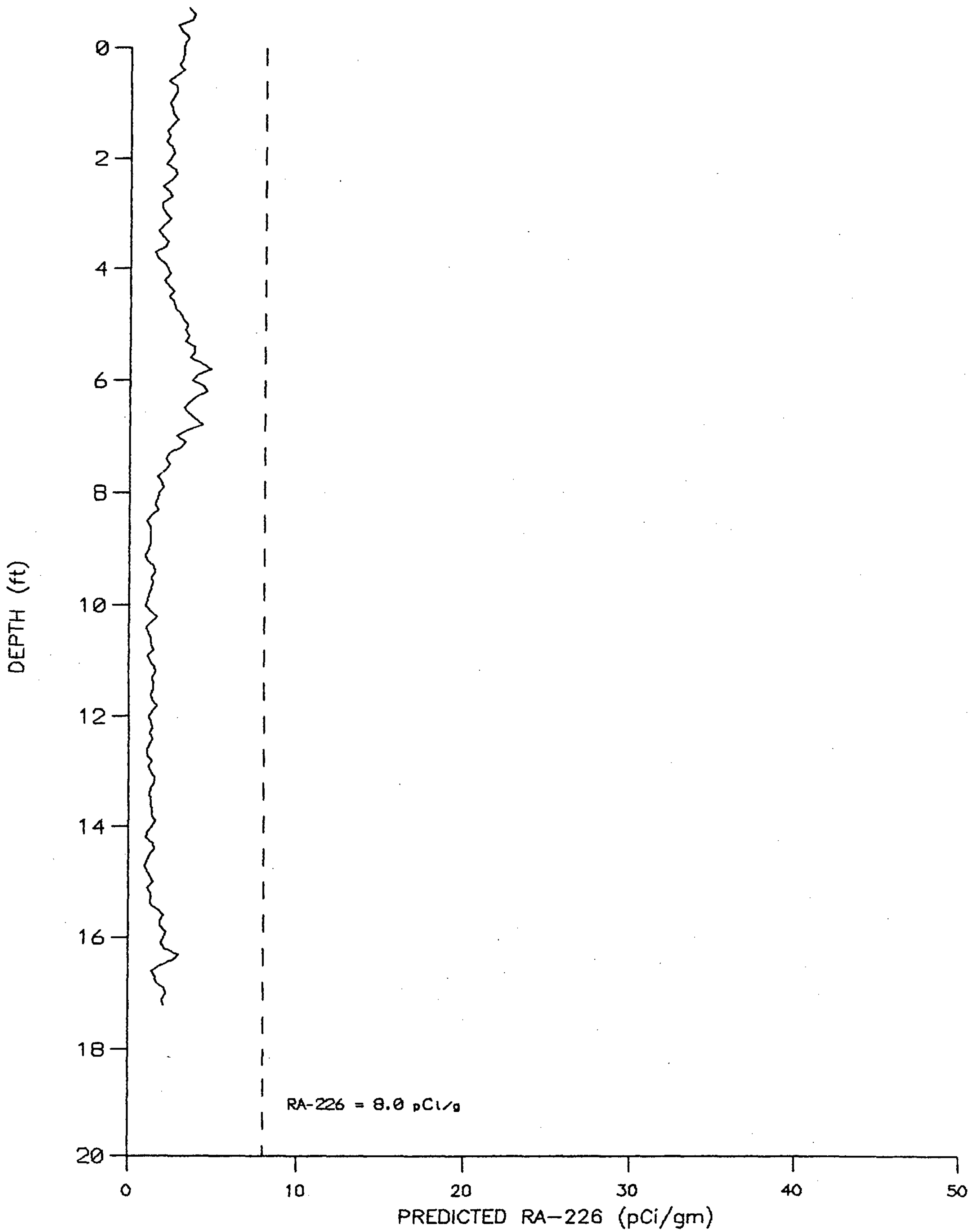


FIGURE A.3-24. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-8.

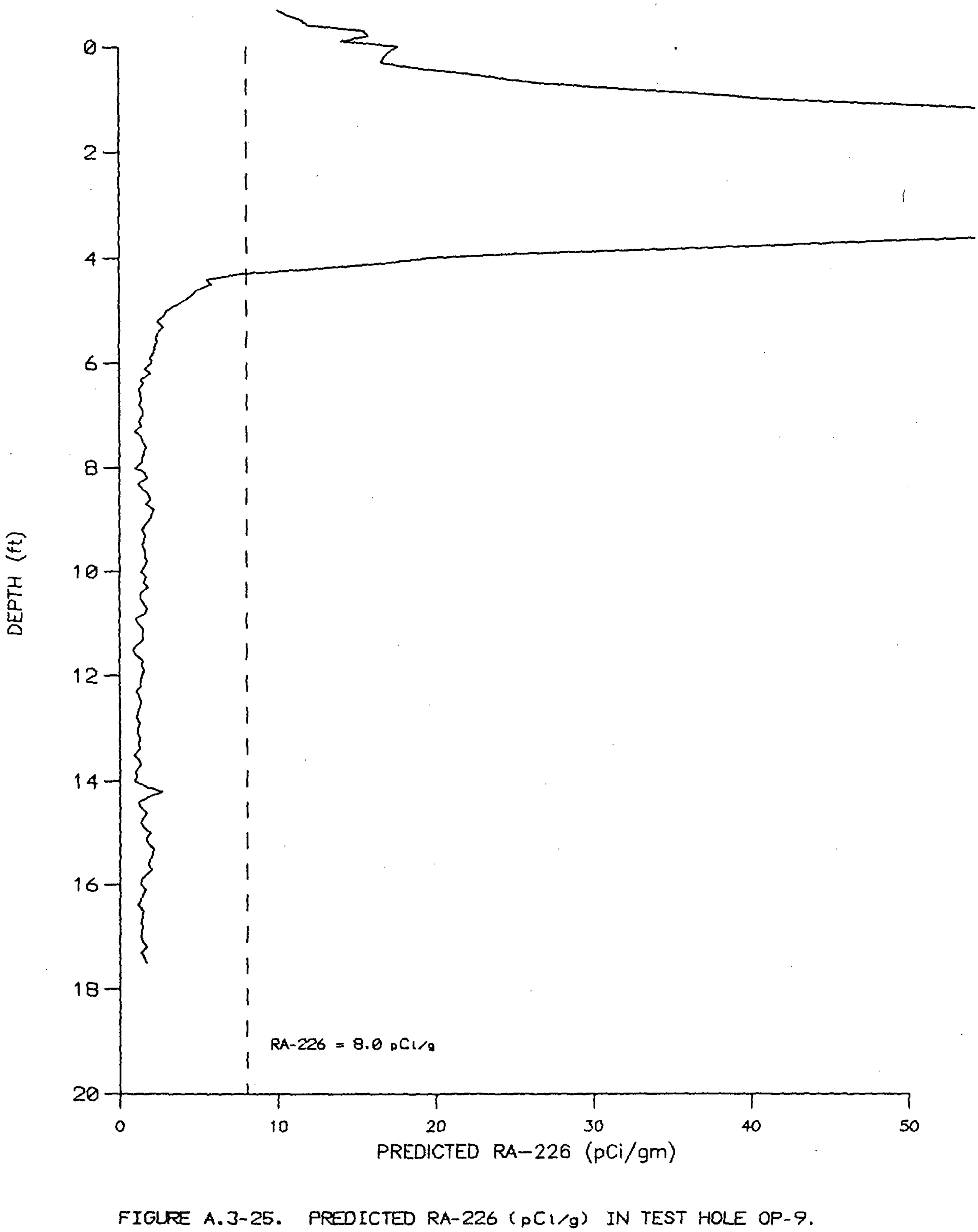


FIGURE A.3-25. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-9.

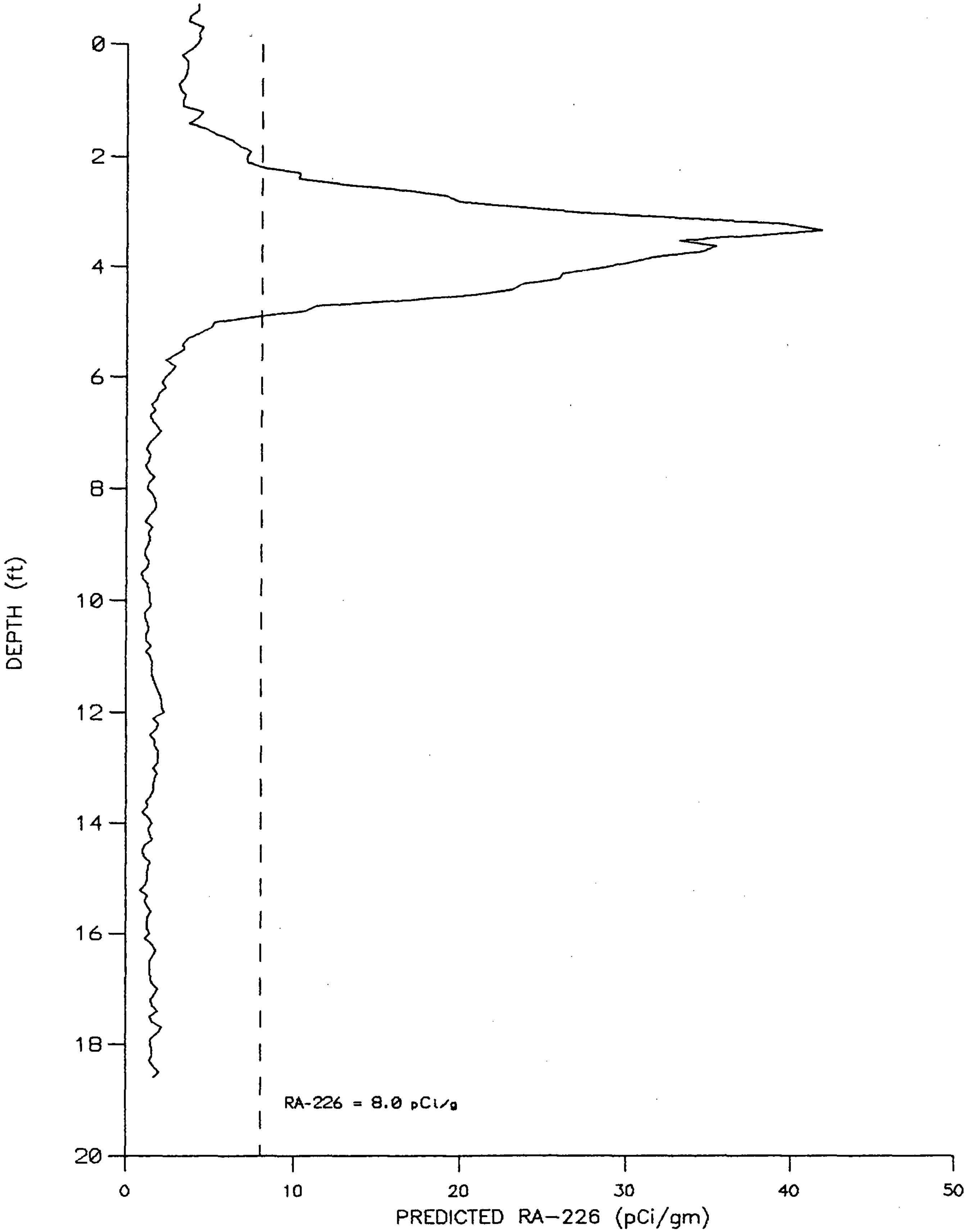


FIGURE A.3-26. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-10.

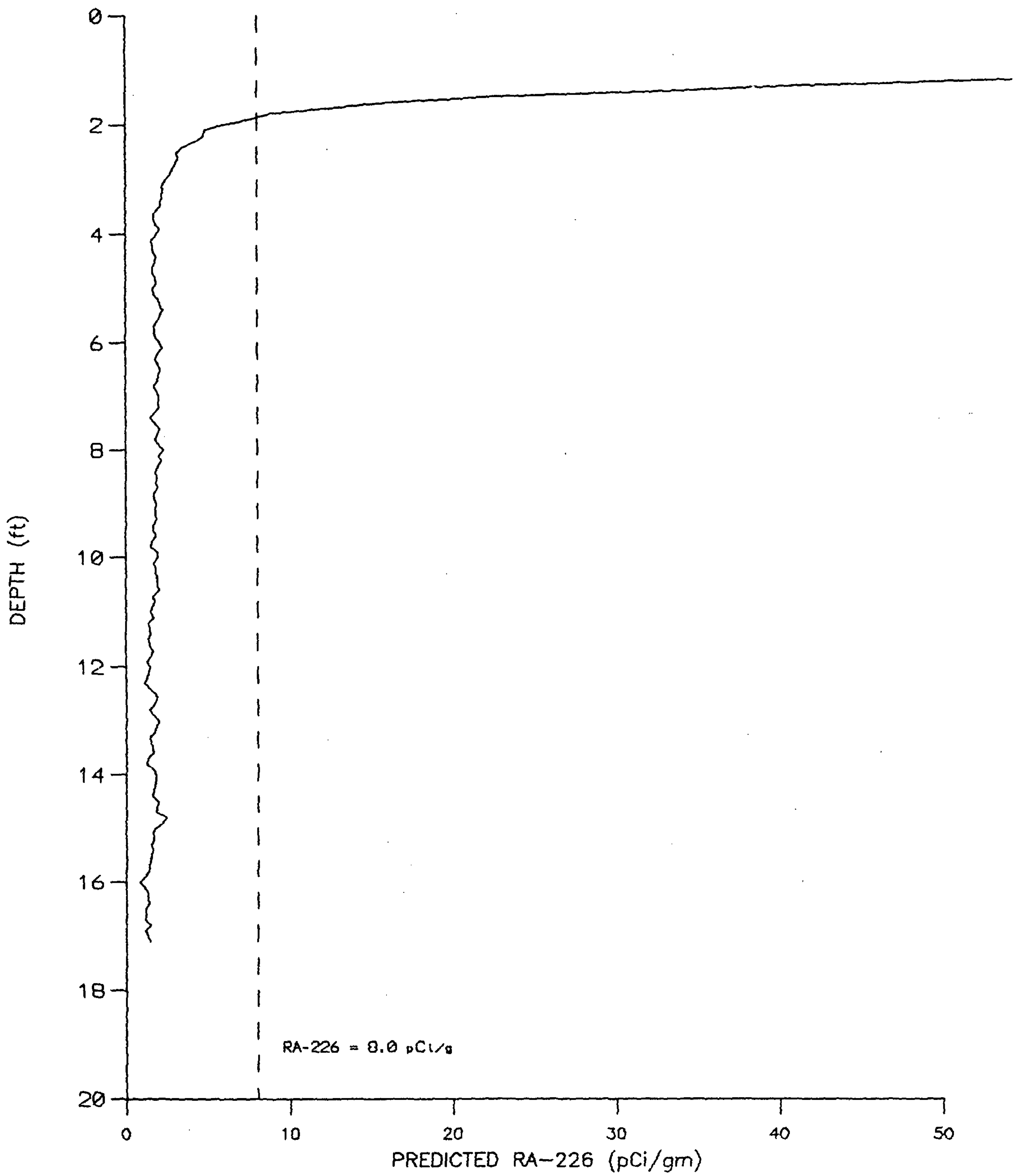


FIGURE A.3-27. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-11.

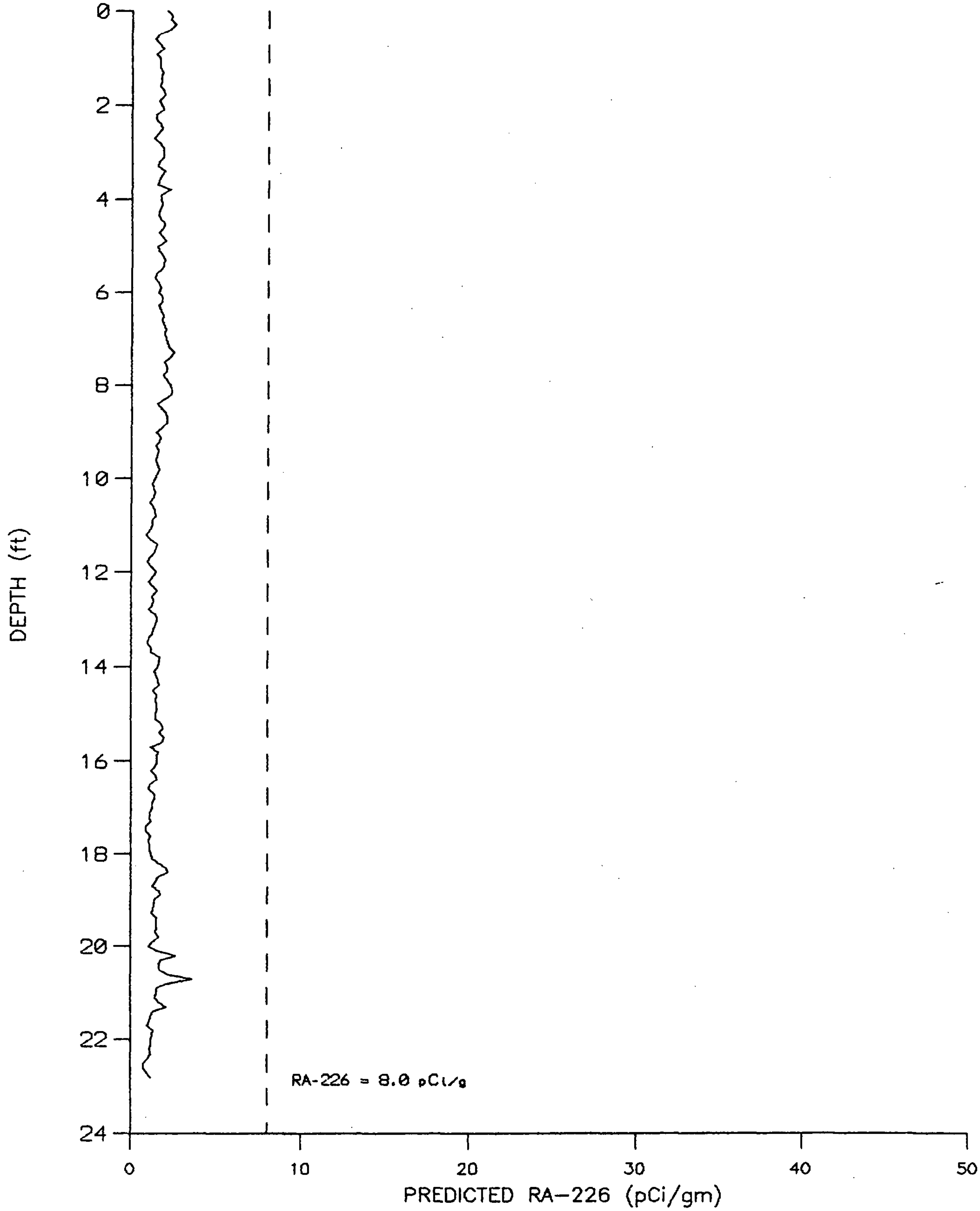


FIGURE A.3-28. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-12.

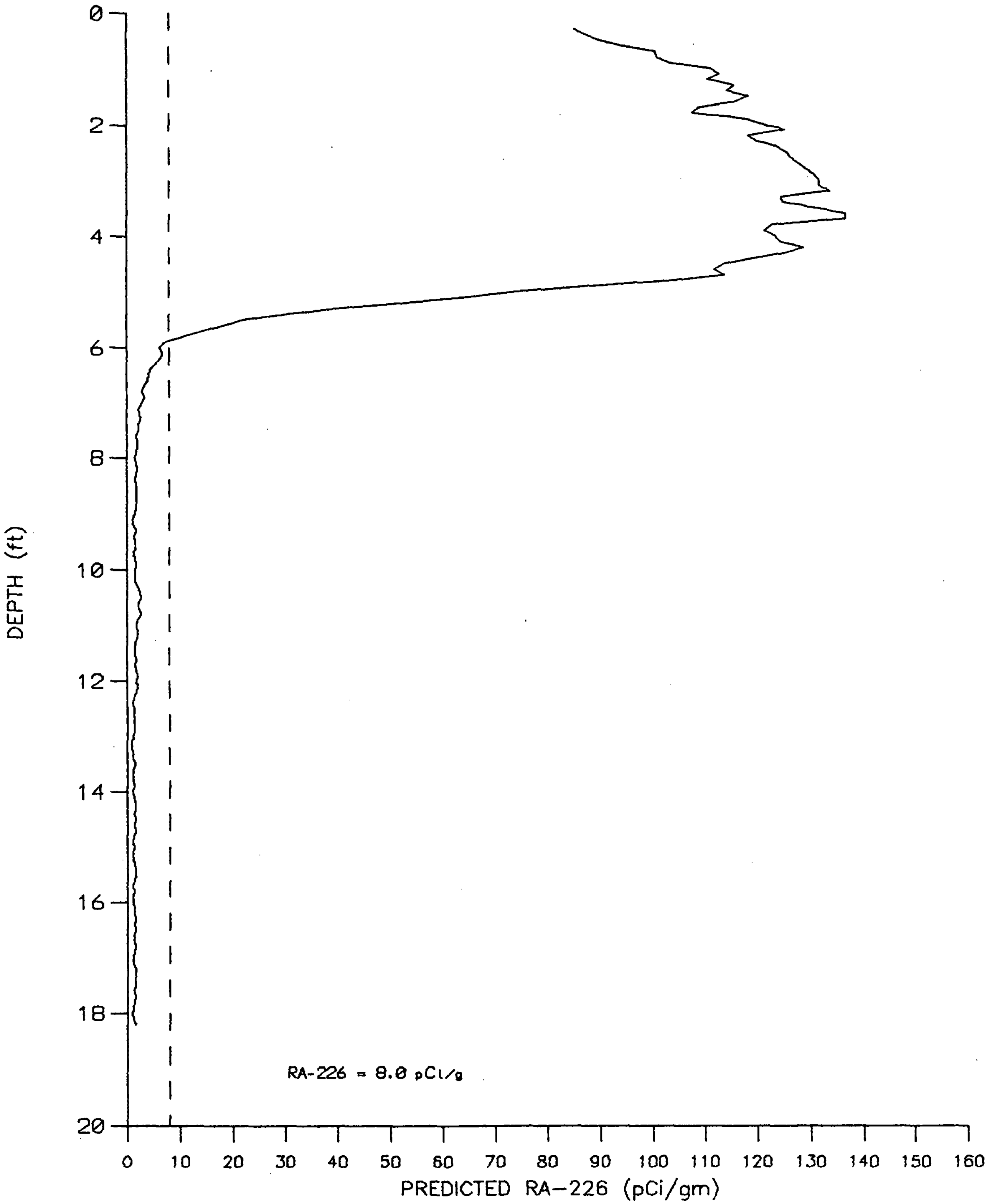


FIGURE A.3-29. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-13.

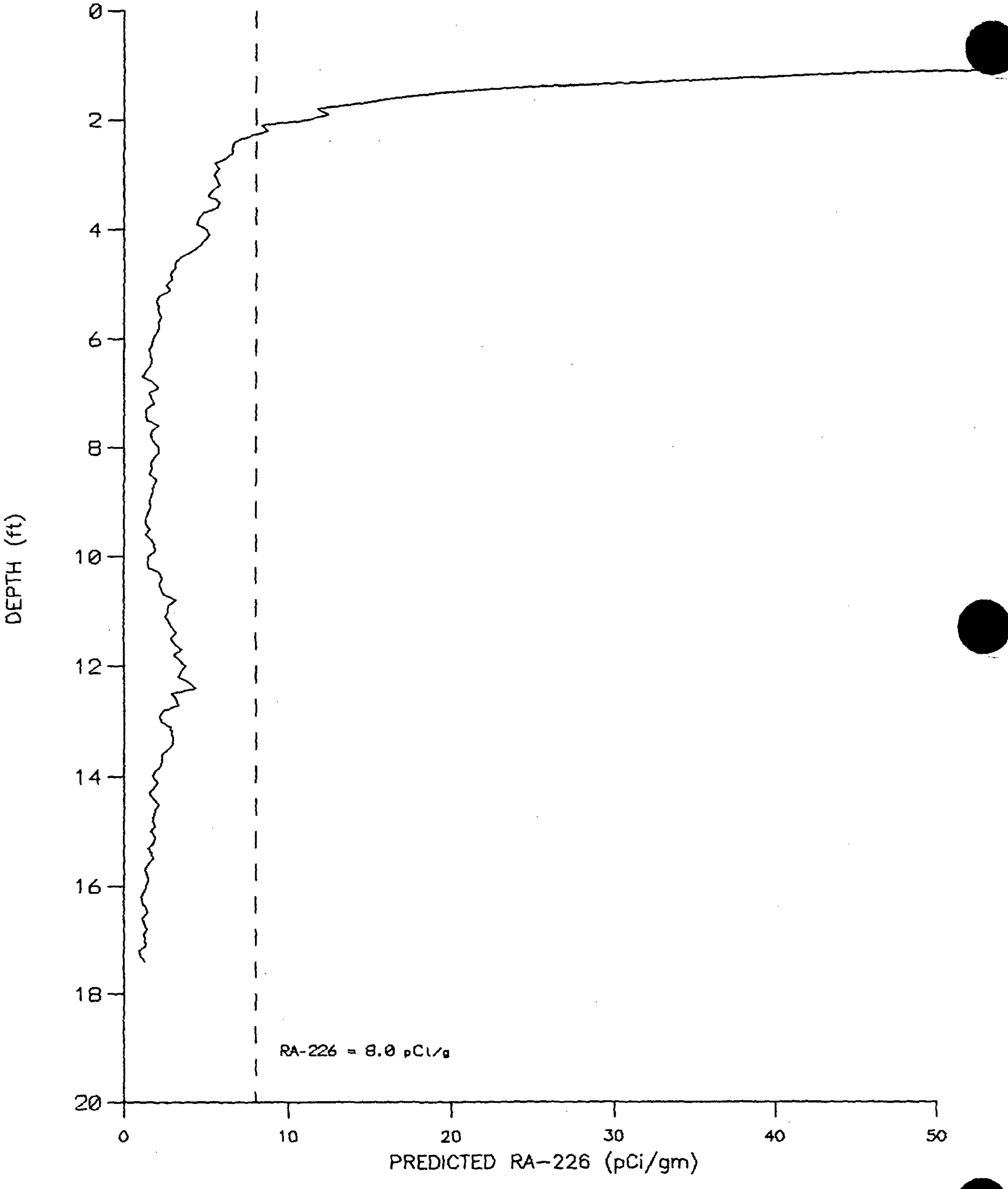


FIGURE A.3-30. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-14.

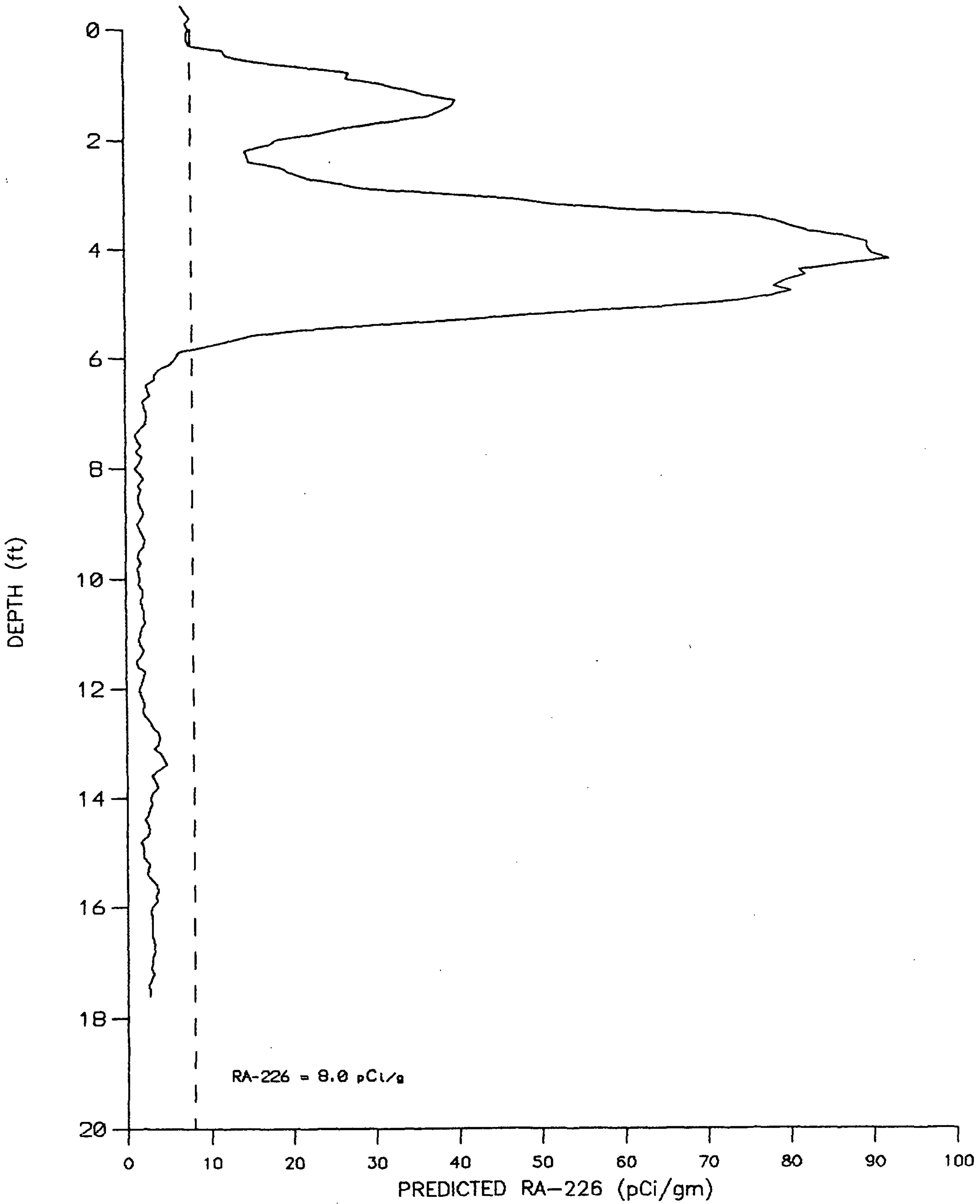


FIGURE A.3-31. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-15.

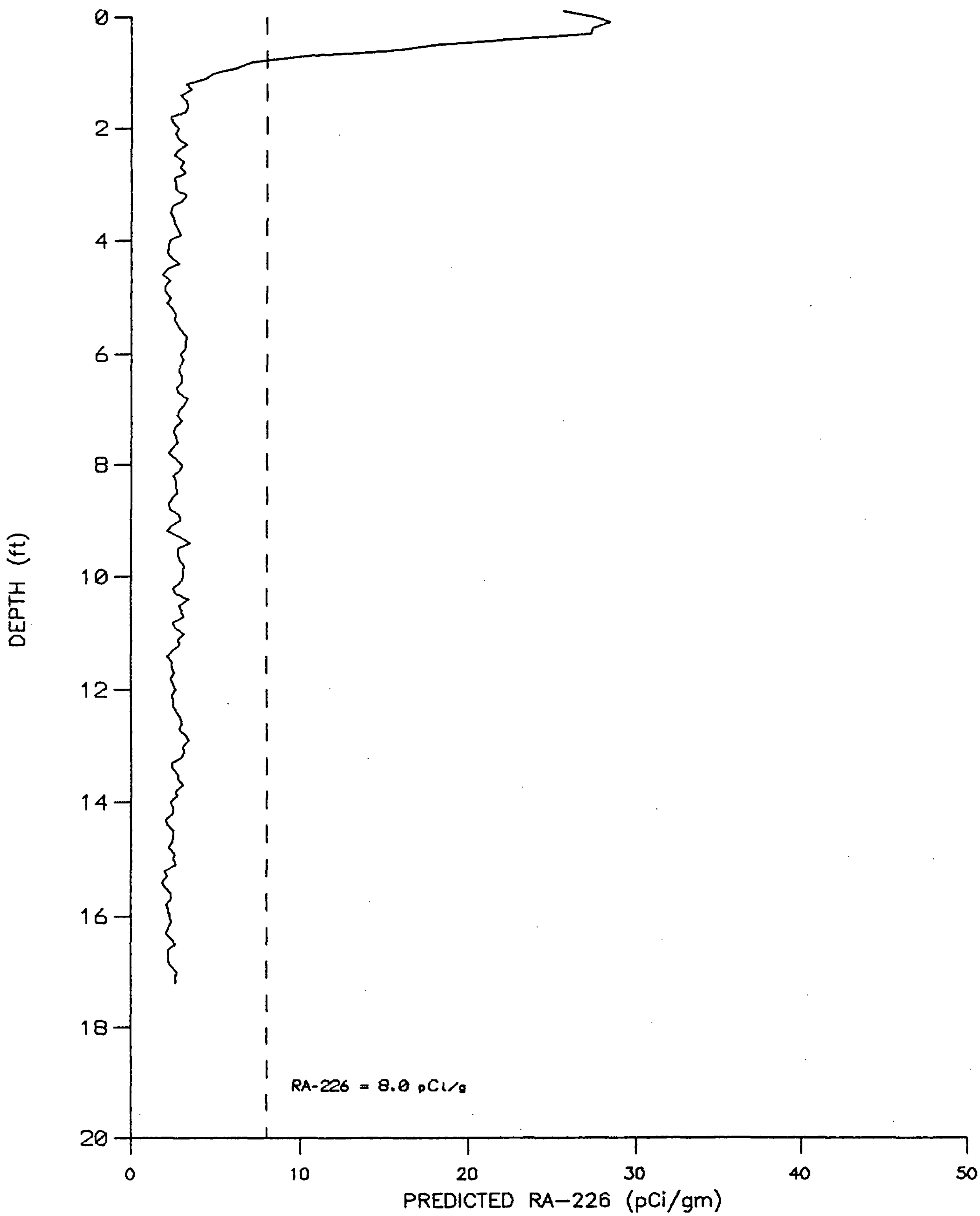


FIGURE A.3-32. PREDICTED RA-226 (pCi/g) IN TEST HOLE OP-16.

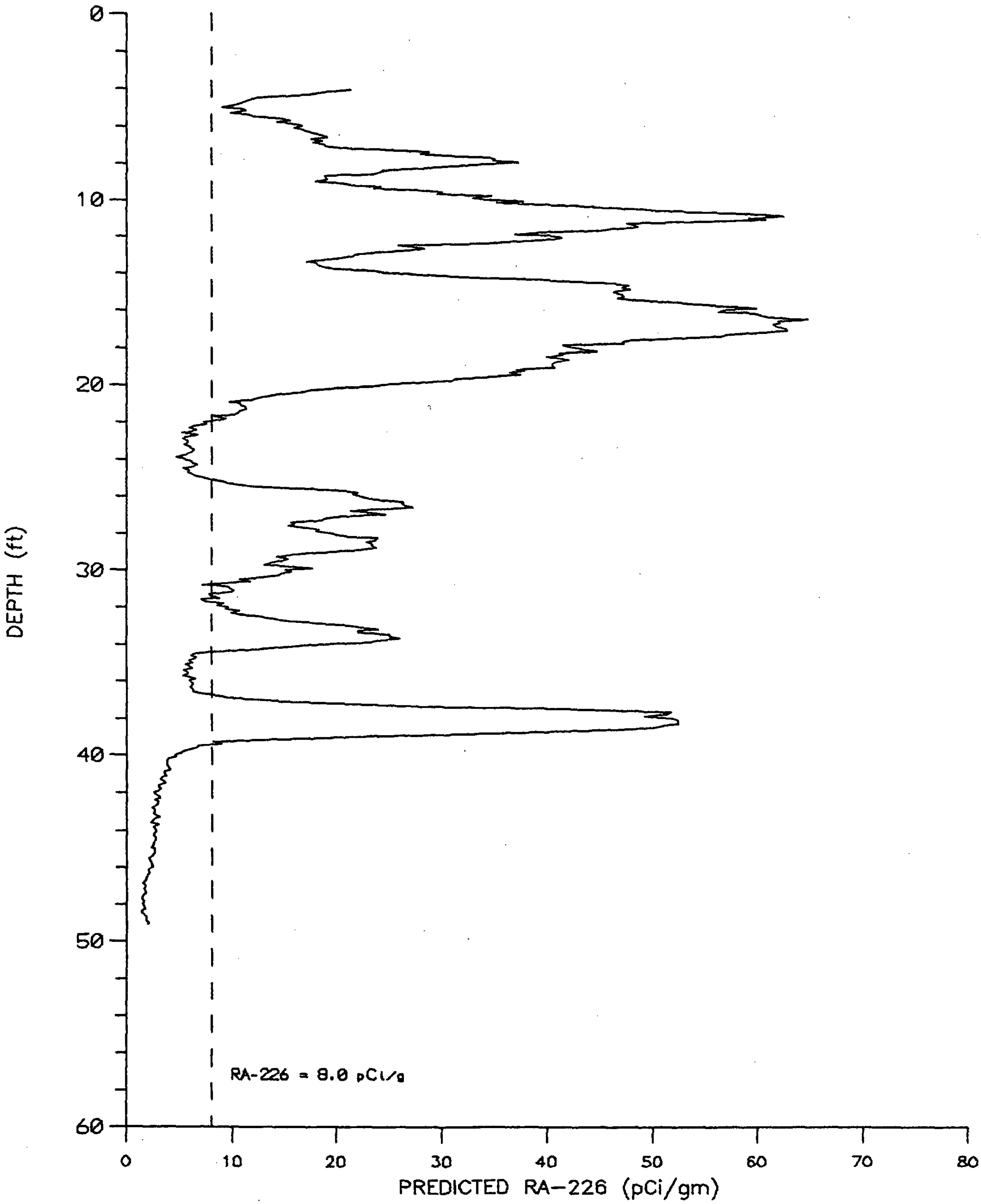


FIGURE A.3-33. PREDICTED RA-226 (pCi/g) IN TEST HOLE LGW-1.

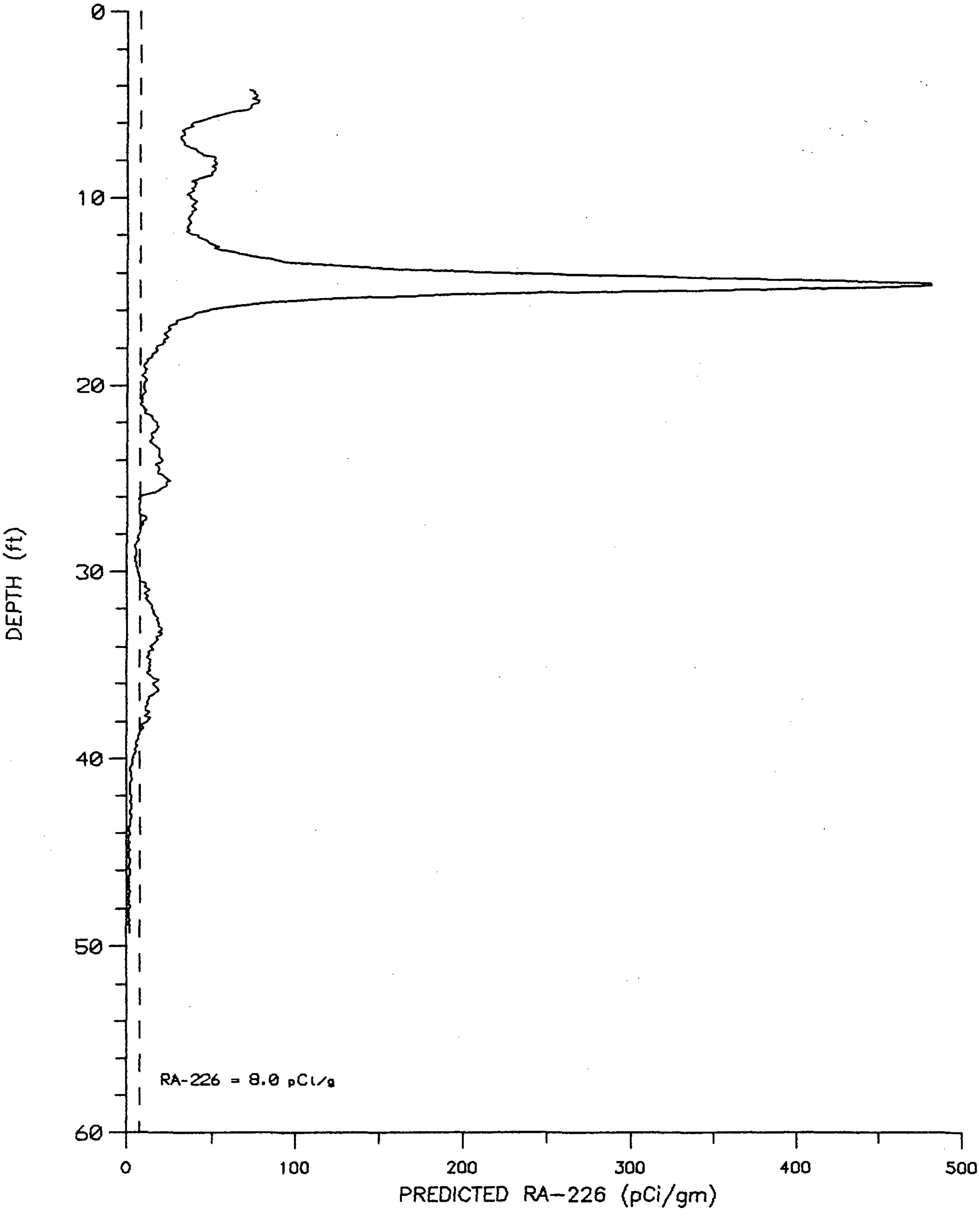


FIGURE A.3-34. PREDICTED RA-226 (pCi/g) IN TEST HOLE LGW-2.

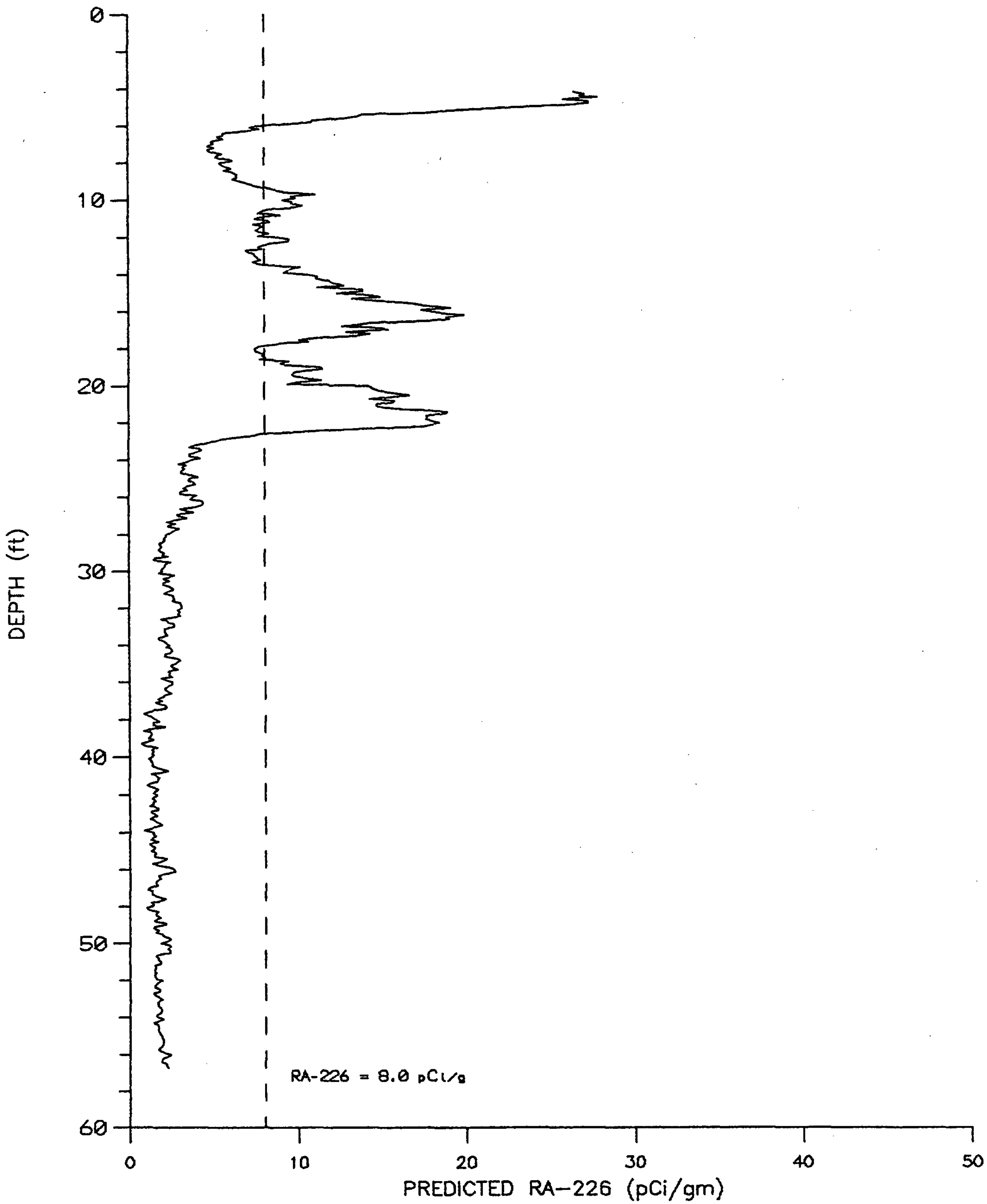


FIGURE A.3-35. PREDICTED RA-226 (pCi/g) IN TEST HOLE LGW-3.

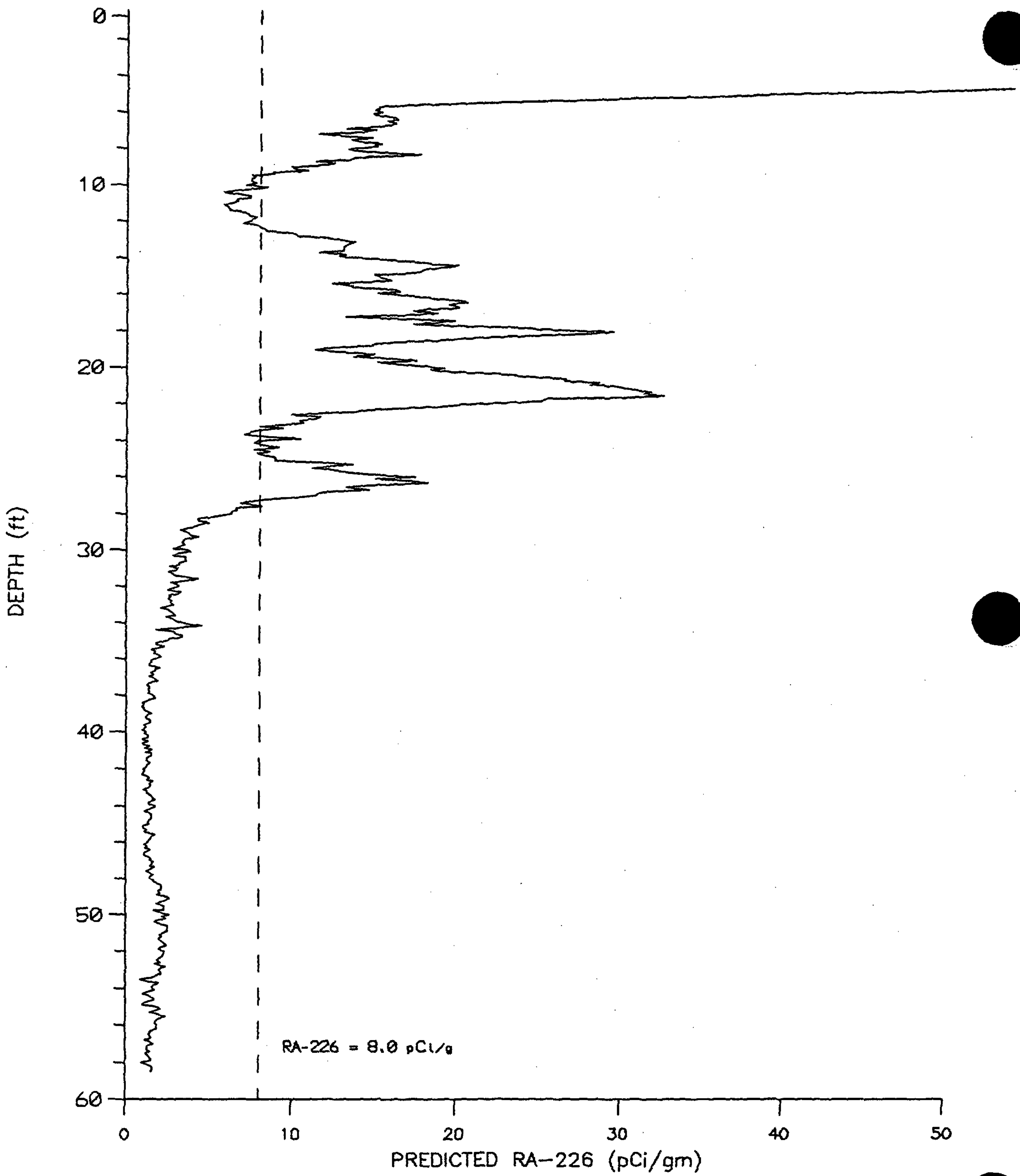


FIGURE A.3-36. PREDICTED RA-226 (pCi/g) IN TEST HOLE LGW-4.

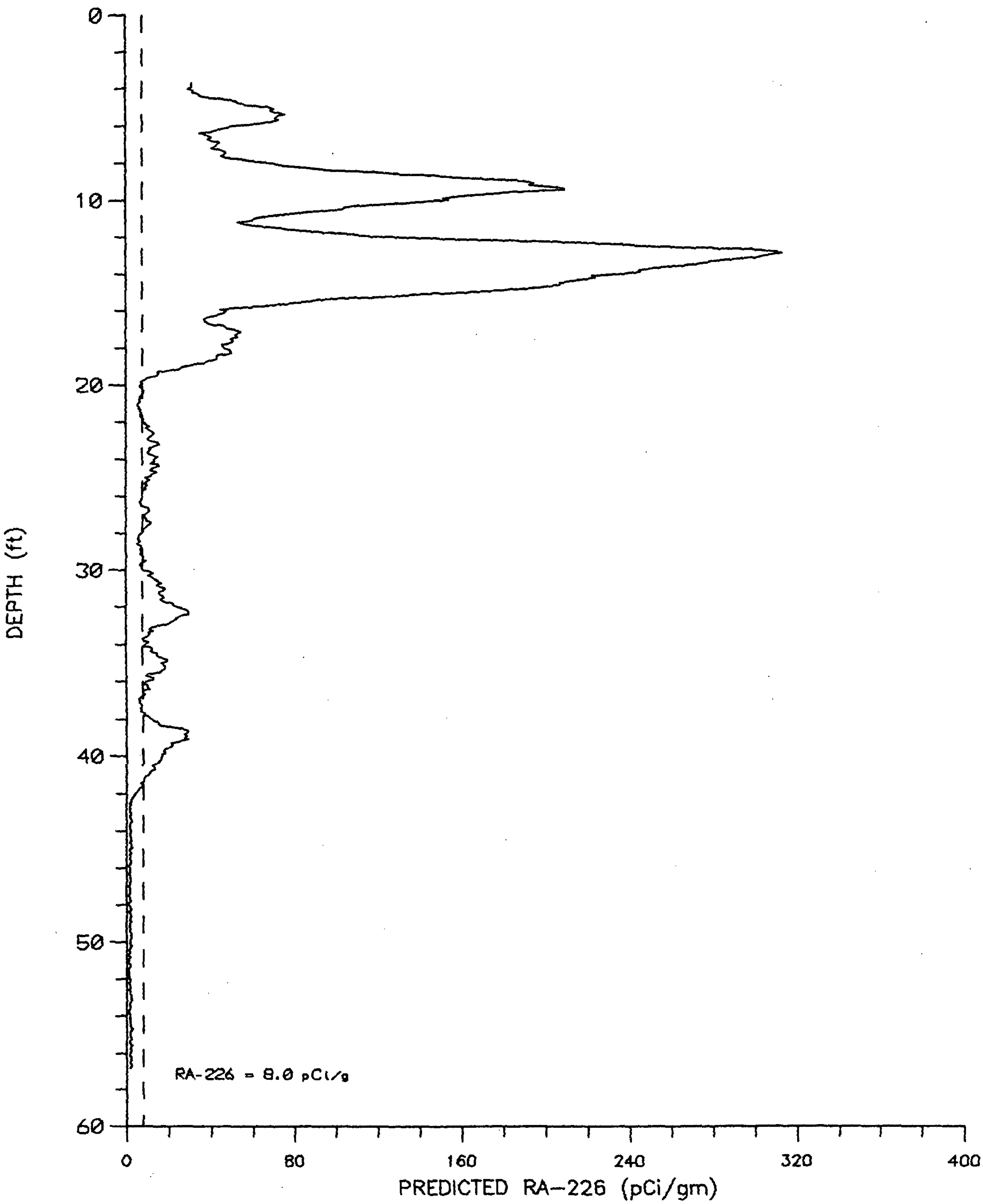


FIGURE A.3-37. PREDICTED RA-226 (pCi/g) IN TEST HOLE LGW-5.

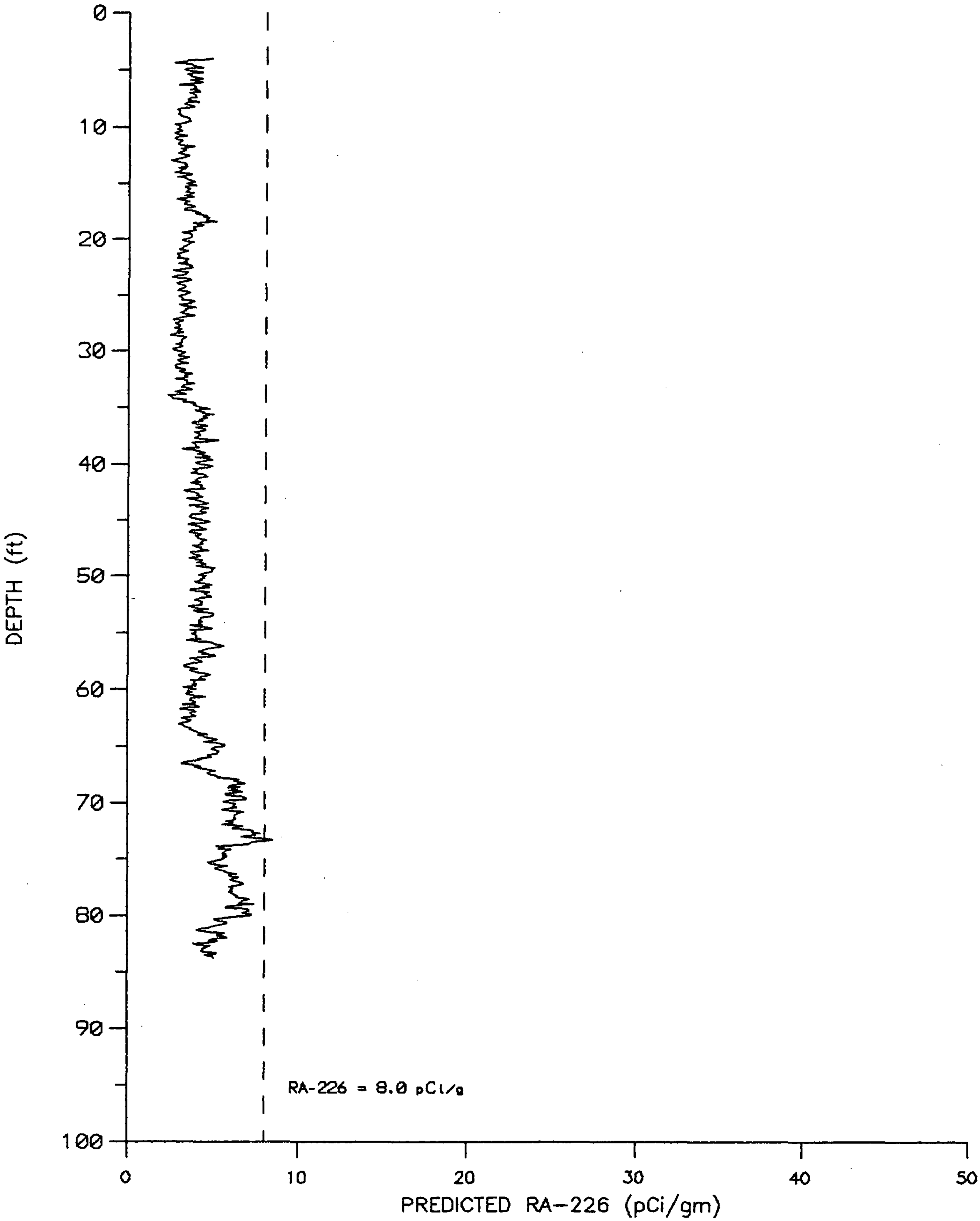


FIGURE A.3-38. PREDICTED RA-226 (pCi/g) IN TEST HOLE STH-1A.

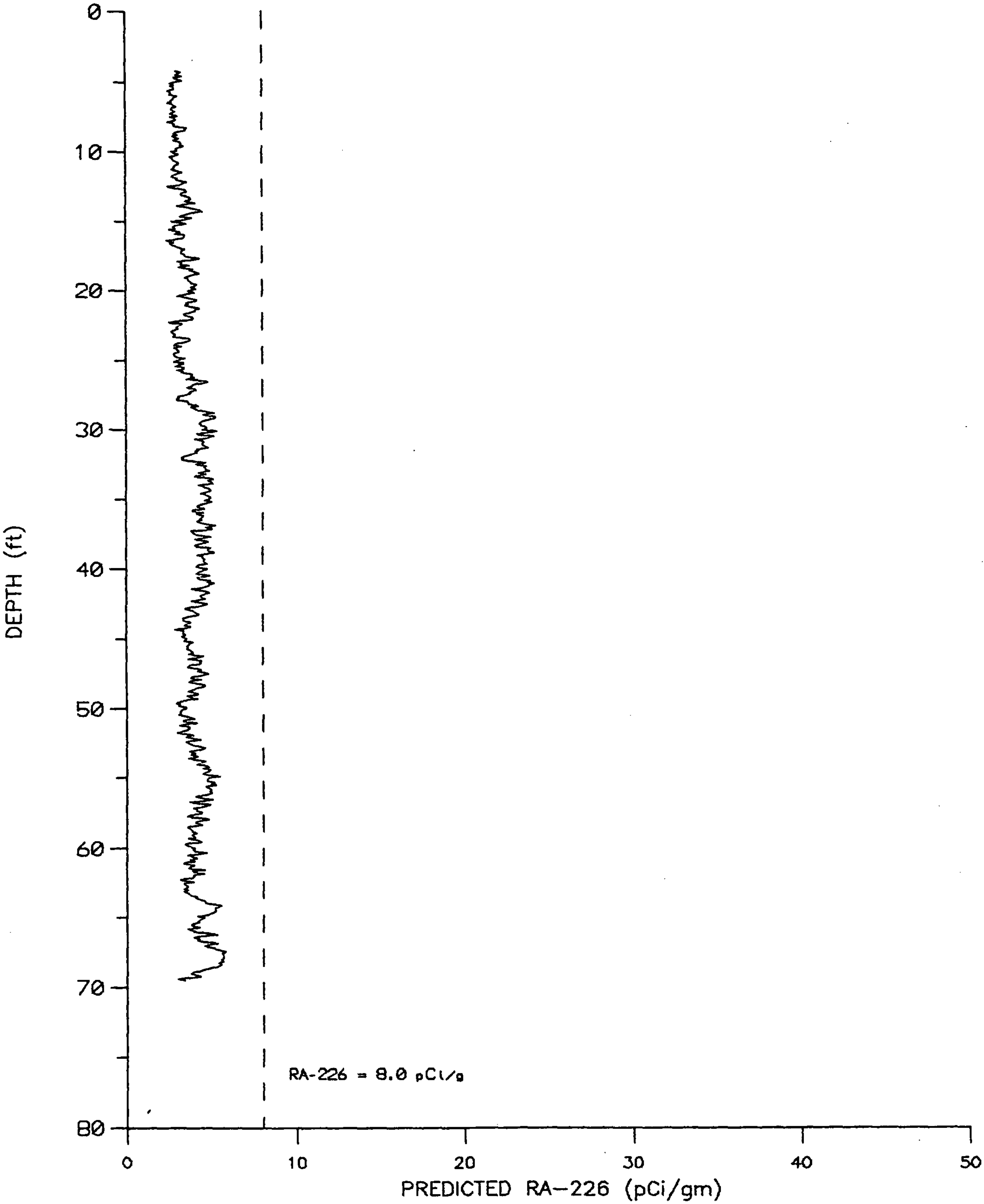


FIGURE A.3-39. PREDICTED RA-226 (pCi/g) IN TEST HOLE STH-3.

APPENDIX B

BACKHOE PIT INFORMATION

APPENDIX B

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B-2 RADIOLOGICAL DATA FOR BACKHOE PITS P4-4A, P4-4B, P4-4C, P4-4D, P4-5A, P4-5B, P4-5C, & P4-5D B-3

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B-6 RADIOLOGICAL DATA FOR BACKHOE PITS P4-13A, P4-13B, P4-13C, P4-14A, P4-14B, P3-1, P3-2, P3-3 & P3-4 ... B-7

B-7 RADIOLOGICAL DATA FOR BACKHOE PITS P5-1A, P5-1B, P5-2, O-1, & O-2 .... B-8

B.1 APPENDIX B TEXT

This appendix contains gamma profiles for the backhoe pits dug during this study. The gamma values presented are hand-held gamma meter readings taken in the field by placing the probe at the specified interval against the pit wall. Intervals of six inches or one foot were used to define the profile. The hand-held gamma meter - laboratory Ra-226 relationships are described in Section 2.4. Table 2-1 gives the radium results for the pit samples. The values in the tables in this Appendix are presented in µR/hr times Ø.1.

TABLE B-1. RADIOLOGICAL DATA FOR BACKHOE PITS P4-1A, P4-1B, P4-1C, P4-2A, P4-2B, P4-3A, P4-3B, & P4-3C.

Field Gamma Readings in μR/hr x 10-1

Pathfinder Mines Corporation
Shirley Basin Mine
Tailings Reclamation
Test Pit Gamma Profiles

Depth From Surface	Pit P4-1A Gamma	Pit P4-1B Gamma	Pit P4-1C Gamma
0"-6"	1.2	6	6
6"-12"	1.4	6.8	9
12"-18"	1.4	7	2.2
18"-24"	1.4	4	1.8
24"-30"	1.4	2.2	2
30"-36"	1.6	3	1.8
36"-42"	1.8	2.6	2
42"-48"	1.8	2.8	1.4
48"-54"	1.4	2.4	
54"-60"	1.2	2.6	
60"-66"	1.2	2.2	
66"-72"	1	2.6	

Depth From Surface	Pit P4-2A Gamma	Pit P4-2B Gamma
0"-6"	2.8	3.2
6"-12"	2.8	3
12"-18"	2.6	3
18"-24"	2.4	3.2
24"-30"	2.2	3.2
30"-36"	2.4	3.7
36"-42"	2	2.4
42"-48"	2.4	2.2
48"-54"	2.4	2
54"-60"	2.4	
60"-66"	2.2	
66"-72"	1.2	
72"-78"	1.2	

Depth From Surface	Pit P4-3A Gamma
0"-6"	2.5
6"-12"	2.4
12"-18"	2.4
18"-24"	2.3
24"-30"	2.2
30"-36"	1.8
36"-42"	1.6
42"-48"	1.6
48"-54"	1.6
54"-60"	1.4
60"-66"	1.5

Depth From Surface	Pit P4-3B Gamma	Pit P4-3C Gamma
0"-12"	28	6
12"-24"	14	3.2
24"-36"	6.5	2.2
36"-48"	5.5	
48"-60"	5.9	

TABLE B-2. RADIOLOGICAL DATA FOR BACKHOE PITS P4-4A, P4-4B, P4-4C, P4-4D, P4-5A, P4-5B, P4-5C, & P4-5D.

Field Gamma Readings in μR/hr x 10-1

Pathfinder Mines Corporation
Shirley Basin Mine
Tailings Reclamation
Test Pit Gamma Profiles

Depth From Surface	Pit P4-4A Gamma	Pit P4-4B Gamma	Pit P4-4C Gamma	Pit P4-4D Gamma
0"-6"	9	14	14	7
6"-12"	9	20	18	8
12"-18"	18	25	24	16
18"-24"	28	34	30	24
24"-30"	31	38	37	28
30"-36"	34	36	38	42
36"-42"	44	36	42	80
42"-48"	48	40	52	40
48"-54"	58	40	58	18
54"-60"	80	40	96	12
60"-66"	78	40	120	10
66"-72"	52	40	200	
72"-78"	42	44	220	
78"-84"	20	56	56	
84"-90"	16	58	25	
90"-96"	14	54	20	
96"-102"	12	58	20	
102"-108"	10	64	15	
108"-114"		72		
114"-120"		58		

Depth From Surface	Pit P4-5A Gamma	Pit P4-5B Gamma	Pit P4-5C Gamma	Depth From Surface	Pit P4-5D Gamma
0"-12"	1.6	6	4.8	0"-6"	11
				6"-12"	14
12"-24"	1.4	12	24	12"-18"	16
				18"-24"	24
24"-36"	1.6	4.4	44	24"-30"	40
				30"-36"	62
36"-48"	6.5	1.6	36	36"-42"	95
				42"-48"	150
48"-60"	3.8	1.4	9	48"-54"	60
				54"-60"	18
60"-72	1.8	1.4	6.5	60"-66"	12
				66"-72"	8.5
72"-84"	1.2	1.2	5.5	72"-78"	8
				78"-84"	7
84"-96"	1.4			84"-90"	6
				90"-96"	1.2

TABLE B-3. RADIOLOGICAL DATA FOR BACKHOE PITS P4-6A, P4-6B, P4-7A, P4-7B, P4-8A, & P4-8B.

Field Gamma Readings in µR/hr x 10^{-1}

Pathfinder Mines Corporation
Shirley Basin Mine
Tailings Reclamation
Test Pit Gamma Profiles

Depth From Surface	Pit P4-6A Gamma	Pit P4-6B Gamma
0"-12"	12	12
12"-24"	30	28
24"-36"	28	32
36"-48"	32	38
48"-60"	32	42
60"-72"	32	42
72"-84"	36	44
84"-96"	10	44
96"-108"		46

Depth From Surface	Pit P4-7A Gamma	Pit P4-7B Gamma
0"-12"	9	14
12"-24"	27	30
24"-36"	28	42
36"-48"	30	30
48"-60"	50	30
60"-72"	19	30
72"-84"	5.2	32
84"-96"	3.4	
96"-102"	3	

Depth From Surface	Pit P4-8A Gamma	Depth From Surface	Pit P4-8B Gamma
0"-6"	20	0"-12"	6
6"-12"	22		
12"-18"	26	12"-24"	13
18"-24"	32		
24"-30"	58	24"-36"	32
30"-36"	11		
36"-42"	6	36"-48"	34
42"-48"	4.4		
48"-60"	32		
48"-60"	4.2		
60"-72"	28		
60"-72"	4.2		
72"-84"	30		
72"-84"	2.6		
84"-96"	7.5		
84"-96"	2.8		
96"-102"	3.6		
102"-114"	2.4		
114"-126"	4.2		
126-138"	4.2		

TABLE B-4. RADIOLOGICAL DATA FOR BACKHOE PITS P4-9A, P4-9B, P4-9C, P4-9D, P4-10A, & P4-10B.

Field Gamma Readings in µR/hr x 10-1

Pathfinder Mines Corporation
Shirley Basin Mine
Tailings Reclamation
Test Pit Gamma Profiles

Depth From Surface	Pit P4-9A Gamma	Pit P4-9B Gamma	Pit P4-9C Gamma	Depth From Surface	Pit P4-9D Gamma
0"-6"	2	2.8	4.5	0"-12"	42
6"-12"	2	2.4	6.8		
12"-18"	1.6	2	9.1	12"-24"	200
18"-24"	1.4	1.6	15		
24"-30"	1.2	1.4	18	24"-36"	100
30"-36"	1.2	1.2	24		48
36"-42"	1	1.2	18	36"-48"	34
42"-48"	1	1.2	14		28
48"-54"	1.2	1.1	6	48"-60"	32
54"-60"		1	4.4		
60"-66"		1	4		
66"-72"		1	3.2		
72"-78"			3.2		
78"-84"			2.8		

Depth From Surface	Pit P4-10A Gamma	Pit P4-10B Gamma
0"-6"	20	3.6
6"-12"	28	3.4
12"-18"	30	2.8
18"-24"	38	2.4
24"-30"	26	1.8
30"-36"	42	1.8
36"-42"	44	1.8
42"-48"	22	1.4
48"-54"	12	1.6
54"-60"	10	1.4
60"-66"	11	1.2
66"-72"	12	1.2
72"-78"	12	
78"-84"	12	

TABLE B-5. RADIOLOGICAL DATA FOR BACKHOE PITS P4-11A, P4-11B, P4-11C, P4-12A, P4-12B, P4-12C, & P4-12D.

Field Gamma Readings in µR/hr x 10-1

Pathfinder Mines Corporation
Shirley Basin Mine
Tailings Reclamation
Test Pit Gamma Profiles

Depth From Surface	Pit P4-11A Gamma	Pit P4-11B Gamma	Pit P4-11C Gamma
0"-6"	4.5	9	3.6
6"-12"	6.5	16	5
12"-18"	20	18	4
18"-24"	24	14	2
24"-30"	32	8	1.4
30"-36"	42	3.8	1.4
36"-42"	5	3.2	1.4
42"-48"	3.2	2.6	
48"-54"	2.4	2.5	
54"-60"	2.2	2.2	
60"-66"	1.8	2.5	
66"-72"	1.8		
72"-78"	1.7		
78"-84"	1.8		
84"-90"	1.6		
90"-96"	1.8		

Depth From Surface	Pit P4-12A Gamma	Pit P4-12B Gamma	Pit P4-12C Gamma	Pit P4-12D Gamma
0"-6"	2.4	3	5	1.4
6"-12"	2.1	3.1	6.2	1.2
12"-18"	3	4	7.8	1.3
18"-24"	4.2	4.3	8.4	1.2
24"-30"	2.2	2.5	9	1.2
30"-36"	1.8	2.6	9	1.2
36"-42"	1.8	2	11	1
42"-48"	1.8	1.7	18	1
48"-54"	1.4	1.4	22	1
54"-60"	1.2	1.4	10	1.2
60"-66"	1.2	1.6	8	1.2
66"-72"	1	1	8	1.2
72"-78"	1	1	5.2	1
78"-84"			4.2	1.2
84"-90"			5	1
90"-96"				1.2

TABLE B-6. RADIOLOGICAL DATA FOR BACKHOE PITS P4-13A, P4-13B, P4-13C, P4-14A, P4-14B, P3-1, P3-2, P3-3 & P3-4.

Field Gamma Readings in µR/hr x 1Ø-1

Pathfinder Mines Corporation
Shirley Basin Mine
Tailings Reclamation
Test Pit Gamma Profiles

Depth From Surface	Pit P4-13A Gamma	Pit P4-13B Gamma	Pit P4-13C Gamma
Ø"-6"	2.2	1.2	1.6
6"-12"	2.4	1.2	1.6
12"-18"	2	1.6	2.4
18"-24"	2.2	2	2.3
24"-3Ø"	2.2	1	2.1
3Ø"-36"	2.2	1.2	1.1
36"-42"	2.2	1	1.1
42"-48"	2	1	1.1
48"-54"	2	1	1.1
54"-6Ø"	2	1	
6Ø"-66"	2		
66"-72"	2		

Depth From Surface	P4-14A Gamma	Pit P4-14B Gamma
Ø"-6"	2	2.3
6"-12"	2.2	2
12"-18"	2.2	2
18"-24"	2.2	1.6
24"-3Ø"	2.4	1.5
3Ø"-36"	2.5	1.2
36"-42"	2.4	1.2
42"-48"	2.8	1.3
48"-54"	3	1.4
54"-6Ø"	3	1.3
6Ø"-66"	3.4	1.2
66"-72"	2.8	

Depth From Surface	Pit P3-1 Gamma	Pit P3-2 Gamma	Pit P3-3 Gamma	Pit P3-4 Gamma
Ø"-6"	2.6	9.5	12	4.4
6"-12"	2.7	14	17	4.8
12"-18"	2.4	18	18	5.2
18"-24"	2	2Ø	9	5.2
24"-3Ø"	2.8	14	6	5
3Ø"-36"	2.8	1Ø	5	5.2
36"-42"	2.6	8	4.5	
42"-48"	1.4	6.5		

TABLE B-7. RADIOLOGICAL DATA FOR BACKHOE PITS P5-1A, P5-1B, P5-2, O-1, & O-2.

Field Gamma Readings in µR/hr x 10-1

Pathfinder Mines Corporation
Shirley Basin Mine
Tailings Reclamation
Test Pit Gamma Profiles

Depth From Surface	Pit P5-1A Gamma	Pit P5-1B Gamma	Pit P5-2 Gamma
0"-6"	5.8	5.2	2.2
6"-12"	7.5	3	2.2
12"-18"	12	12	2.2
18"-24"	16	14	2.2
24"-30"	18	14	2.2
30"-36"	18	14	1.8
36"-42"	18	14	1.7
42"-48"	18	16	1.6
48"-54"	20	18	1.4
54"-60"	18	20	1.2
60"-66"	18	20	1.5
66"-72"	16	20	1.4
72"-78"	20	24	1.4

Depth From Surface	Pit O-1 Gamma	Depth From Surface	Pit O-2 Gamma
0"-6"	4.4		
6"-12"	6	0"-12"	3.4
12"-18"	5.5		
18"-24"	5.5	12"-24"	4.6
24"-36"	5.8	24"-36"	5.8
36"-48"	7	36"-48"	8.5
48"-60"	10	48"-60"	12
60"-72"	8.5	60"-72"	14
72"-84"	9	72"-84"	16
84"-96"	9	84"-96"	40
96"-108"	7.5	96"-108"	20
108"-120"		108"-120"	28
120"-132"		120"-132"	24

APPENDIX C

LABORATORY REPORTS - MATERIALS PROPERTIES

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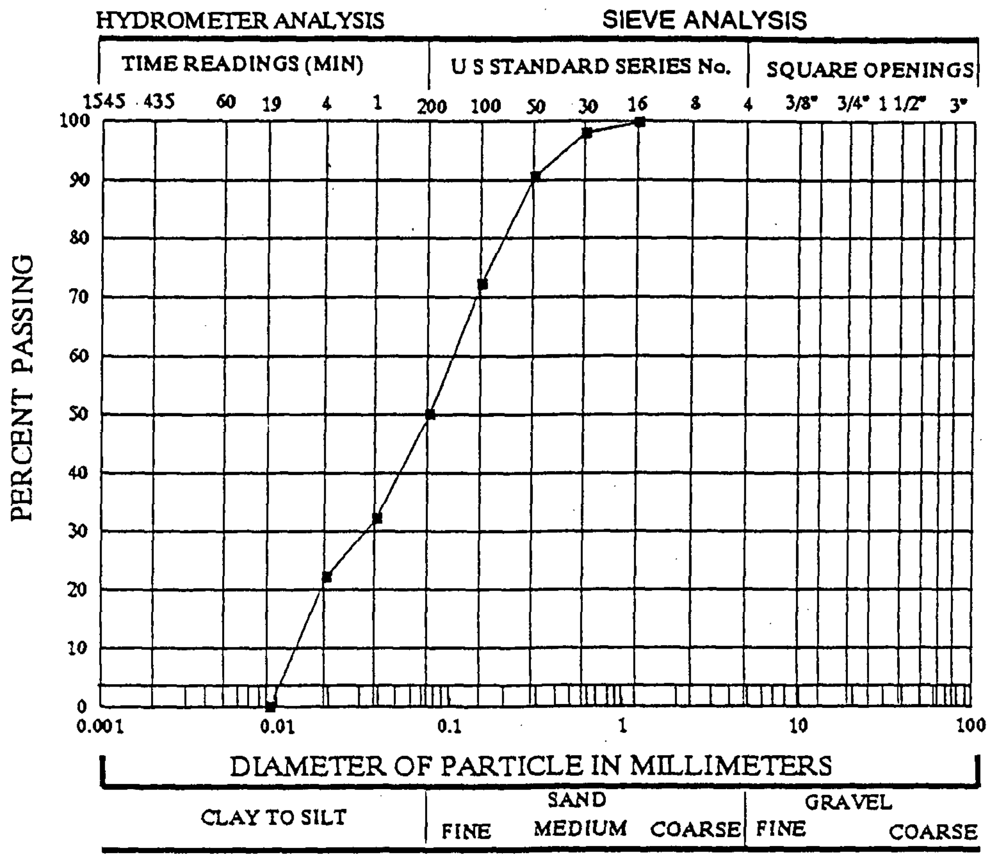
HUNTINGDON
CHEN–NORTHERN, INC.

SUMMARY OF LABORATORY TEST RESULTS
PATHFINDER – SHIRLEY BASIN TAILINGS

TABLE C.1-1. SUMMARY OF TAILINGS PHYSICAL PROPERTIES FROM DRILLING SAMPLES.

BORING	DEPTH (ft)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS		GRADATION ANALYSIS			WATER SOLUBLE SULFATE (%)	SOIL CLASSIFICATION
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)	+ #4 (%)	– #4 + #200 (%)	– #200 (%)		
TW4–1B	25–27	36	85	43	20	0	50	50		SANDY LEAN CLAY/CLAYEY SAND (CL/SC)
TW4–4B	5–7	20	93	22	NP	0	92	8		POORLY GRADED SAND WITH SILTY (SP–SM)
TW4–5B	5.5–8	16	91	30	NP	0	84	16		SILTY SAND (SM)
TW4–1C	3–5	20	94	23	NP	0	95	5		POORLY GRADED SAND WITH SILT (SP–SM)
TW4–2C	40–42	80	55	103	62	0	23	77		FAT CLAY WITH SAND (CH)
TW4–3C	42–43	62	62	84	55	0	0	100		FAT CLAY (CH)
TW5–2B	3	27	89	NV	NP	0	94	6		POORLY GRADED SAND WITH SILT (SP–SM)



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	50
FINES (SILT AND CLAY)	50

ATTERBERG LIMITS

LIQUID LIMIT (%)	43
PLASTICITY INDEX (%)	20

SAMPLE: TW4-1B DEPTH (ft): 25 to 27

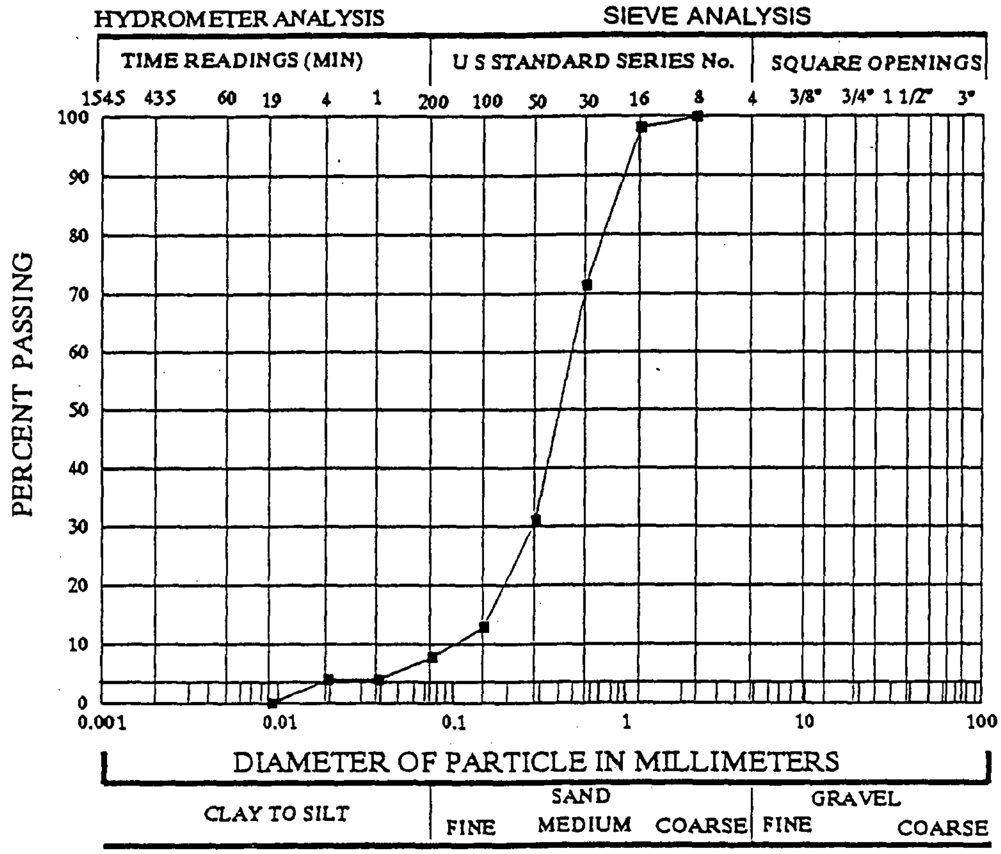
SOIL CLASSIFICATION:
SANDY LEAN CLAY/CLAYEY SAND (CL/SC)

PATHFINDER - SHIRLEY BASIN TAILINGS
HYDRO-ENGINEERING

HCN 9-12

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS

FIGURE C.1-1. GRADATION AND ATTERBERG LIMIT RESULTS FOR SAMPLE TW4-1B (25'-27').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	92
FINES (SILT AND CLAY)	8

ATTERBERG LIMITS

LIQUID LIMIT (%)	22
PLASTICITY INDEX (%)	NP

SAMPLE: TW4-4B DEPTH (ft): 5 to 7

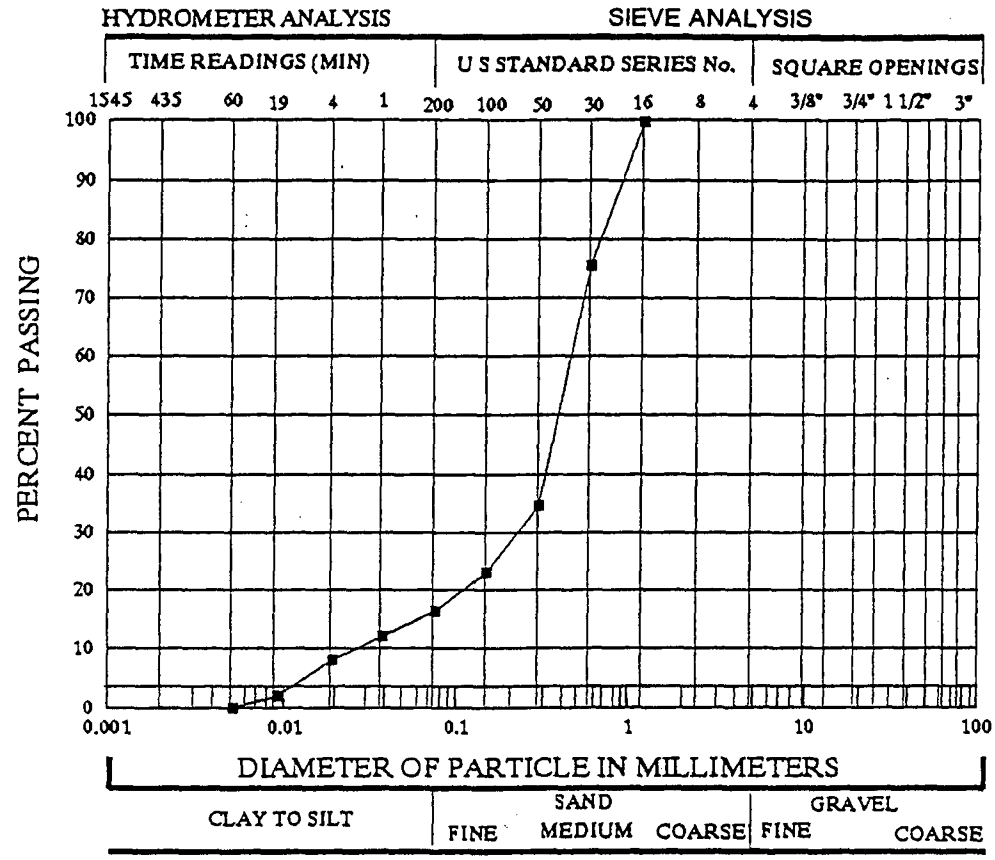
SOIL CLASSIFICATION:
POORLY GRADED SAND WITH SILT (SP-SM)

PATHFINDER - SHIRLEY BASIN TAILINGS
HYDRO-ENGINEERING

HCN 9-12

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS

FIGURE C.1-2. GRADATION AND ATTERBERG LIMIT RESULTS FOR SAMPLE TW4-4B (5'-7').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	84
FINES (SILT AND CLAY)	16

ATTERBERG LIMITS

LIQUID LIMIT (%)	30
PLASTICITY INDEX (%)	NP

SAMPLE: TW4-5B DEPTH (ft): 5.5 to 8

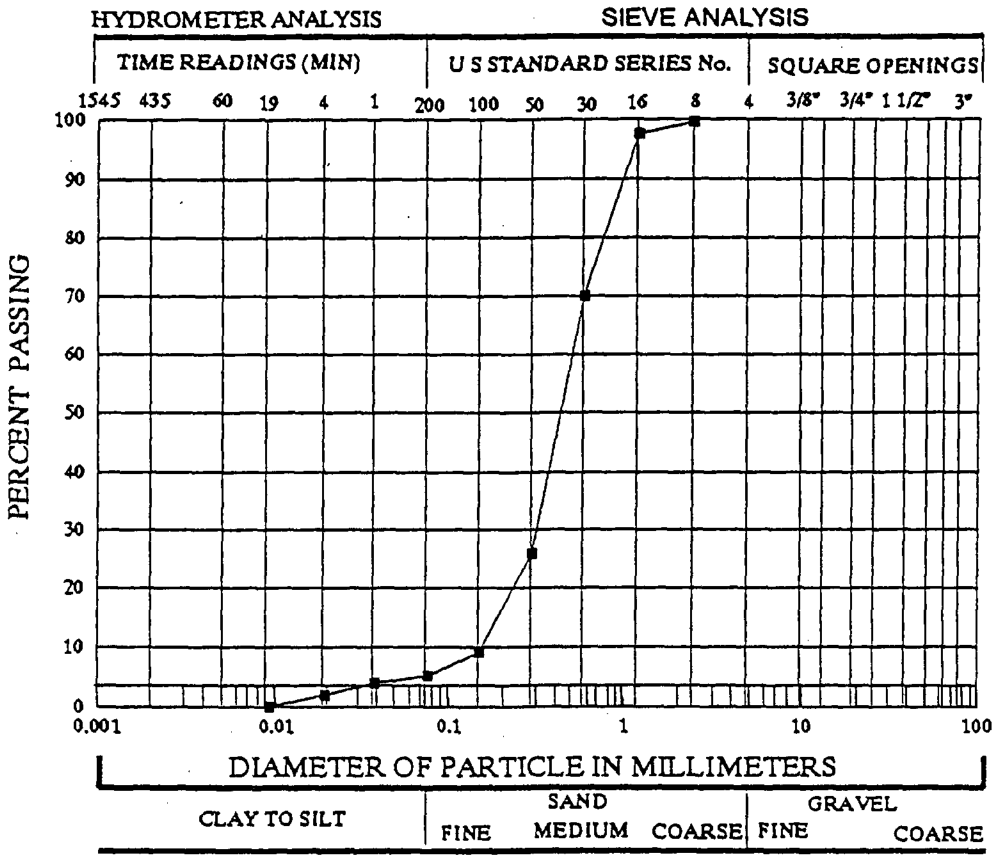
SOIL CLASSIFICATION:
SILTY SAND (SM)

PATHFINDER – SHIRLEY BASIN TAILINGS
HYDRO-ENGINEERING

HCN 9-12

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS

FIGURE C.1-3. GRADATION AND ATTERBERG LIMIT RESULTS FOR SAMPLE TW4-5B (5.5'-8').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	95
FINES (SILT AND CLAY)	5

ATTERBERG LIMITS

LIQUID LIMIT (%)	23
PLASTICITY INDEX (%)	NP

SAMPLE: TW4-1C DEPTH (ft): 3 to 5

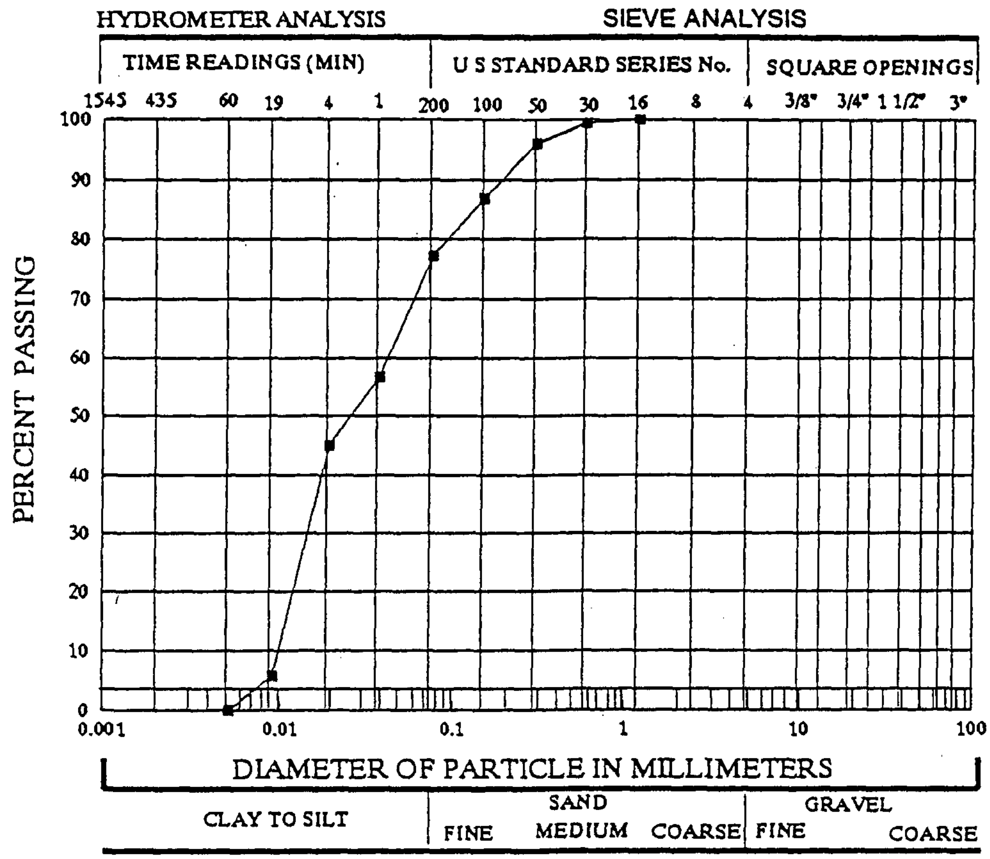
SOIL CLASSIFICATION:
POORLY GRADED SAND WITH SILT (SP-SM)

PATHFINDER - SHIRLEY BASIN TAILINGS
HYDRO-ENGINEERING

HCN 9-12

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS

FIGURE C.1-4. GRADATION AND ATTERBERG LIMIT RESULTS FOR SAMPLE TW4-1C (3'-5').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	23
FINES (SILT AND CLAY)	77

ATTERBERG LIMITS

LIQUID LIMIT (%)	103
PLASTICITY INDEX (%)	62

SAMPLE: TW4–2C DEPTH (ft): 40 to 42

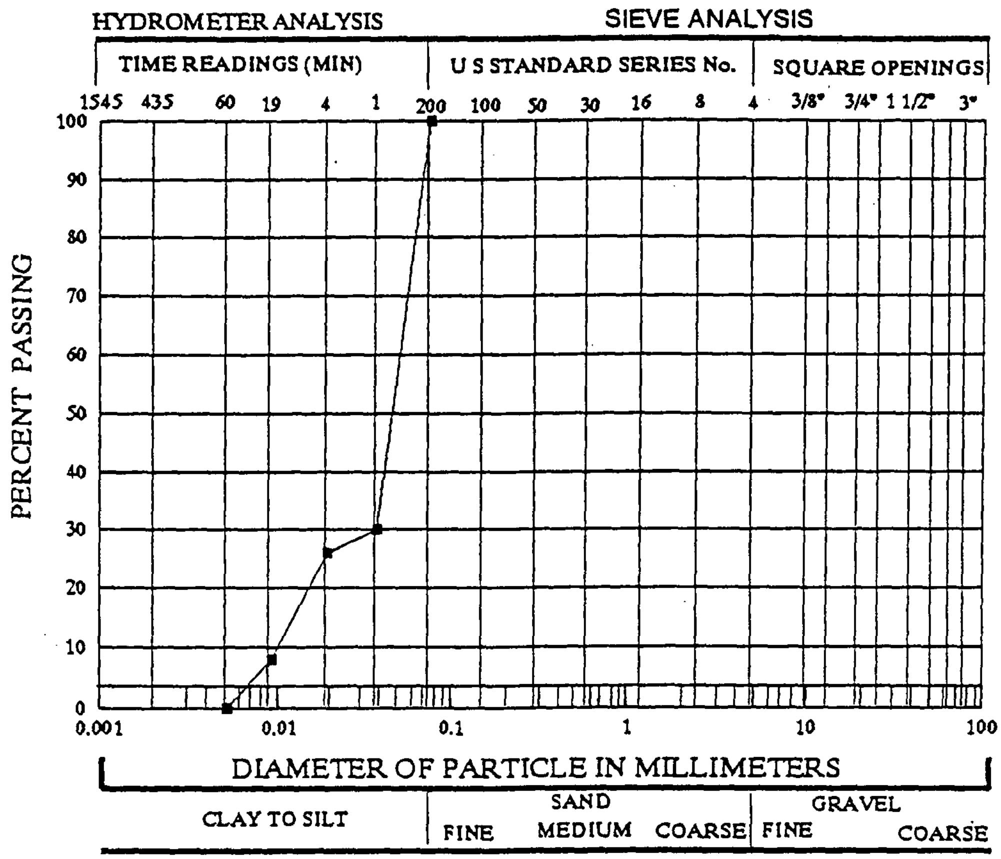
SOIL CLASSIFICATION:
FAT CLAY WITH SAND (CH)

PATHFINDER – SHIRLEY BASIN TAILINGS
HYDRO–ENGINEERING

HCN 9-12

93–4511	HUNTINGDON CHEN–NORTHERN, INC.	GRADATION ANALYSIS

FIGURE C.1-5. GRADATION AND ATTERBERG LIMIT RESULTS FOR SAMPLE TW4-2C (40'-42').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	0
FINES (SILT AND CLAY)	100

ATTERBERG LIMITS

LIQUID LIMIT (%)	84
PLASTICITY INDEX (%)	55

SAMPLE: TW4-3C DEPTH (ft): 42 to 43

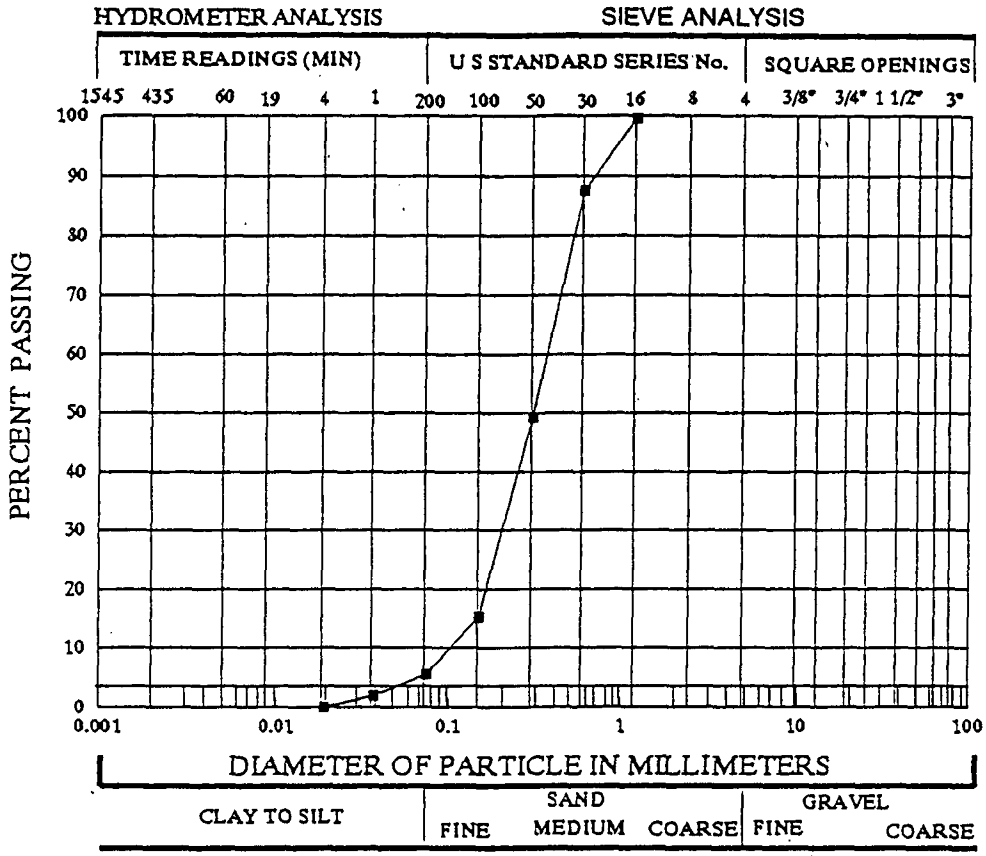
SOIL CLASSIFICATION:
FAT CLAY (CH)

PATHFINDER - SHIRLEY BASIN TAILINGS
HYDRO-ENGINEERING

HCN 9-12

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS

FIGURE C.1-6. GRADATION AND ATTERBERG LIMIT RESULTS FOR SAMPLE TW-3C (42'-43').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	94
FINES (SILT AND CLAY)	6

ATTERBERG LIMITS

LIQUID LIMIT (%)	NV
PLASTICITY INDEX (%)	NP

SAMPLE: TW5-2B DEPTH (ft): 3

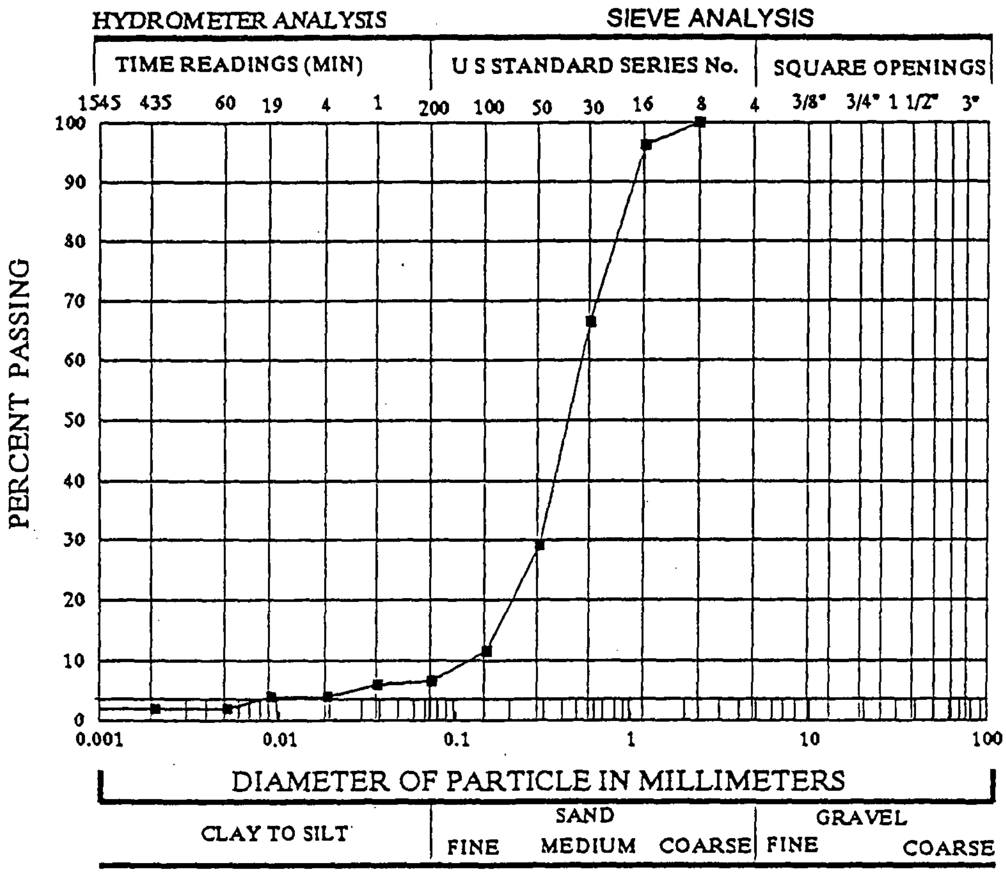
SOIL CLASSIFICATION:
POORLY GRADED SAND WITH SILT (SP-SM)

PATHFINDER - SHIRLEY BASIN TAILINGS
HYDRO-ENGINEERING

HCN 9-12

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS

FIGURE C.1-7. GRADATION AND ATTERBERG LIMIT RESULTS FOR SAMPLE TW5-2B (3').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	94
FINES (SILT AND CLAY)	6

ATTERBERG LIMITS

LIQUID LIMIT	23
PLASTICITY INDEX	NP

SAMPLE TW 5-3
DEPTH (ft): 6'-8'
SOIL CLASSIFICATION:
SAND WITH SILT (SP-SM)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS

FIGURE C.1-8. GRADATION AND ATTERBERG LIMIT RESULTS FOR SAMPLE TW5-3 (6'-8').

HUNTINGDON

CHEN–NORTHERN, INC.

TIME–CONSOLIDATION, SWELL–SETTLEMENT TEST

JOB NUMBER: 93-4511

JOB NAME: Hydro Engineering (Pathfinder-

VISUAL SOIL DESCRIPTION: Shirley Basin-Tailings)

BORING: TW4-2C

DEPTH: 40-42'

BLOW CT: —

DATE: 3-7-93

BY: [illegible]

MACHINE NO: 1

LOAD (psf):	.5	
DATE:	3-8-93	
BY:		
CLOCK TIME	ELAPSED TIME (MIN)	DIAL READING
7:35	0	.1825
	0.1	.1795
	0.25	.1792
	0.5	.1790
7:36	1	.1787
7:37	2	.1785
7:39	4	.1780
7:43	8	.1774
7:50	15	.1766
8:05	30	.1736
8:35	1 hr.	.1724
9:35	2 hrs.	.1696
11:35	4 hrs.	.1676
3:35	8 hrs.	.1482
7:35	24 hrs.	.1422
REMARKS:		
machine		
Deflection:		
.5 = 0.0036		

LOAD (psf):	1	
DATE:	3-9-93	
BY:		
CLOCK TIME	ELAPSED TIME (MIN)	DIAL READING
7:50	0	.1423
	0.1	.1385
	0.25	.1379
	0.5	.1374
7:51	1	.1370
52	2	.1366
54	4	.1360
58	8	.1363
8:05	15	.1359
8:20	30	.1355
8:50	1 hr.	.1349
9:50	2 hrs.	.1344
11:50	4 hrs.	.1327
3:50	8 hrs.	.1317
7:50	24 hrs.	.1290
REMARKS:		
1 = 0.0044		

LOAD (psf):	2	
DATE:	3-10-93	
BY:		
CLOCK TIME	ELAPSED TIME (MIN)	DIAL READING
7:28	0	1390
	0.1	1388
	0.25	1387
	0.5	1386
7:29	1	1373
30	2	1364
32	4	1355
36	8	1349
7:43	15	1345
7:58	30	1340
8:28	1 hr.	1338
9:28	2 hrs.	1346
11:28	4 hrs.	1338
3:28	8 hrs.	1329
7:28	24 hrs.	1357
REMARKS:		
2 = 0.005-		

LOAD (psf):	4	
DATE:	3-11-93	
BY:		
CLOCK TIME	ELAPSED TIME (MIN)	DIAL READING
7:52	0	1157
	0.1	1142
	0.25	1130
	0.5	1120
7:53	1	1107
54	2	1104
56	4	1095
8:00	8	1088
8:07	15	1080
8:22	30	1075
8:52	1 hr.	1068
9:52	2 hrs.	1062
11:52	4 hrs.	1055
3:52	8 hrs.	1043
7:52	24 hrs.	0984
REMARKS:		
4 = 0.0053		

FIGURE C.1-9. CONSOLIDATION TEST WORKSHEET FOR SAMPLE TW4-2C (40'-42').

HUNTINGDON

CHEN–NORTHERN, INC.

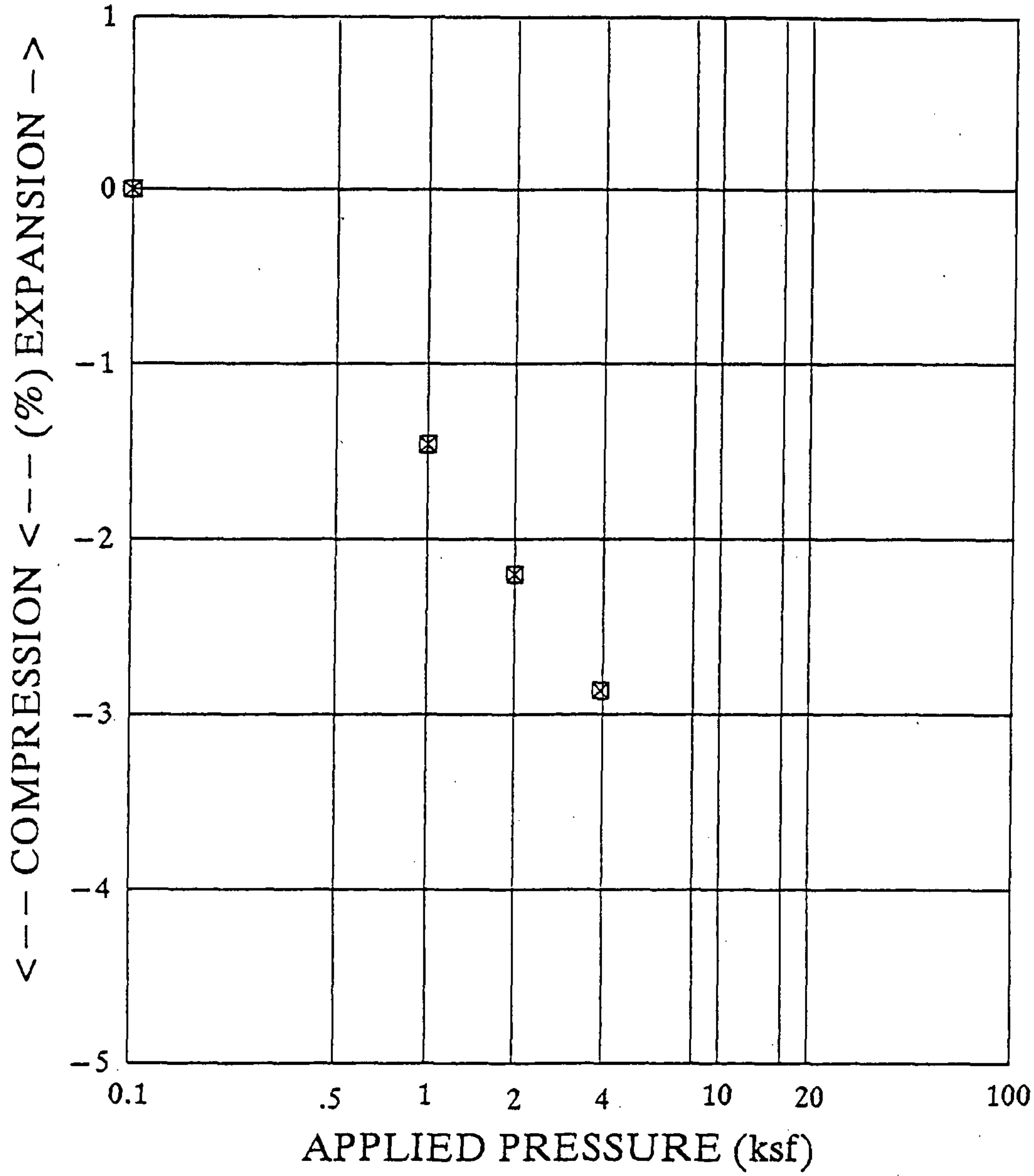
TIME–CONSOLIDATION, SWELL–SETTLEMENT TEST

JOB NUMBER: 93-4511	BORING: TW4-1B
JOB NAME: Hydro Engineering (Pathfinder -	DEPTH: 25-27'
VISUAL SOIL DESCRIPTION: - Shirley Basin Tailings)	BLOW CT: —
	DATE: 3-8-93
[illegible]	BY: [illegible]

MACHINE NO: 3

LOAD (psf): .5			LOAD (psf): 1			LOAD (psf): 2			LOAD (psf): 4		
DATE: 3-8-93			DATE: 3-9-93			DATE: 3-10-93			DATE: 3-11-93		
BY:			BY:			BY:			BY:		
CLOCK TIME	ELAPSED TIME (MIN)	DIAL READING	CLOCK TIME	ELAPSED TIME (MIN)	DIAL READING	CLOCK TIME	ELAPSED TIME (MIN)	DIAL READING	CLOCK TIME	ELAPSED TIME (MIN)	DIAL READING
7:41	0	1971	8:00	0	1827	7:34	0	1593	8:00	0	1198
	0.1	1913		0.1	1810		0.1	1576		0.1	1195
	0.25	1909		0.25	1808		0.25	1575		0.25	1198
	0.5	1905		0.5	1805		0.5	1573		0.5	1177
42	1	1891	8:01	1	1794	7:35	1	1543	8:01	1	1120
43	2	1895	2	2	1791	36	2	1525	2	2	1105
45	4	1887	4	4	1785	38	4	1514	4	4	1095
49	8	1880	8	8	1780	42	8	1502	8	8	1086
7:56	15	1875	8:15	15	1778	7:49	15	1424	8:15	15	1070
8:11	30	1866	8:30	30	1775	8:04	30	1415	8:30	30	1053
8:41	1 hr.	1861	9:00	1 hr.	1761	8:34	1 hr.	1397	9:00	1 hr.	1043
9:41	2 hrs.	1845	10:00	2 hrs.	1745	9:34	2 hrs.	1388	10:00	2 hrs.	1014
11:41	4 hrs.	1834	12:00	4 hrs.	1713	11:34	4 hrs.	1343	12:00	4 hrs.	0994
3:41	8 hrs.	1875	4:00	8 hrs.	1665	3:34	8 hrs.	1292	4:00	8 hrs.	0946
7:41	24 hrs.	1827	8:00	24 hrs.	1593	7:34	24 hrs.	1198	8:00	24 hrs.	6840
REMARKS: Machine			REMARKS:			REMARKS:			REMARKS:		
Deflections											
.5 = 0.0022			1 = 0.0032			2 = 0.0042			4 = 0.0058		

FIGURE C.1-10. CONSOLIDATION TEST WORKSHEET FOR SAMPLE TW4-1B (25'-27').



WATER CONTENT (%): 16 DRY DENSITY (pcf): 91
TESTED LOAD INCREMENTS (ksf): 1, 2, 4,

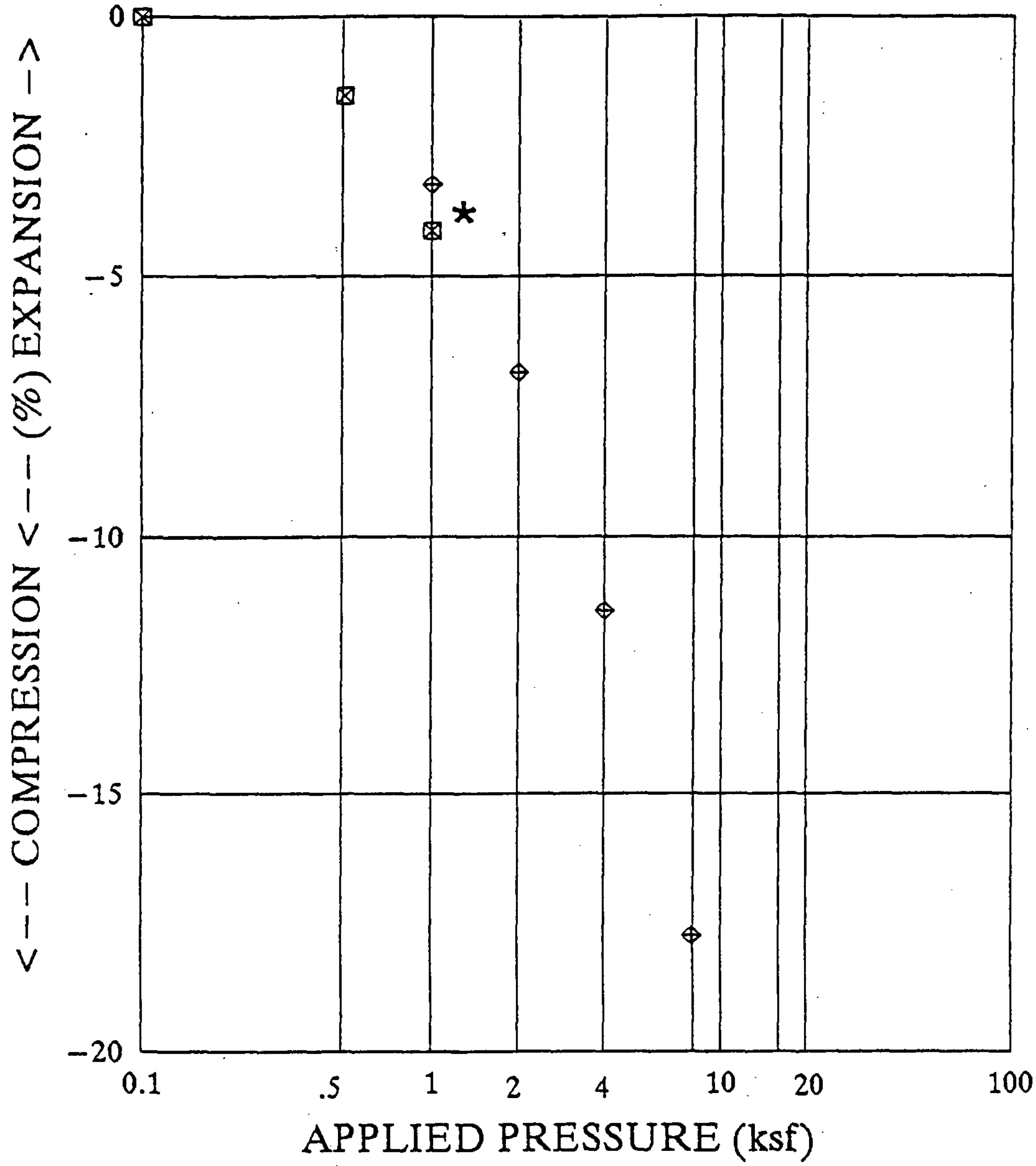
TEST SAMPLE IDENTIFICATION:
SAMPLE TW4-5B DEPTH (ft): 5.5 to 8

SOIL CLASSIFICATION:
SILTY SAND (SM)

PATHFINDER – SHIRLEY BASIN TAILINGS
HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN.INC.	SWELL-SETTLEMENT GRAPHICS

FIGURE C.1-11. CONSOLIDATION RESULTS FOR SAMPLE TW4-5B.(5.5'-8').



*EXPANSION UNDER CONSTANT LOAD AFTER WETTING

WATER CONTENT (%): 62 DRY DENSITY (pcf): 62
TESTED LOAD INCREMENTS (ksf): 1, wetting, 2, 4, 8

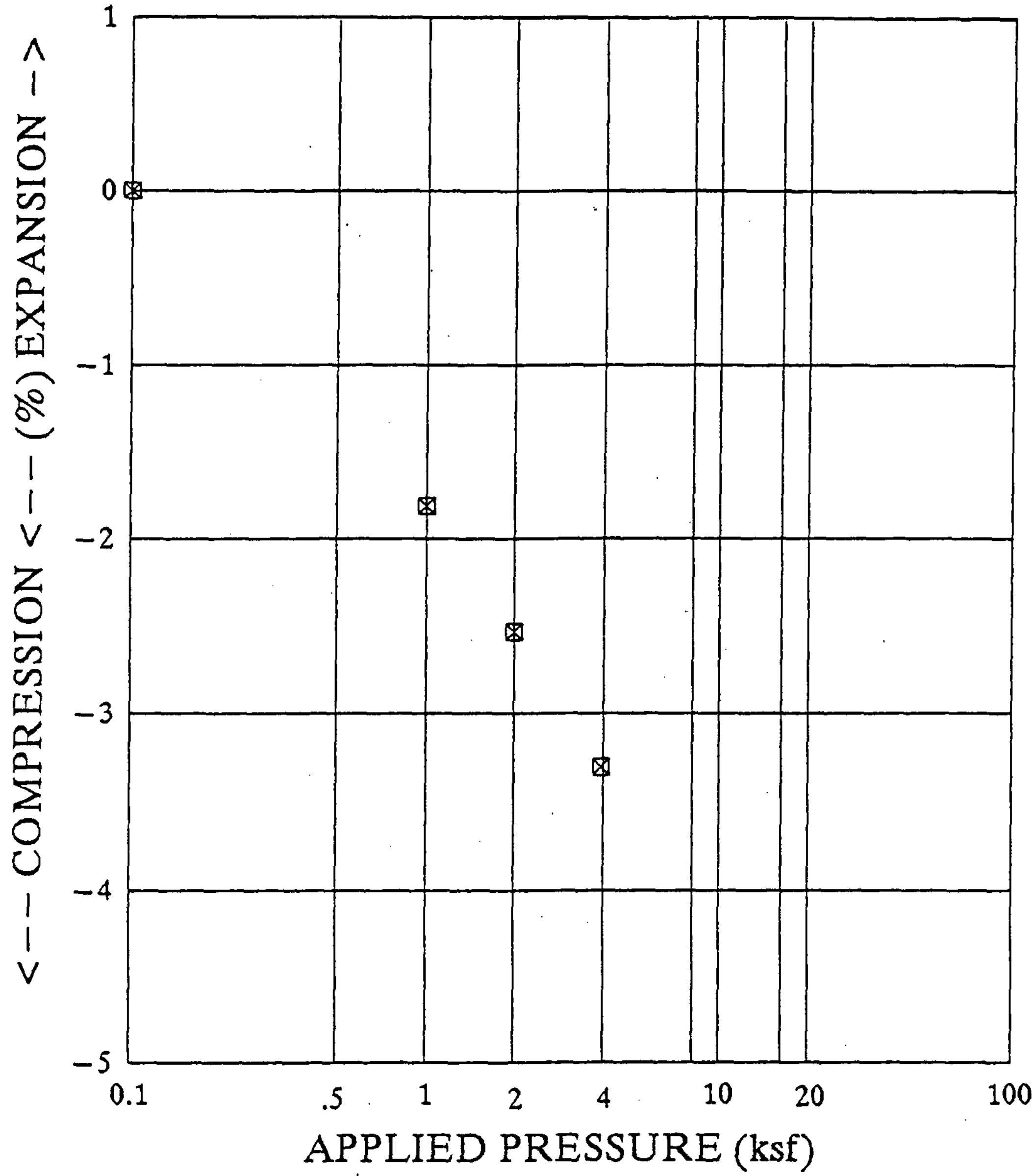
TEST SAMPLE IDENTIFICATION:
SAMPLE: TW4-3C DEPTH (ft): 42 to 43

SOIL CLASSIFICATION:
FAT CLAY (CH)

PATHFINDER - SHIRLEY BASIN TAILINGS
HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN.INC.	SWELL-SETTLEMENT GRAPHICS

FIGURE C.1-12. CONSOLIDATION RESULTS FOR SAMPLE TW4-3C (42'-43').



WATER CONTENT (%): 20 DRY DENSITY (pcf): 94
TESTED LOAD INCREMENTS (ksf): 1, 2, 4,

TEST SAMPLE IDENTIFICATION:
SAMPLE TW4−1C DEPTH (ft): 3 to 5

SOIL CLASSIFICATION:
POORLY GRADED SAND WITH SILT (SP−SM)

PATHFINDER − SHIRLEY BASIN TAILINGS
HYDRO−ENGINEERING

93−4511	HUNTINGDON CHEN−NORTHERN.INC.	SWELL−SETTLEMENT GRAPHICS

FIGURE C.1-13. CONSOLIDATION RESULTS FOR SAMPLE TW4-1C (3'-5').

HUNTINGDON
CHEN-NORTHERN, INC.

SUMMARY OF LABORATORY TEST RESULTS
HYDRO-ENGINEERING

TABLE C.2-1. SUMMARY OF DRILLING PROGRAM FOR COVER PHYSICAL PROPERTIES TESTING.

BORING	DEPTH (ft)	NATURAL MOISTURE (%)	ATTERBERG LIMITS		GRADATION ANALYSIS			SPECIFIC GRAVITY	ORGANIC CONTENT (%)	PERMEABILITY (cm/sec)	SOIL CLASSIFICATION
			LIQUID LIMIT (%)	PLASTICITY INDEX (%)	+ #4 (%)	− #4 + #200 (%)	− #200 (%)				
STH-2	60-67	18	54	34	0	17	83		7.2		FAT CLAY WITH SAND (CH)
STH-4	30-37	15	61	40	0	8	92		6.2		FAY CLAY (CH)
STH-5	40-47	9	58	35	0	7	93		6.2	2.6x10-8	FAT CLAY (CH)
STH-6	20-27	6	45	25	0	17	83		5.9		LEAN CLAY WITH SAND (CL)
STH-7	40-47		57	37	0	45	55	2.36	4.2	1.54x10-9	SANDY FAT CLAY (CH)
STH-11	20-27	13	64	37	0	4	96		10.4		FAT CLAY (CH)
NTH-1	60-67		65	38	0	15	85	2.31	8.0	1.96x10-8	FAT CLAY WITH SAND (CH)
NTH-3	140-147	6	42	27	10	61	29	2.36			SANDY LEAN CLAY (CL)
NTH-5	20-27	16	65	42	0	10	90		10.0		FAT CLAY (CH)
	120-127	10	55	39	7	45	48				SANDY FAT CLAY (CH)

HUNTINGDON
CHEN–NORTHERN, INC.

SUMMARY OF LABORATORY TEST RESULTS
HYDRO–ENGINEERING

TABLE C.2-2. SUMMARY OF CP SERIES COVER MATERIAL PHYSICAL PROPERTIES TESTING.

BORING	DEPTH (ft)	NATURAL MOISTURE (%)	ORGANIC MATTER (%)	ATTERBERG LIMITS		GRADATION ANALYSIS			SPECIFIC GRAVITY	SOIL CLASSIFICATION
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)	+ #4 (%)	– #4 + #200 (%)	– #200 (%)		
CP–1	10	14	4.14	56	29	0	25	75	2.63	SANDY CLAY (CL)
CP–2	9	16	3.72	50	26	0	25	75	2.61	SANDY CLAY (CL)
CP–3	9	15	2.76	52	27	0	23	77	2.67	SANDY CLAY (CL)

HUNTINGDON
CHEN-NORTHERN, INC.

SUMMARY OF LABORATORY TEST RESULTS
HYDRO-ENGINEERING

TABLE C.2-3. SUMMARY OF ND SERIES COVER MATERIAL PHYSICAL PROPERTIES TESTING.

BORING	DEPTH (ft)	NATURAL MOISTURE (%)	ORGANIC MATTER (%)	ATTERBERG LIMITS		GRADATION ANALYSIS			SPECIFIC GRAVITY	SOIL CLASSIFICATION
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)	+ #4 (%)	- #4 + #200 (%)	- #200 (%)		
ND-1		30	3.6	59	33	1	22	77	2.68	LEAN CLAY WITH SAND (CL)
ND-2		25	2.7	64	36	0	27	73	2.69	LEAN CLAY WITH SAND (CL)
ND-3		35	3.7	75	40	1	23	76	2.60	LEAN CLAY WITH SAND (CL)
ND-4		36	3.1	69	36	0	25	75	2.66	LEAN CLAY WITH SAND (CL)
ND-5		23	3.3	61	33	0	14	86	2.66	LEAN CLAY (CL)
ND-6		23	2.6	65	34	1	27	72	2.63	LEAN CLAY WITH SAND (CL)

TABLE C.2-4. SUMMARY OF CP SERIES COVER MATERIAL PERMEABILITY TESTING.

HUNTINGDON
CHEN-NORTHERN, INC.

SUMMARY OF PERMEABILITY TESTING
HYDRO-ENGINEERING

Sample ID	Maximum Dry Density (pcf)	Optimum Water Content (%)	Remolded Density (pcf)	Percent of Maximum Dry Density (%)	Coefficient of Permeability (cm/sec)
CP-1	92.8	26.5	88.3	95	$7.6x10^{-9}$
CP-3	94.9	27.5	90.2	95	$7.7x10^{-8}$
CP-2	96.4	24.3	91.8	95	$3.9x10^{-8}$

TABLE C.2-5. SUMMARY OF SET SERIES COVER MATERIAL PERMEABILITY TESTING.

INBERG-MILLER ENGINEERS
1120 EAST "C" STREET CASPER, WYOMING 82601-2195 307-577-0806

August 27, 1991 5390-CM

Hydro Engineering
770 East Magnolia
Casper, WY 82604

ATTENTION: LARRY STEELE

RE: LABORATORY TESTING

Gentlemen:

As requested, we have performed laboratory testing on samples submitted to our laboratory on June 13, 1991. The tests performed included moisture-density analysis, permeability, hydrometer, organic content, and specific gravity.

The results of the testing are as follows:

	Permeability (cm/sec)	Organic Content (%)	Specific Gravity
Set #1	$2.6x10^{-7}$ (90%) $5.3x10^{-9}$ (95%) $3.6x10^{-9}$ (100%)	8.8	2.680
Set #2	$2.3x10^{-6}$ (90%) $3.6x10^{-8}$ (95%) $6.7x10^{-9}$ (100%)	8.0	2.672
Set #3	$8.2x10^{-9}$ (90%) $3.5x10^{-9}$ (95%) $2.0x10^{-9}$ (100%)	7.1	2.702

The numbers in parentheses indicate percent of maximum density as determined by Standard Proctor. The soil for each sample was remolded to the percentage of compaction shown before each permeability test was conducted.

The moisture-density and hydrometer analyses are plotted on the attached forms.

Please contact us if you have any questions regarding these testing results or if we can be of additional assistance.

Sincerely,

INBERG-MILLER ENGINEERS

James D. Filkins, E.I.T.
Civil Engineer

JDF:cag:ltr

Enclosures as stated

MOISTURE–DENSITY ANALYSIS

PROJECT: SOIL TESTING

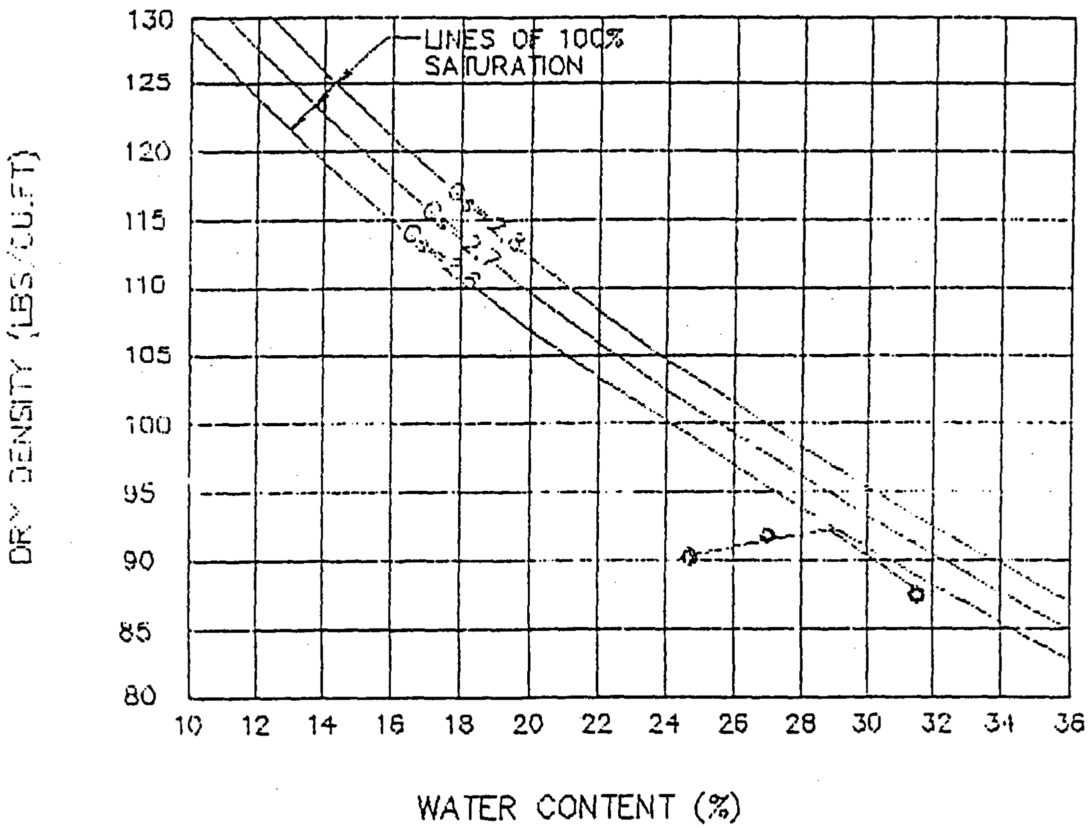
JOB NO: 5390-CM

CLIENT: HYDRO ENGINEERING

TEST DATE: 6-24-91

TESTED BY: SRE

TEST METHOD: ASTM D-698 METHOD "A"



SOIL DESCRIPTION: PALE BROWN CLAY SHALE, LITTLE COAL

% PASSING #200 SIEVE: ______

LIQUID LIMIT: ____ %

PLASTICITY INDEX: ____ %

SAMPLED BY: CLIENT

SOURCE: CLIENT SET #1

OPTIMUM WATER CONTENT: 25.8 %

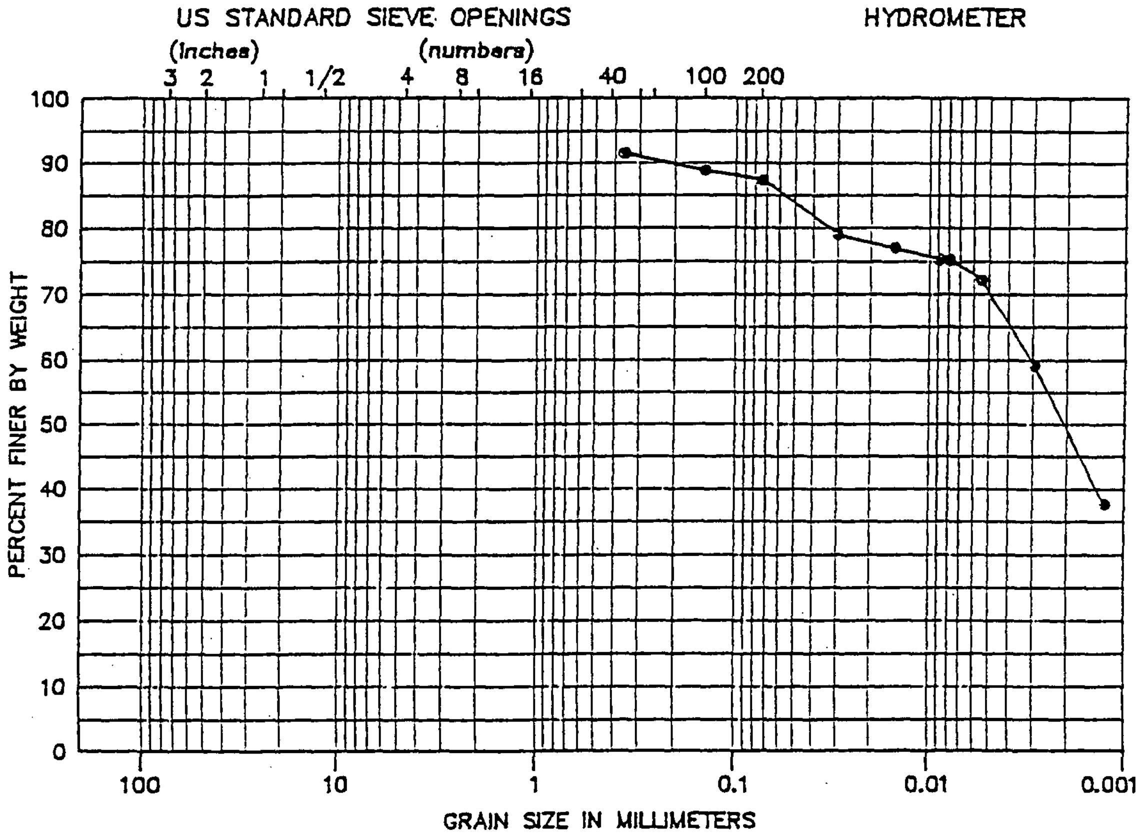
MAX. DRY DENSITY: 92.5 (LBS/CU.FT.)

INBERG - MILLER ENGINEERS

FIGURE C.2-1. STANDARD PROCTOR RESULTS FOR SAMPLE SET #1.

PARTICLE SIZE ANALYSIS

PROJECT: Soil Testing TEST DATE: 6/26/91
JOB NO: 5390-CM TESTED BY: TDT
CLIENT: Hydro Engineering TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SIEVE DESIGNATION DETERMINED PERCENT FINER SPECIFIED PERCENT FINER

SOIL DESCRIPTION: Pale Brown, Clay Shale, Little Coal SOURCE: Client Set #1
SAMPLE NO: Set #1 REVIEWED BY: [signature]
SAMPLED BY: Client DATE: [illegible]

INBERG - MILLER ENGINEERS

FIGURE C.2-2. GRADATION RESULTS FOR SAMPLE SET #1.

MOISTURE-DENSITY ANALYSIS

PROJECT: SOIL TESTING

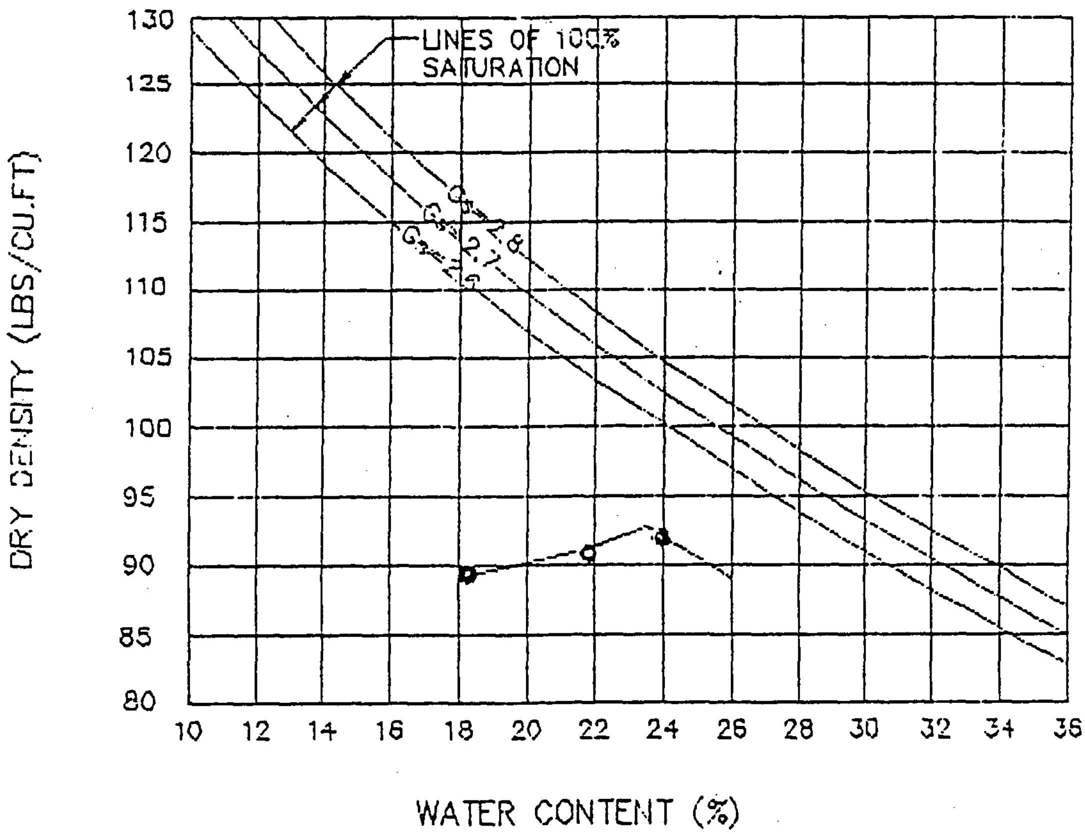
JOB NO: 5390-CM

CLIENT: HYDRO ENGINEERING

TEST DATE: 6-24-91

TESTED BY: SRE

TEST METHOD: ASTM D-698
METHOD "A"



SOIL DESCRIPTION: PALE BROWN CLAY SHALE, LITTLE COAL

SAMPLED BY: CLIENT

% PASSING #200 SIEVE: ________

SOURCE: CLIENT SET #2

LIQUID LIMIT ______ %

PLASTICITY INDEX: ______ %

OPTIMUM WATER CONTENT: 23.5 %

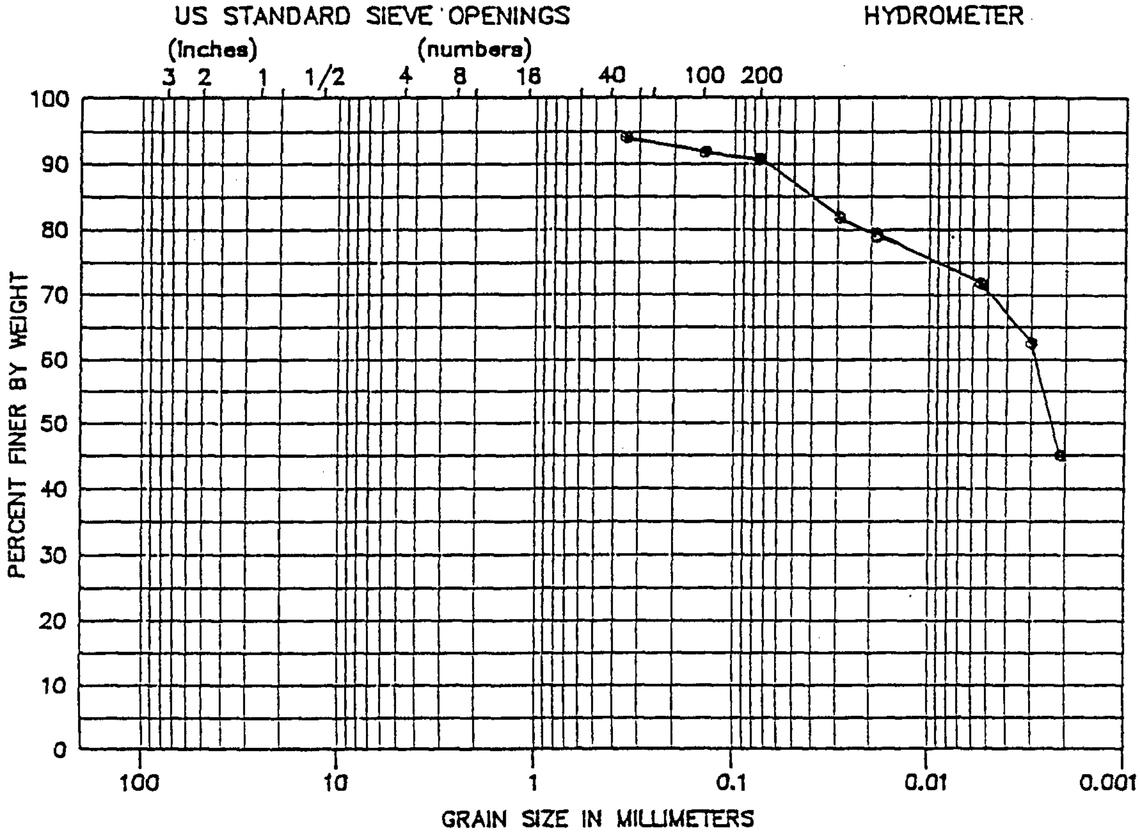
MAX. DRY DENSITY: 93.0 (LBS/CU.FT.)

INBERG - MILLER ENGINEERS

FIGURE C.2-3. STANDARD PROCTOR RESULTS FOR SAMPLE SET #2.

PARTICLE SIZE ANALYSIS

PROJECT: Soil Testing
TEST DATE: 8/26/91
JOB NO: 5390-CM
TESTED BY: TDT
CLIENT: Hydro Engineering
TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SIEVE DESIGNATION	DETERMINED PERCENT FINER	SPECIFIED PERCENT FINER

SOIL DESCRIPTION: Pale Brown. Clay Shale. Little Coal
SOURCE: Client Set #2

SAMPLE NO: Set #2
SAMPLED BY: Client

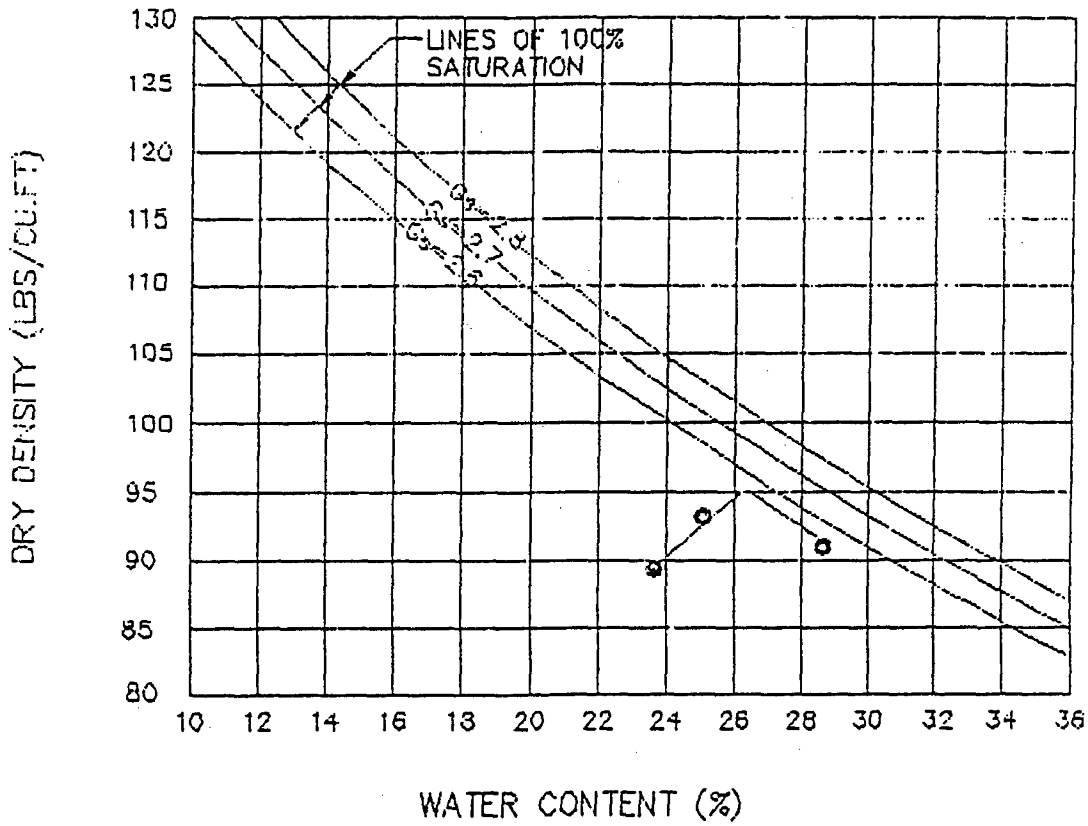
REVIEWED BY: [signature]
DATE: [handwritten date]

INBERG - MILLER ENGINEERS

FIGURE C.2-4. GRADATION RESULTS FOR SAMPLE SET #2.

MOISTURE-DENSITY ANALYSIS

PROJECT: SOIL TESTING
TEST DATE: 6-24-91
JOB NO: 5390-CM
TESTED BY: SRE
CLIENT: HYDRO ENGINEERING
TEST METHOD: ASTM D-698 METHOD "A"



SOIL DESCRIPTION: PALE BROWN CLAY SHALE, LITTLE COAL
SAMPLED BY: CLIENT
% PASSING #200 SIEVE: ______
SOURCE: CLIENT SET #3
LIQUID LIMIT: ______ %
OPTIMUM WATER CONTENT: 26.3 %
PLASTICITY INDEX: ______ %
MAX. DRY DENSITY: 95.0 (LBS/CU.FT.)

INBERG - MILLER ENGINEERS

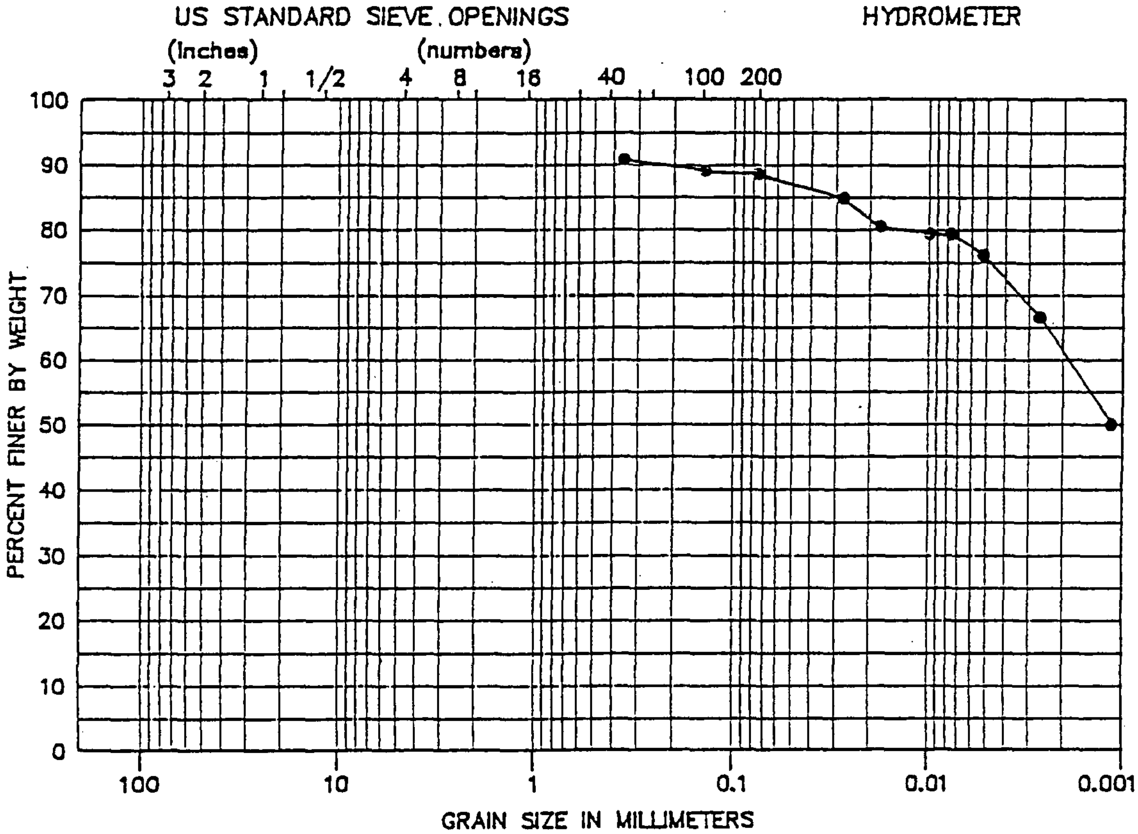
FIGURE C.2-5. STANDARD PROCTOR RESULTS FOR SAMPLE SET #3.

PARTICLE SIZE ANALYSIS

PROJECT: Soil Testing TEST DATE: 8/26/91

JOB NO: 5390-CM TESTED BY: TDT

CLIENT: Hydro Engineering TEST METHOD: ASTM D422



COBBLES	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY

SIEVE DESIGNATION	DETERMINED PERCENT FINER	SPECIFIED PERCENT FINER

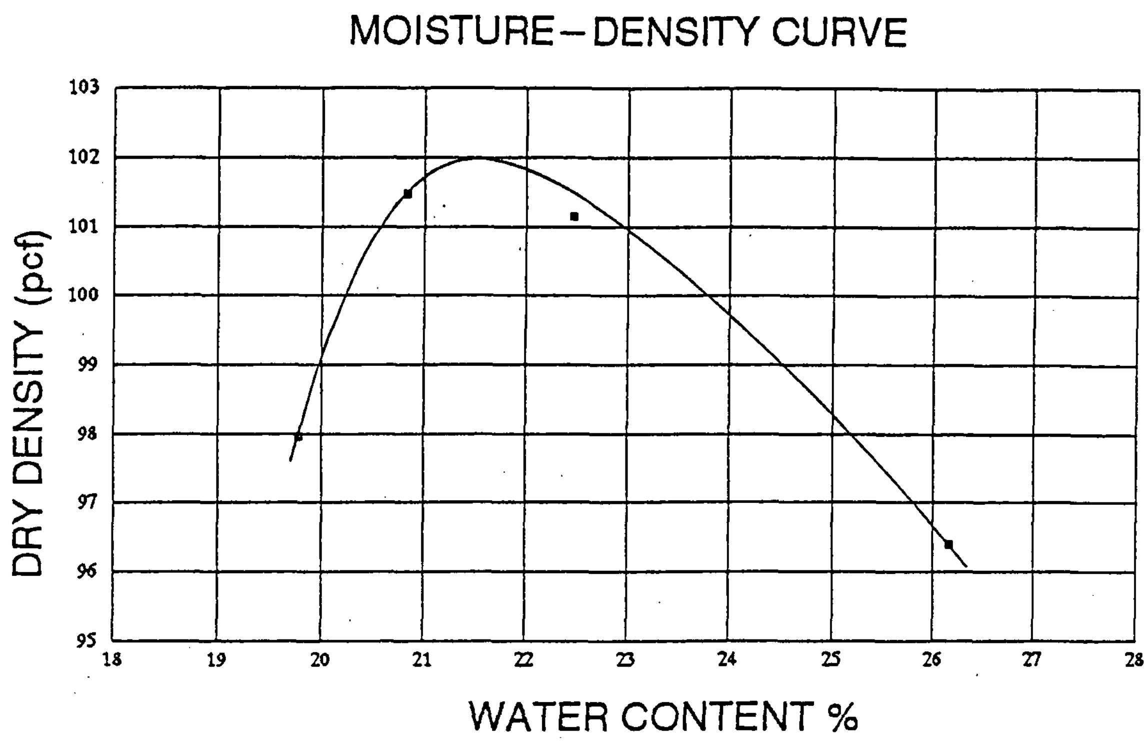
SOIL DESCRIPTION: Pale Brown, Clay Shale, Little Coal SOURCE: Client Set #3

SAMPLE NO: Set #3 REVIEWED BY: STM

SAMPLED BY: Client DATE: [illegible]

INBERG - MILLER ENGINEERS

FIGURE C.2-6. GRADATION RESULTS FOR SAMPLE SET #3.



ASTM 698-78, METHOD A

OPTIMUM WATER CONTENT 21.5% MAXIMUM DRY DENSITY 102.0 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	17
FINES (SILT AND CLAY)	83

ATTERBERG LIMITS

LIQUID LIMIT	54
PLASTICITY INDEX	34

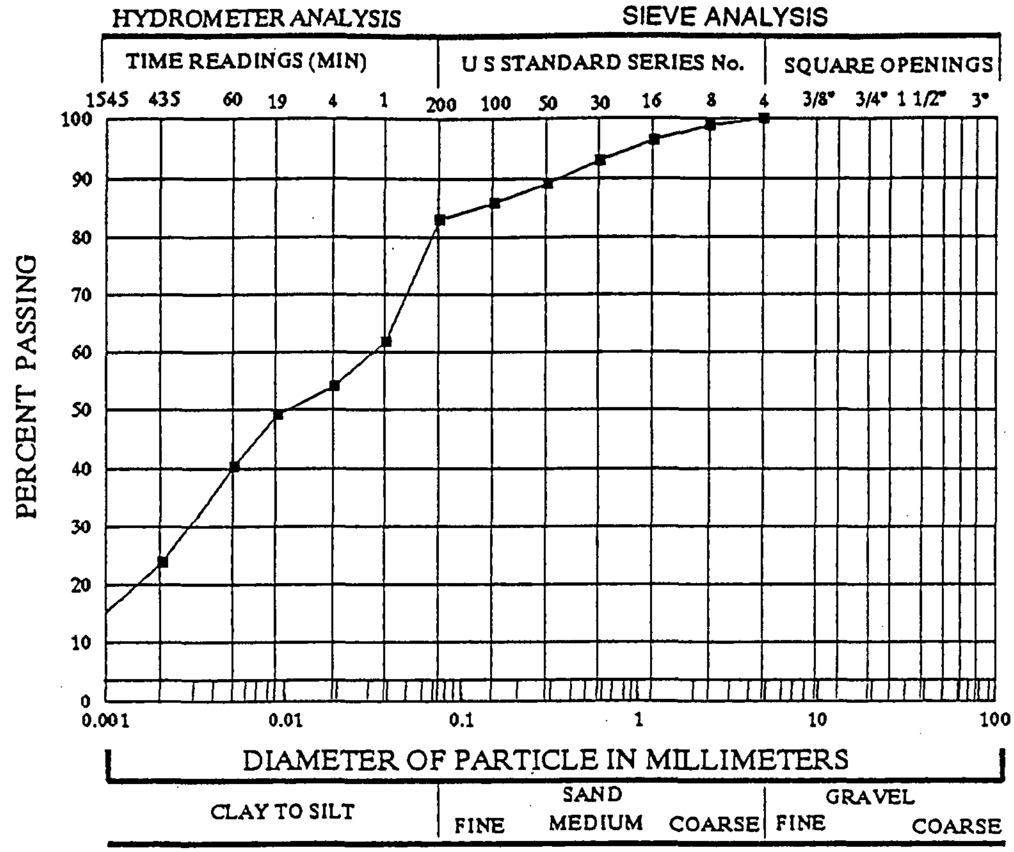
SAMPLE IDENTIFICATION:
BORING STH-2 DEPTH (ft): 60 to 67

SOIL CLASSIFICATION:
FAT CLAY WITH SAND (CH)

HYDRO-ENGINEERING

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	MOISTURE-DENSITY RELATIONSHIP	Fig. 1

FIGURE C.2-7. STANDARD PROCTOR RESULTS FOR SAMPLE STH-2 (60'-67').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	17
FINES (SILT AND CLAY)	83

ATTERBERG LIMITS

LIMIT LIMIT	54
PLASTICITY INDEX	34

SAMPLE IDENTIFICATION:
BORING STH-2 DEPTH (ft): 60 to 67

SOIL CLASSIFICATION:
FAT CLAY WITH SAND (CH)

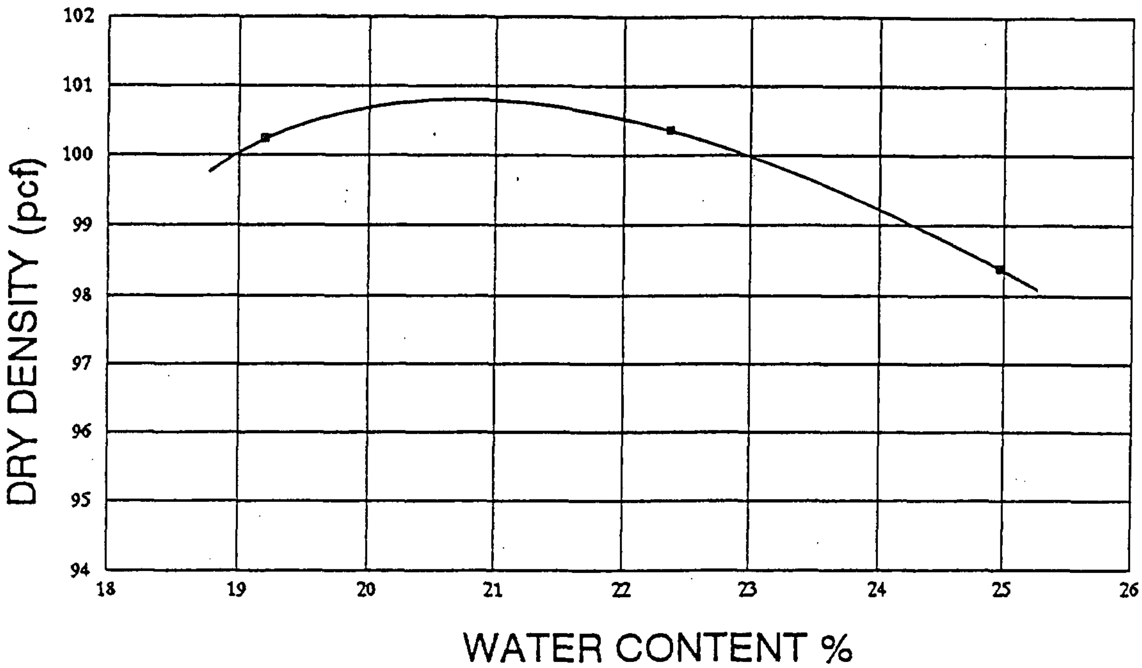
HYDRO-ENGINEERING

HCN 9-12

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 2

FIGURE C.2-8. GRADATION RESULTS FOR SAMPLE STH-2 (60'-67').

MOISTURE–DENSITY CURVE



ASTM 698–78, METHOD A

OPTIMUM WATER CONTENT 20.8% MAXIMUM DRY DENSITY 100.7 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	8
FINES (SILT AND CLAY)	92

ATTERBERG LIMITS

LIQUID LIMIT	61
PLASTICITY INDEX	40

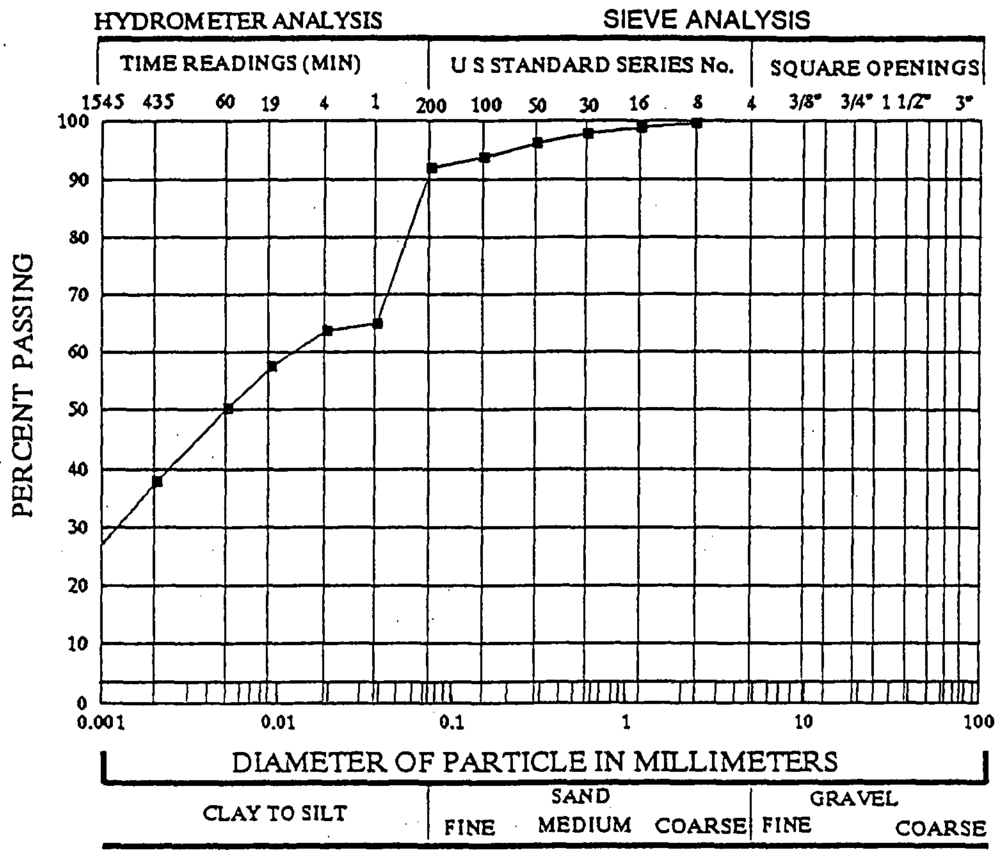
SAMPLE IDENTIFICATION:
BORING STH–4 DEPTH (ft): 30 to 37

SOIL CLASSIFICATION:
FAT CLAY (CH)

HYDRO–ENGINEERING

93–4511A	HUNTINGDON CHEN–NORTHERN, INC.	MOISTURE–DENSITY RELATIONSHIP	Fig. 3

FIGURE C.2-9. STANDARD PROCTOR RESULTS FOR SAMPLE STH-4 (30'-37').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	8
FINES (SILT AND CLAY)	92

ATTERBERG LIMITS

LIQUID LIMIT	61
PLASTICITY INDEX	40

SAMPLE IDENTIFICATION:
BORING STH-4 DEPTH (ft): 30 to 37

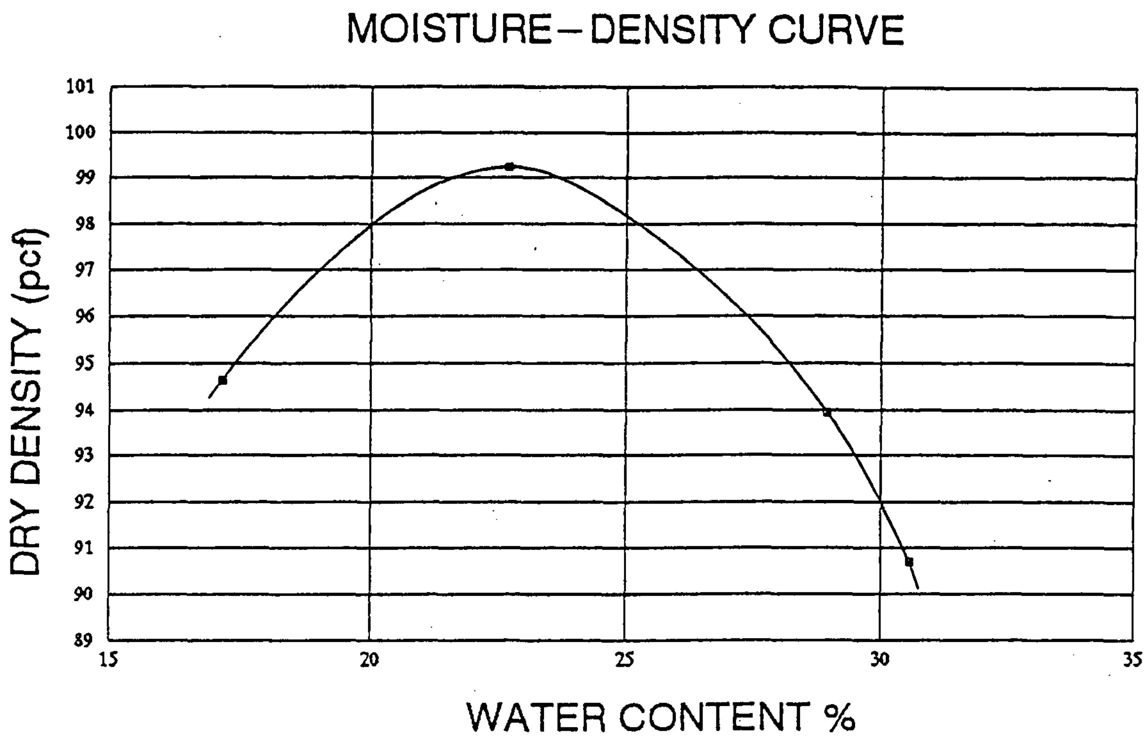
SOIL CLASSIFICATION:
FAT CLAY (CH)

HYDRO-ENGINEERING

HCN 9-12

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 4

FIGURE C.2-10. GRADATION RESULTS FOR SAMPLE STH-4 (30'-37').



ASTM 698-78, METHOD A

OPTIMUM WATER CONTENT 22.6% MAXIMUM DRY DENSITY 99.2 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	7
FINES (SILT AND CLAY)	93

ATTERBERG LIMITS

LIQUID LIMIT	58
PLASTICITY INDEX	35

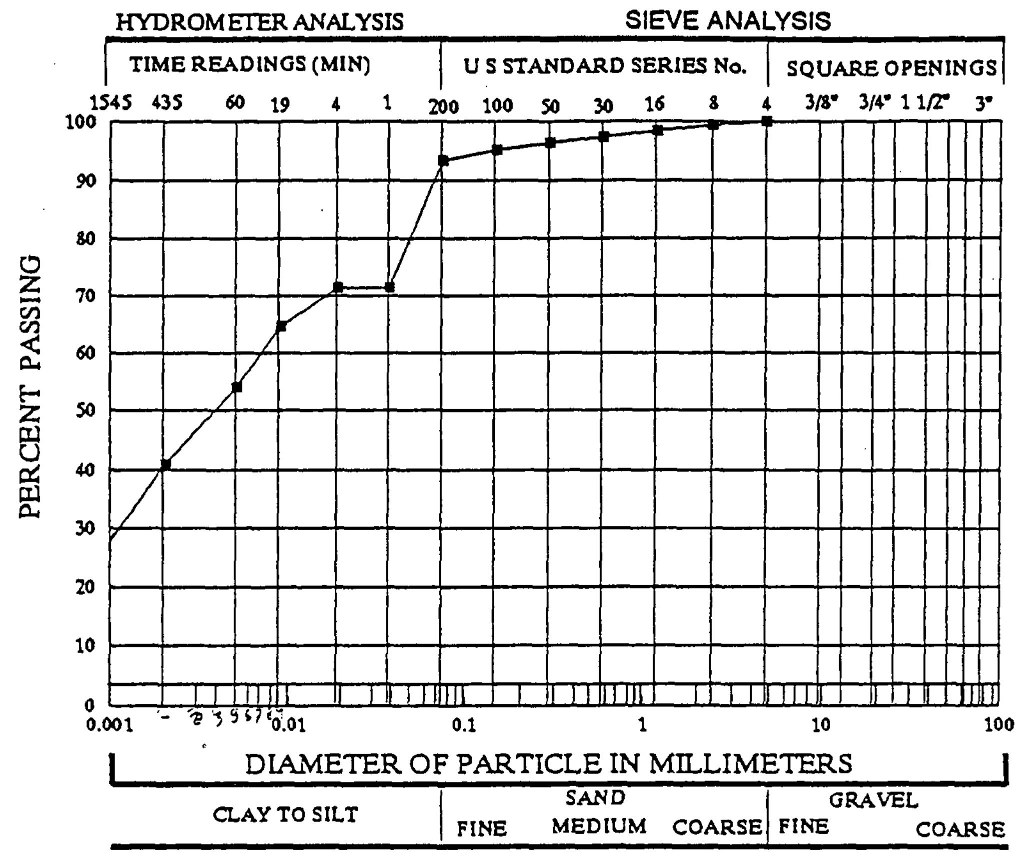
SAMPLE IDENTIFICATION:
BORING STH-5 DEPTH (ft): 40 to 47

SOIL CLASSIFICATION:
FAT CLAY (CH)

HYDRO-ENGINEERING

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	MOISTURE-DENSITY RELATIONSHIP	Fig. 5

FIGURE C.2-11. STANDARD PROCTOR RESULTS FOR SAMPLE STH-5 (40'-47').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	7
FINES (SILT AND CLAY)	93

ATTERBERG LIMITS

LIMIT LIMIT	58
PLASTICITY INDEX	35

SAMPLE IDENTIFICATION:
BORING STH-5 DEPTH (ft): 40 to 47

SOIL CLASSIFICATION:
FAT CLAY (CH)

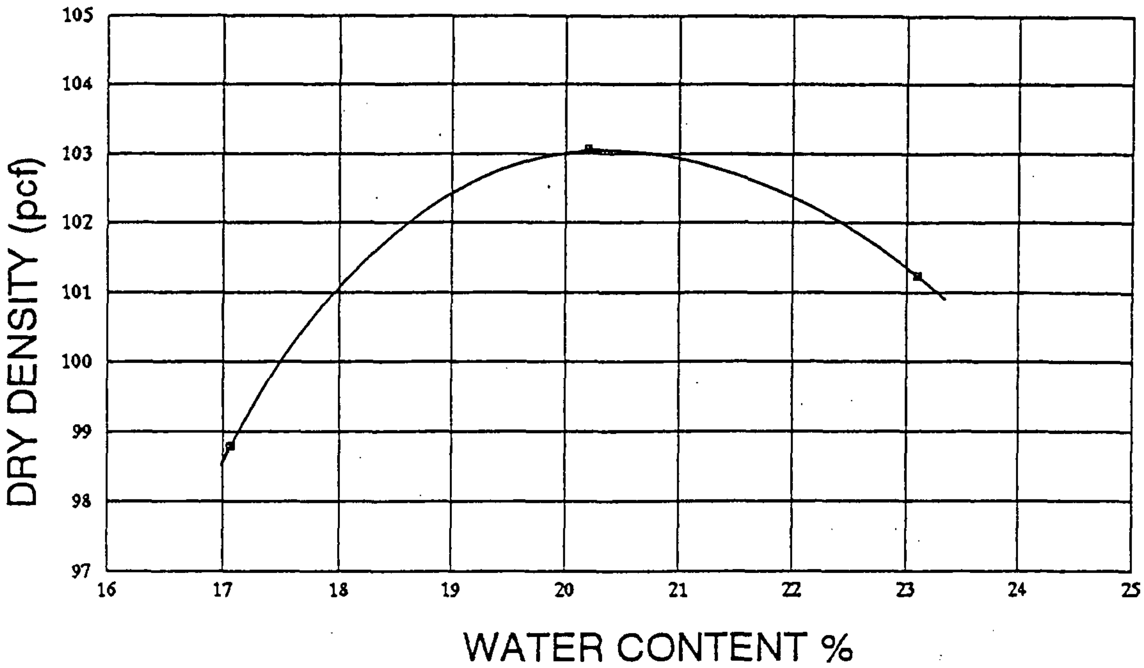
HYDRO-ENGINEERING

HCN 9-12

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 6

FIGURE C.2-12. GRADATION RESULTS FOR SAMPLE STH-5 (40'-47').

MOISTURE–DENSITY CURVE



ASTM 698–78, METHOD A

OPTIMUM WATER CONTENT 20.2% MAXIMUM DRY DENSITY 103.1 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	17
FINES (SILT AND CLAY)	83

ATTERBERG LIMITS

LIQUID LIMIT	45
PLASTICITY INDEX	25

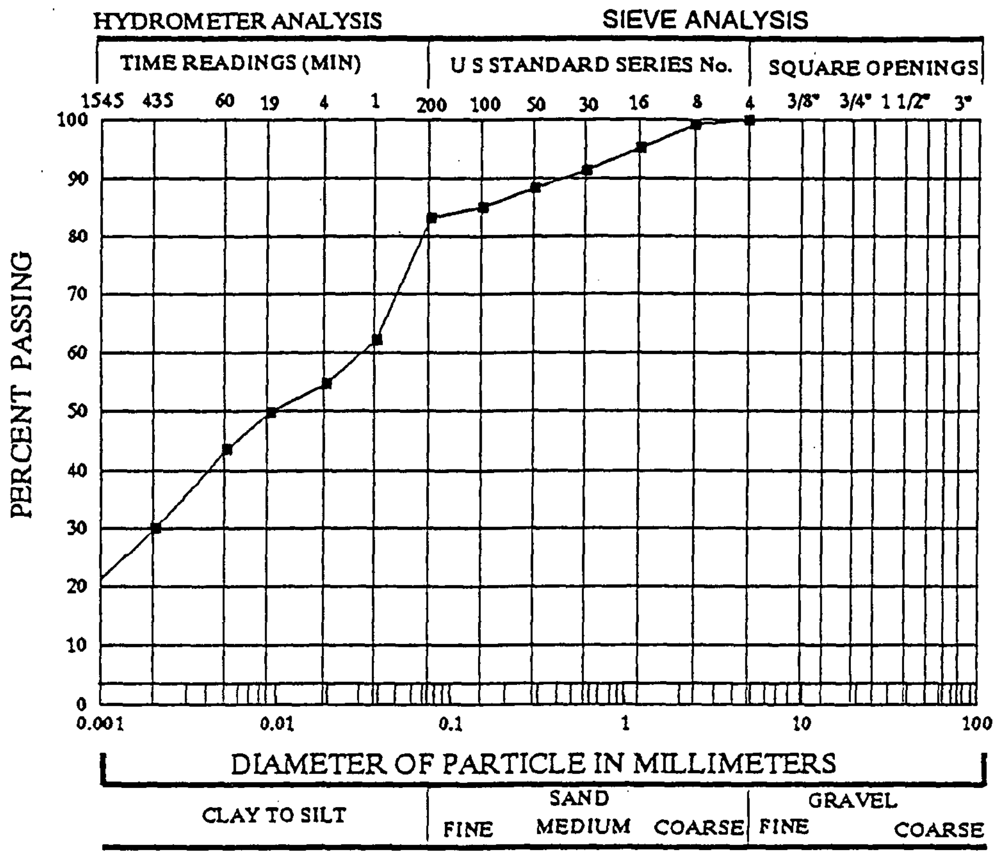
SAMPLE IDENTIFICATION:
BORING STH–6 DEPTH (ft): 20 to 27

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

HYDRO–ENGINEERING

93–4511A	HUNTINGDON CHEN–NORTHERN, INC.	MOISTURE–DENSITY RELATIONSHIP	Fig. 7

FIGURE C.2-13. STANDARD PROCTOR RESULTS FOR SAMPLE STH-6 (20'-27').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	17
FINES (SILT AND CLAY)	83

ATTERBERG LIMITS

LIQUID LIMIT	45
PLASTICITY INDEX	25

SAMPLE IDENTIFICATION:
BORING STH-6 DEPTH (ft): 20 to 27

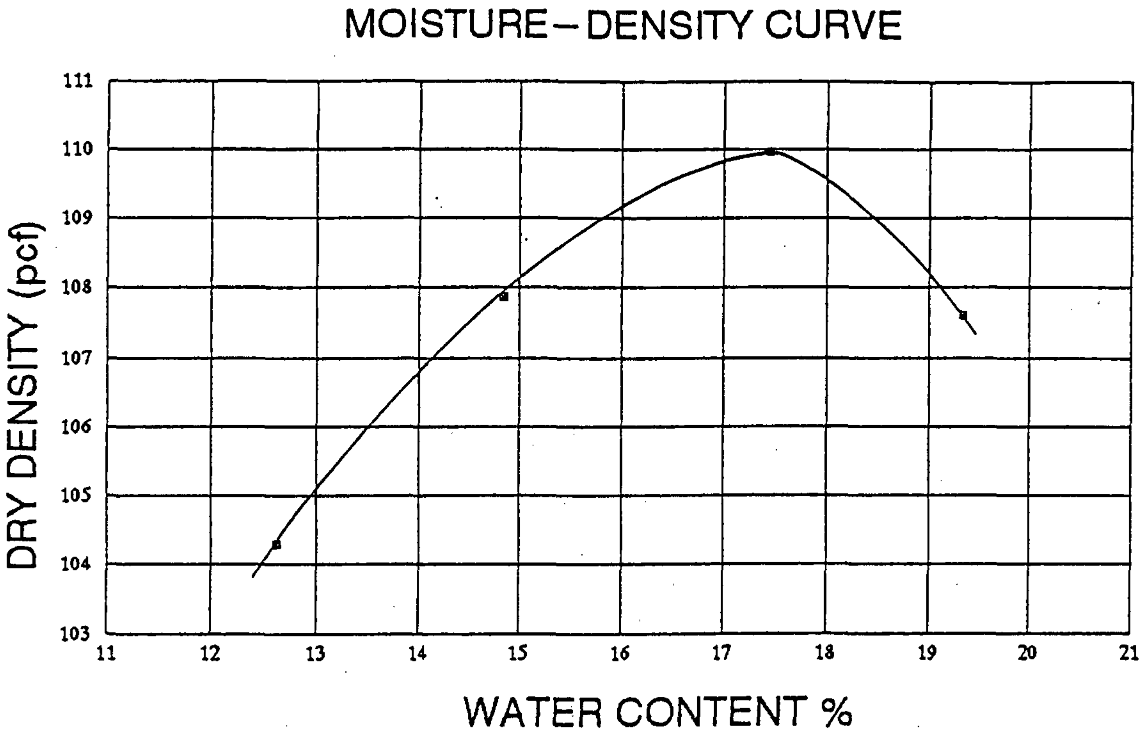
SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

HYDRO-ENGINEERING

HCN 9-12

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 8

FIGURE C.2-14. GRADATION RESULTS FOR SAMPLE STH-6 (20'-27').



ASTM 698-78, METHOD A

OPTIMUM WATER CONTENT 17.5% MAXIMUM DRY DENSITY 110.0 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	45
FINES (SILT AND CLAY)	55

ATTERBERG LIMITS

LIQUID LIMIT	57
PLASTICITY INDEX	37

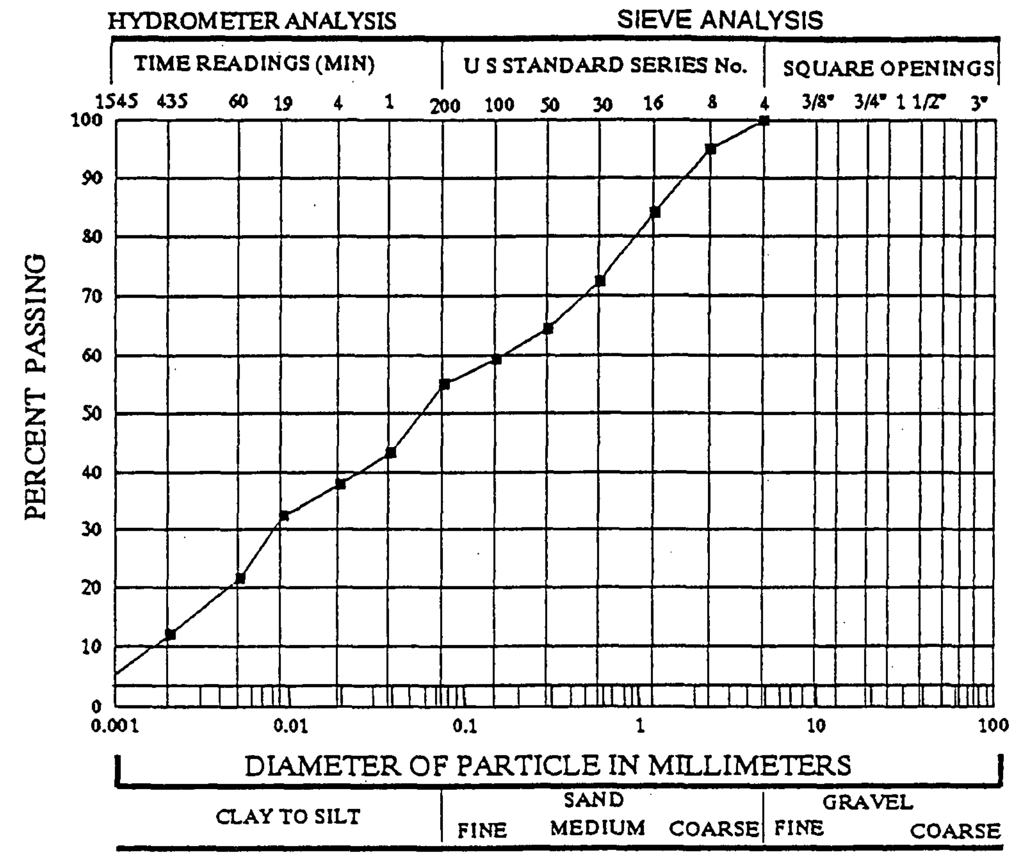
SAMPLE IDENTIFICATION:
BORING STH-7 DEPTH (ft): 40 to 47

SOIL CLASSIFICATION:
SANDY FAT CLAY (CH)

HYDRO-ENGINEERING

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	MOISTURE-DENSITY RELATIONSHIP	Fig. 9

FIGURE C.2-15. STANDARD PROCTOR RESULTS FOR SAMPLE STH-7 (40'-47').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	45
FINES (SILT AND CLAY)	55

ATTERBERG LIMITS

LIQUID LIMIT	57
PLASTICITY INDEX	37

SAMPLE IDENTIFICATION:
BORING STH-7 DEPTH (ft): 40 to 47

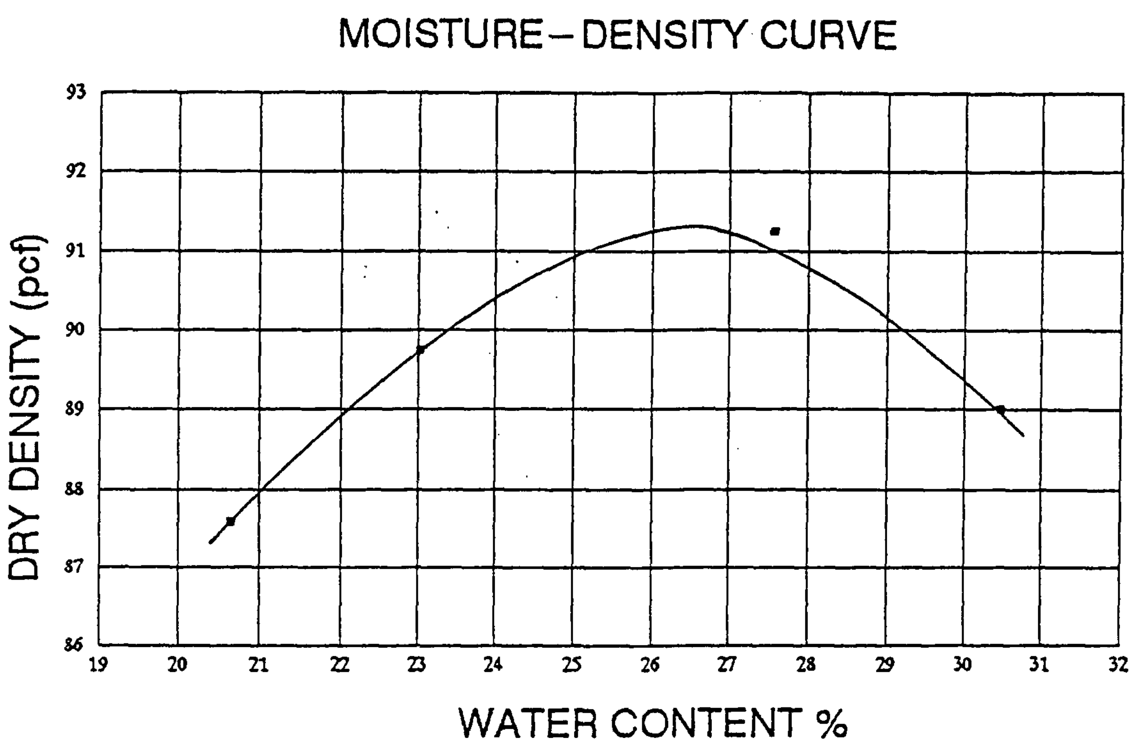
SOIL CLASSIFICATION:
SANDY FAT CLAY (CH)

HYDRO-ENGINEERING

HCN 9-12

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 10

FIGURE C.2-16. GRADATION RESULTS FOR SAMPLE STH-7 (40'-47').



ASTM 698-78, METHOD A

OPTIMUM WATER CONTENT 26.7% MAXIMUM DRY DENSITY 91.3 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	4
FINES (SILT AND CLAY)	96

ATTERBERG LIMITS

LIQUID LIMIT	64
PLASTICITY INDEX	37

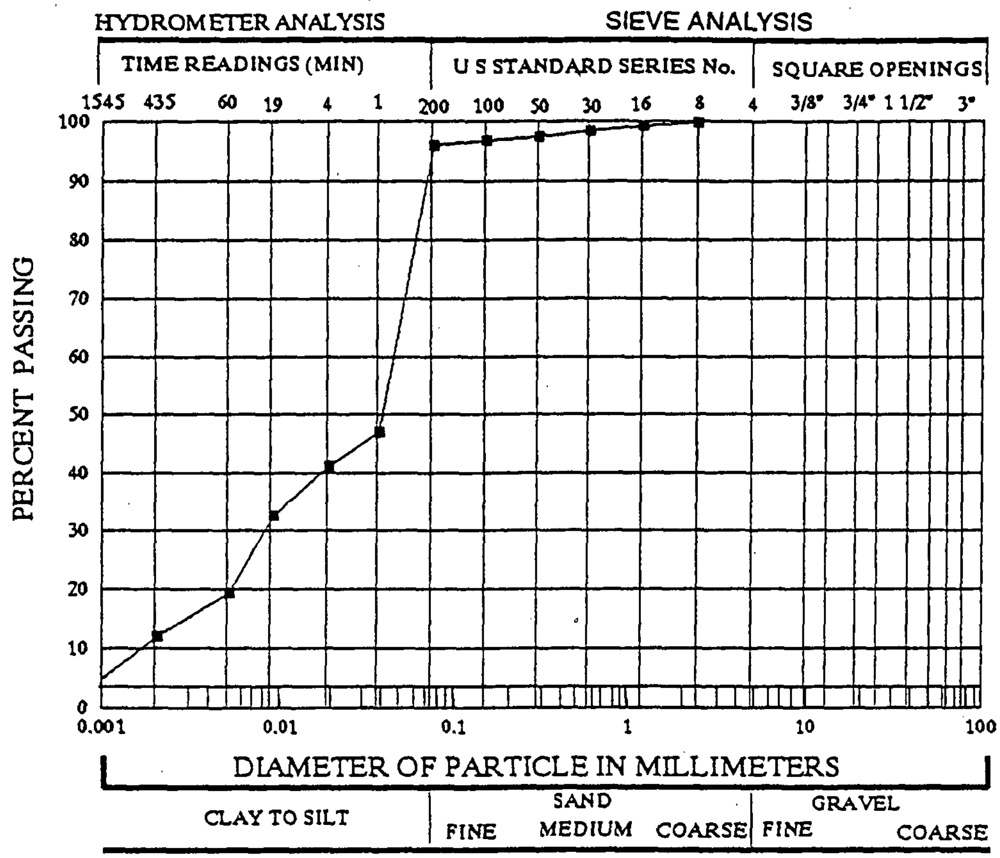
SAMPLE IDENTIFICATION:
BORING STH-11 DEPTH (ft): 20 to 27

SOIL CLASSIFICATION:
FAT CLAY (CH)

HYDRO-ENGINEERING

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	MOISTURE-DENSITY RELATIONSHIP	Fig. 11

FIGURE C.2-17. STANDARD PROCTOR RESULTS FOR SAMPLE STH-11 (20'-27').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	4
FINES (SILT AND CLAY)	96

ATTERBERG LIMITS

LIQUID LIMIT	64
PLASTICITY INDEX	37

SAMPLE IDENTIFICATION:
BORING STH-11 DEPTH (ft): 20 to 27

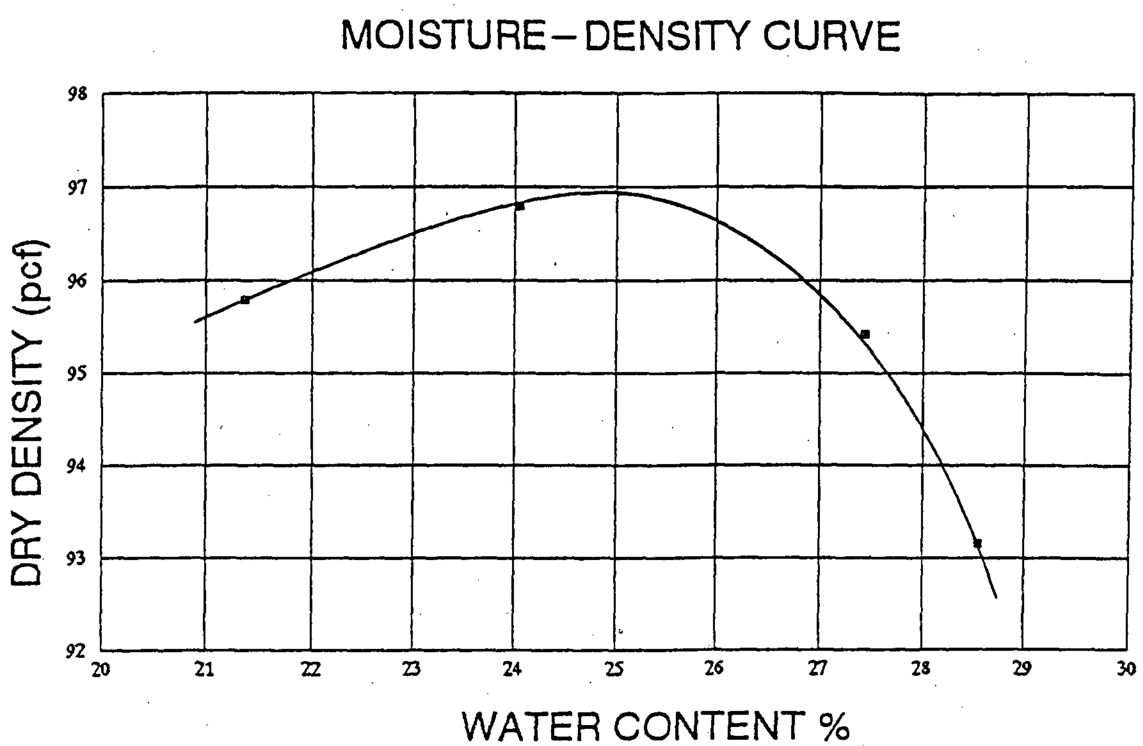
SOIL CLASSIFICATION:
FAT CLAY (CH)

HYDRO-ENGINEERING

HCN 9-12

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 12

FIGURE C.2-18. GRADATION RESULTS FOR SAMPLE STH-11 (20'-27').



ASTM 698-78, METHOD A

OPTIMUM WATER CONTENT 24.8% MAXIMUM DRY DENSITY 96.8 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	15
FINES (SILT AND CLAY)	85

ATTERBERG LIMITS

LIQUID LIMIT	65
PLASTICITY INDEX	38

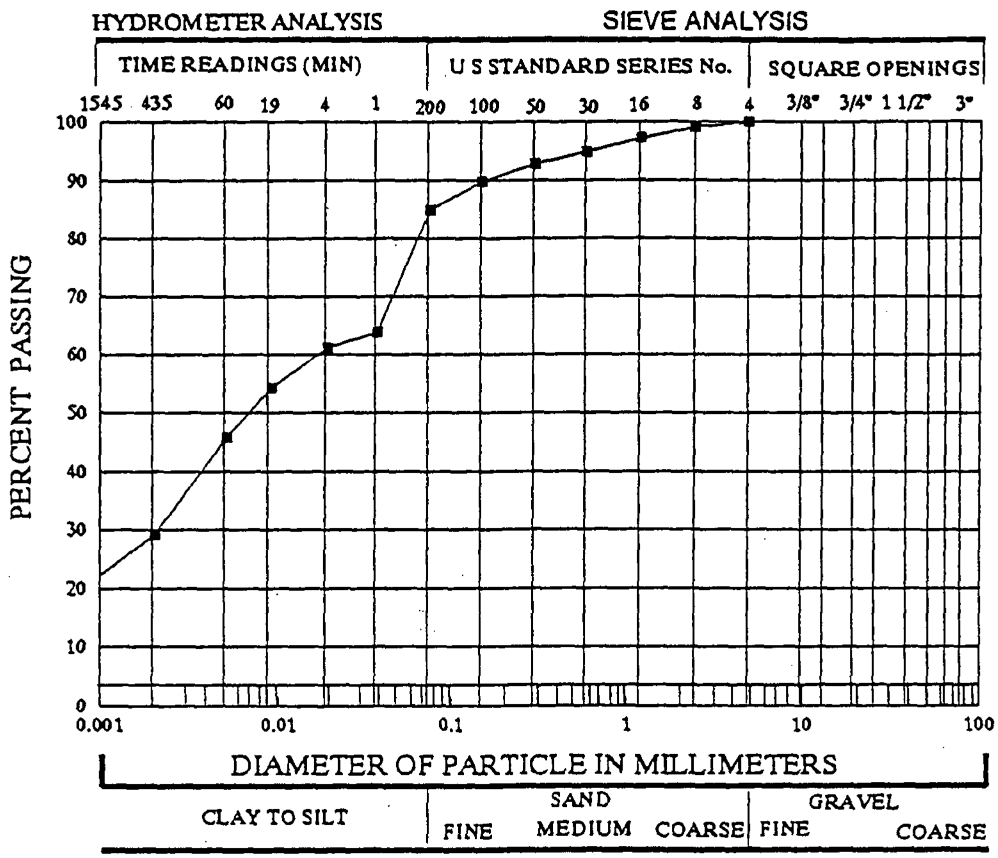
SAMPLE IDENTIFICATION:
BORING NTH-1 DEPTH (ft): 60 to 67

SOIL CLASSIFICATION:
FAT CLAY WITH SAND (CH)

HYDRO-ENGINEERING

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	MOISTURE-DENSITY RELATIONSHIP	Fig. 13

FIGURE C.2-19. STANDARD PROCTOR RESULTS FOR SAMPLE NTH-1 (60'-67').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	15
FINES (SILT AND CLAY)	85

ATTERBERG LIMITS

LIQUID LIMIT	65
PLASTICITY INDEX	38

SAMPLE IDENTIFICATION:
BORING NTH-1 DEPTH (ft): 60 to 67

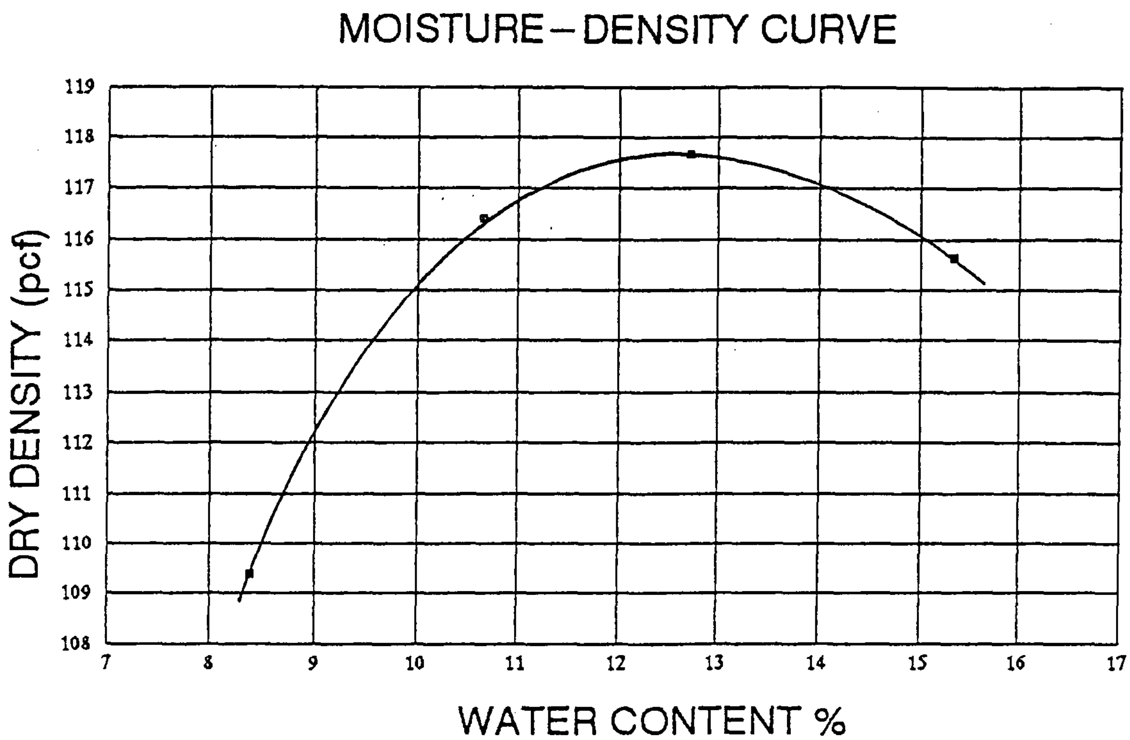
SOIL CLASSIFICATION:
FAT CLAY WITH SAND (CH)

HYDRO-ENGINEERING

HCN 9-12

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 14

FIGURE C.2-20. GRADATION RESULTS FOR SAMPLE NTH-1 (60'-67').



ASTM 698-78, METHOD A

OPTIMUM WATER CONTENT 12.7% MAXIMUM DRY DENSITY 117.7 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	10
SAND	61
FINES (SILT AND CLAY)	29

ATTERBERG LIMITS

LIQUID LIMIT	42
PLASTICITY INDEX	27

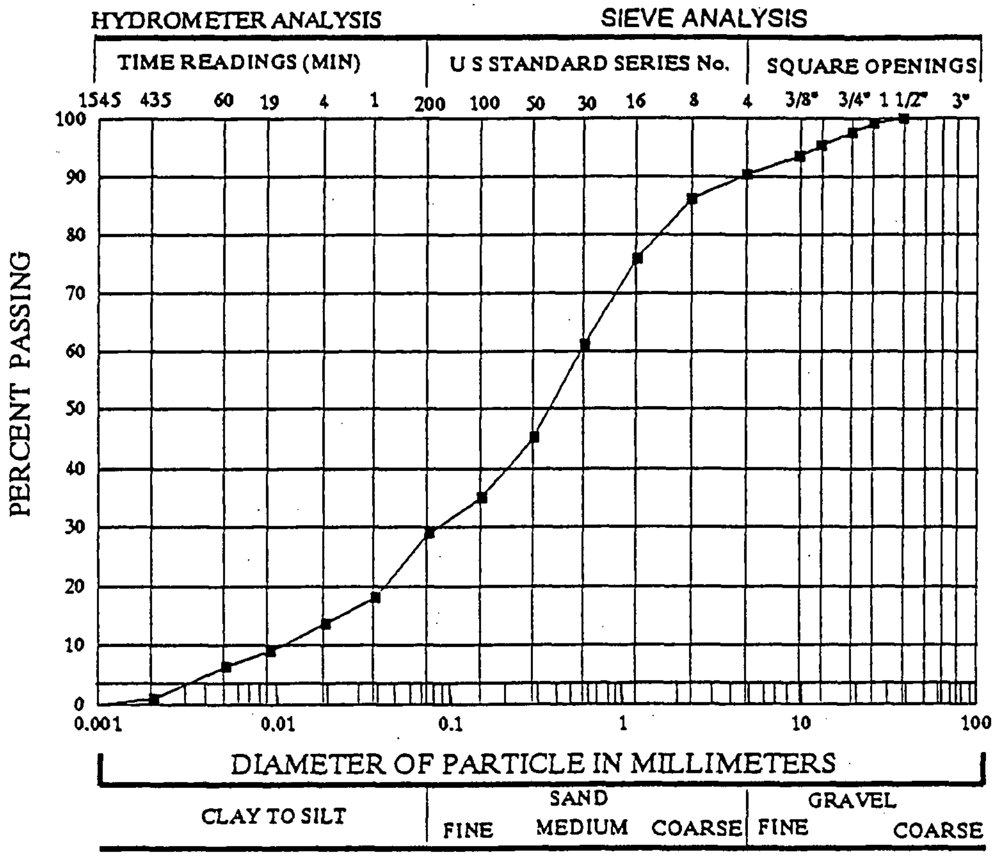
SAMPLE IDENTIFICATION:
BORING NTH-3 DEPTH (ft): 140 to 147

SOIL CLASSIFICATION:
SANDY LEAN CLAY (CL)

HYDRO-ENGINEERING

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	MOISTURE-DENSITY RELATIONSHIP	Fig. 15

FIGURE C.2-21. STANDARD PROCTOR RESULTS FOR SAMPLE NTH-3 (140'-147').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	10
SAND	61
FINES (SILT AND CLAY)	29

ATTERBERG LIMITS

LIQUID LIMIT	42
PLASTICITY INDEX	27

SAMPLE IDENTIFICATION:
BORING NTH-3 DEPTH (ft): 140 to 147

SOIL CLASSIFICATION:
SANDY LEAN CLAY (CL)

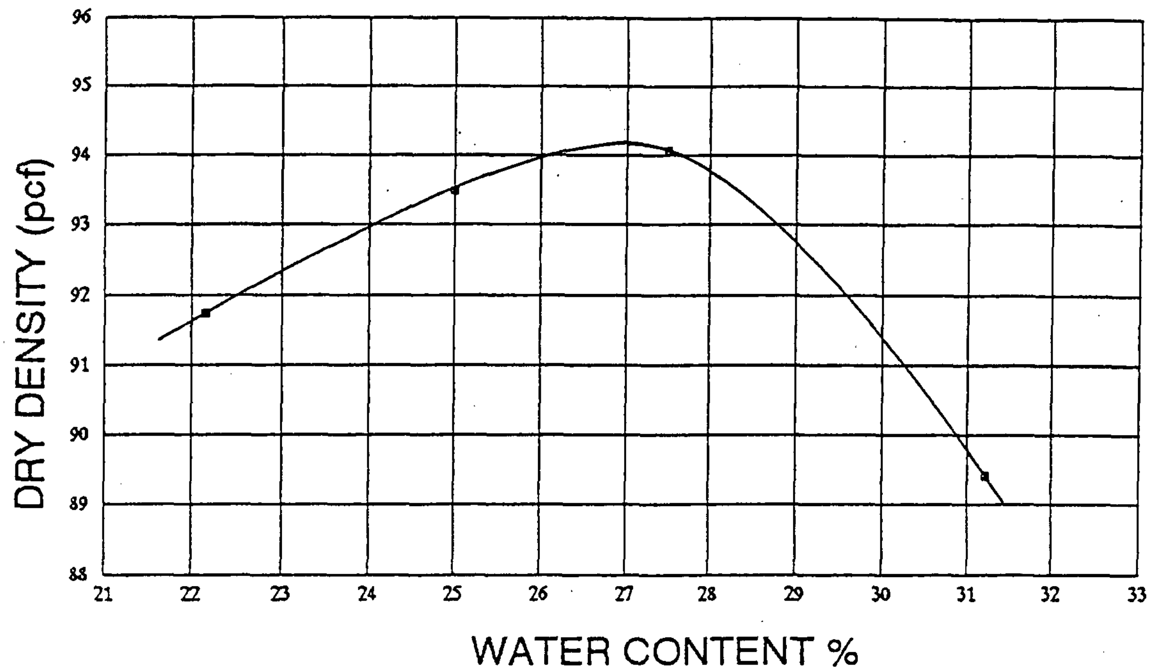
HYDRO-ENGINEERING

HCN 9-12

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 16

FIGURE C.2-22. GRADATION RESULTS FOR SAMPLE NTH-3 (140'-147').

MOISTURE–DENSITY CURVE



ASTM 698–78, METHOD A

OPTIMUM WATER CONTENT 27.0% MAXIMUM DRY DENSITY 94.1 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	10
FINES (SILT AND CLAY)	90

ATTERBERG LIMITS

LIQUID LIMIT	65
PLASTICITY INDEX	42

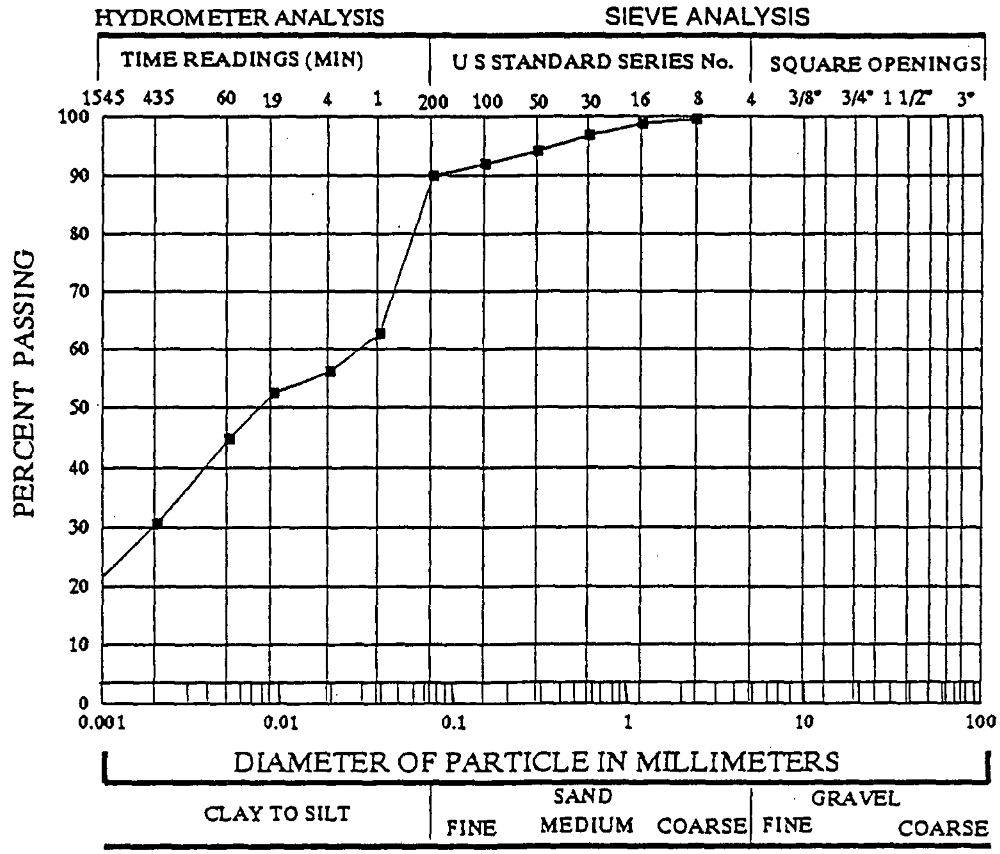
SAMPLE IDENTIFICATION:
BORING NTH–5 DEPTH (ft): 20 to 27

SOIL CLASSIFICATION:
FAT CLAY (CH)

HYDRO–ENGINEERING

93–4511A	HUNTINGDON CHEN–NORTHERN, INC.	MOISTURE–DENSITY RELATIONSHIP	Fig. 17

FIGURE C.2-23. STANDARD PROCTOR RESULTS FOR SAMPLE NTH-5 (20'-27').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	10
FINES (SILT AND CLAY)	90

ATTERBERG LIMITS

LIQUID LIMIT	65
PLASTICITY INDEX	42

SAMPLE IDENTIFICATION:
BORING NTH-5 DEPTH (ft): 20 to 27

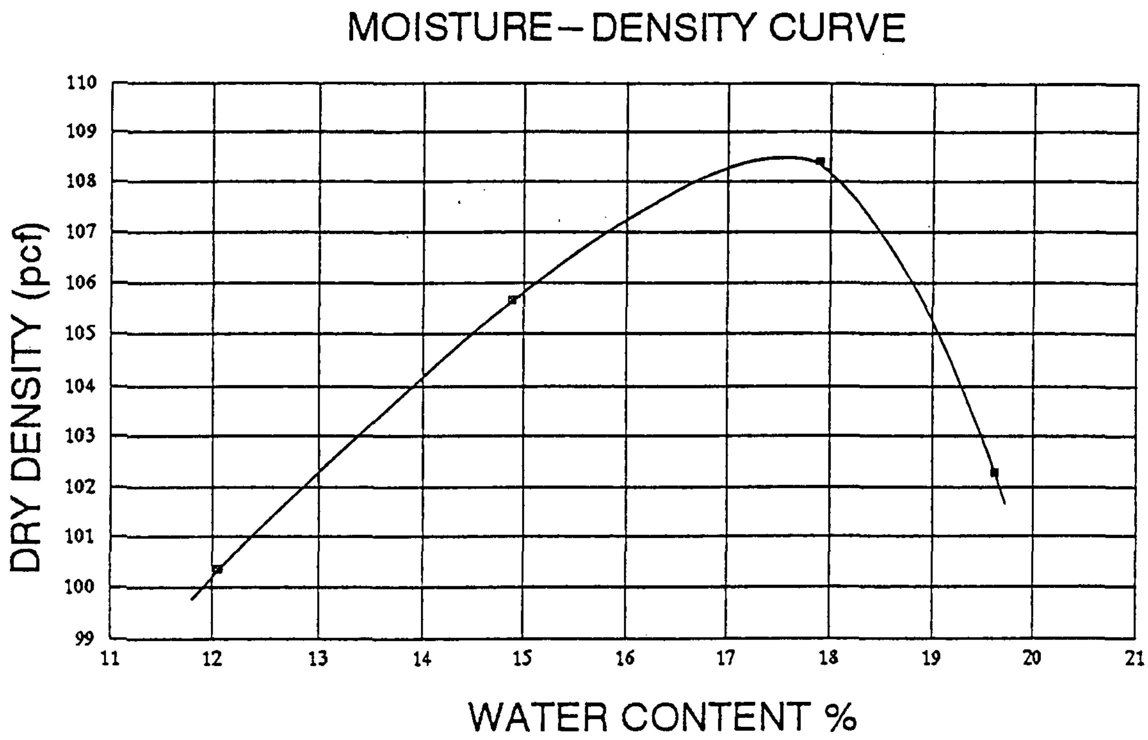
SOIL CLASSIFICATION:
FAT CLAY (CH)

HYDRO-ENGINEERING

HCN 9-12

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 18

FIGURE C.2-24. GRADATION REUSLTS FOR SAMPLE NTH-5 (20'-27').



ASTM 698-78, METHOD A

OPTIMUM WATER CONTENT 17.3% MAXIMUM DRY DENSITY 108.5 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	7
SAND	45
FINES (SILT AND CLAY)	48

ATTERBERG LIMITS

LIQUID LIMIT	55
PLASTICITY INDEX	39

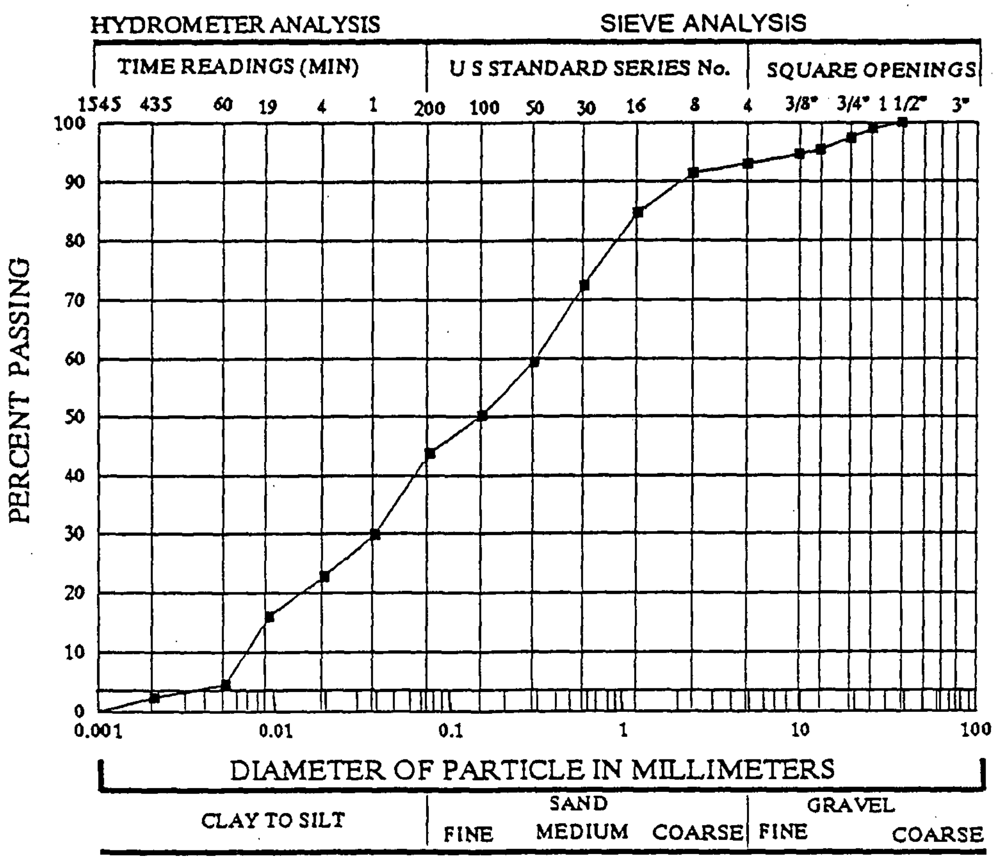
SAMPLE IDENTIFICATION:
BORING NTH-5 DEPTH (ft): 120 to 127

SOIL CLASSIFICATION:
SANDY FAT CLAY (CH)

HYDRO-ENGINEERING

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	MOISTURE-DENSITY RELATIONSHIP	Fig. 19

FIGURE C.2-25. STANDARD PROCTOR RESULTS FOR SAMPLE NTH-5 (120'-127').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	7
SAND	45
FINES (SILT AND CLAY)	48

ATTERBERG LIMITS

LIQUID LIMIT	55
PLASTICITY INDEX	39

SAMPLE IDENTIFICATION:
BORING NTH-5 DEPTH (ft): 120 to 127

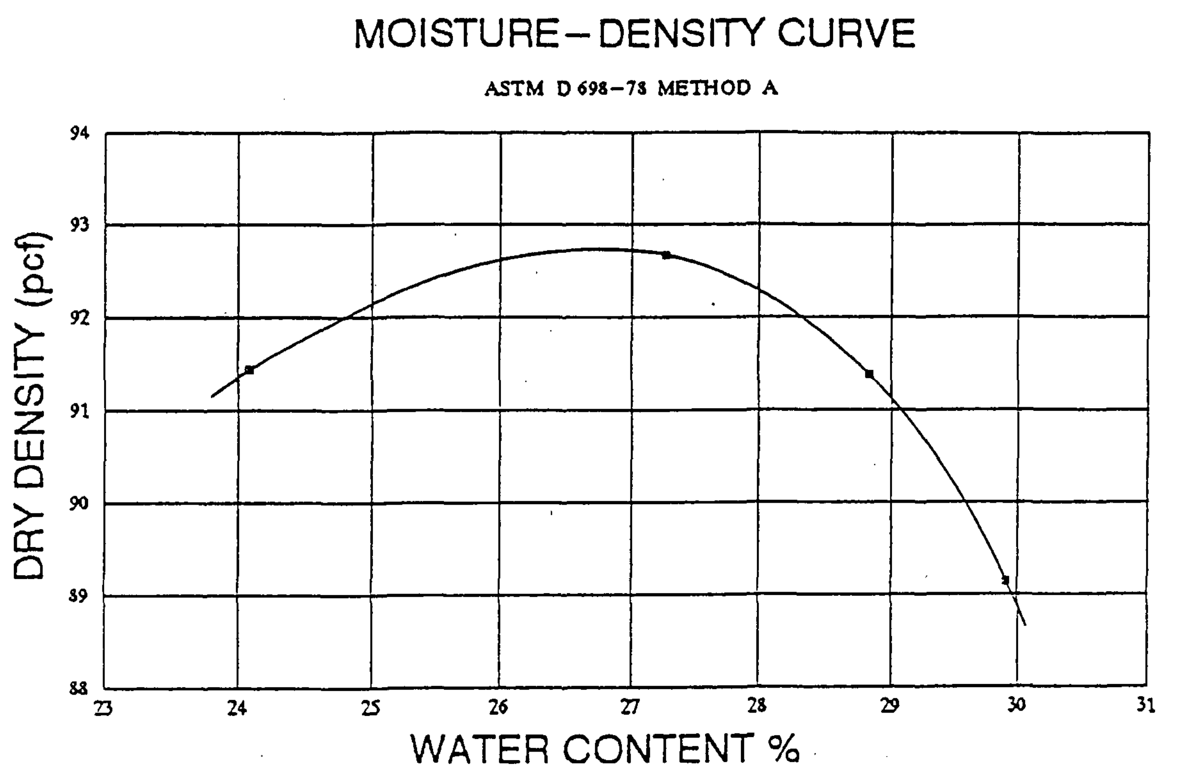
SOIL CLASSIFICATION:
SANDY FAT CLAY (CH)

HYDRO-ENGINEERING

HCN 9-12

93-4511A	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 20

FIGURE C.2-26. GRADATION RESULTS FOR SAMPLE NTH-5 (120'-127').



OPTIMUM WATER CONTENT 26.5% MAXIMUM DRY DENSITY 92.8 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	25
FINES (SILT AND CLAY)	75

ATTERBERG LIMITS

LIQUID LIMIT	56
PLASTICITY INDEX	29

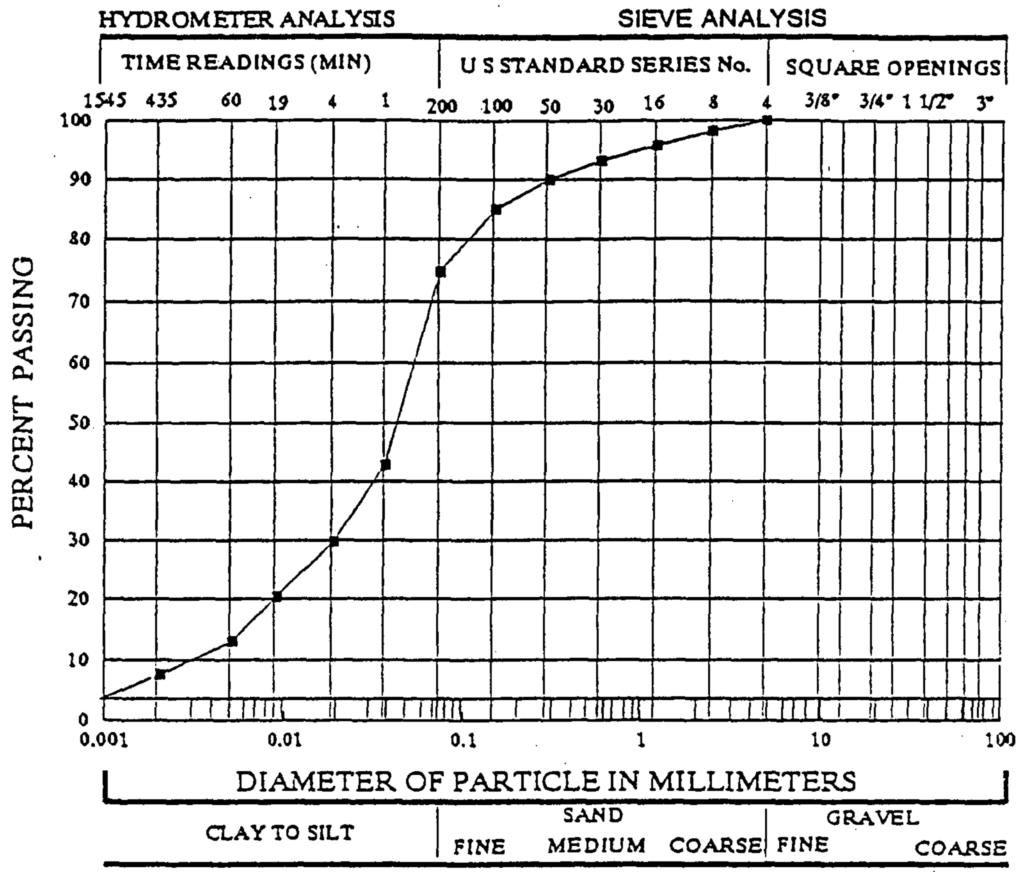
SAMPLE CP–1 DEPTH (ft): 10

SOIL CLASSIFICATION:
SANDY CLAY (CL)

HYDRO – ENGINEERING

93–4511	HUNTINGDON CHEN–NORTHERN. INC.	MOISTURE – DENSITY RELATIONSHIP	Fig. 1

FIGURE C.2-27. STANDARD PROCTOR RESULTS FOR SAMPLE CP-1 (10').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	25
FINES (SILT AND CLAY)	75

ATTERBERG LIMITS

LIQUID LIMIT	56
PLASTICITY INDEX	29

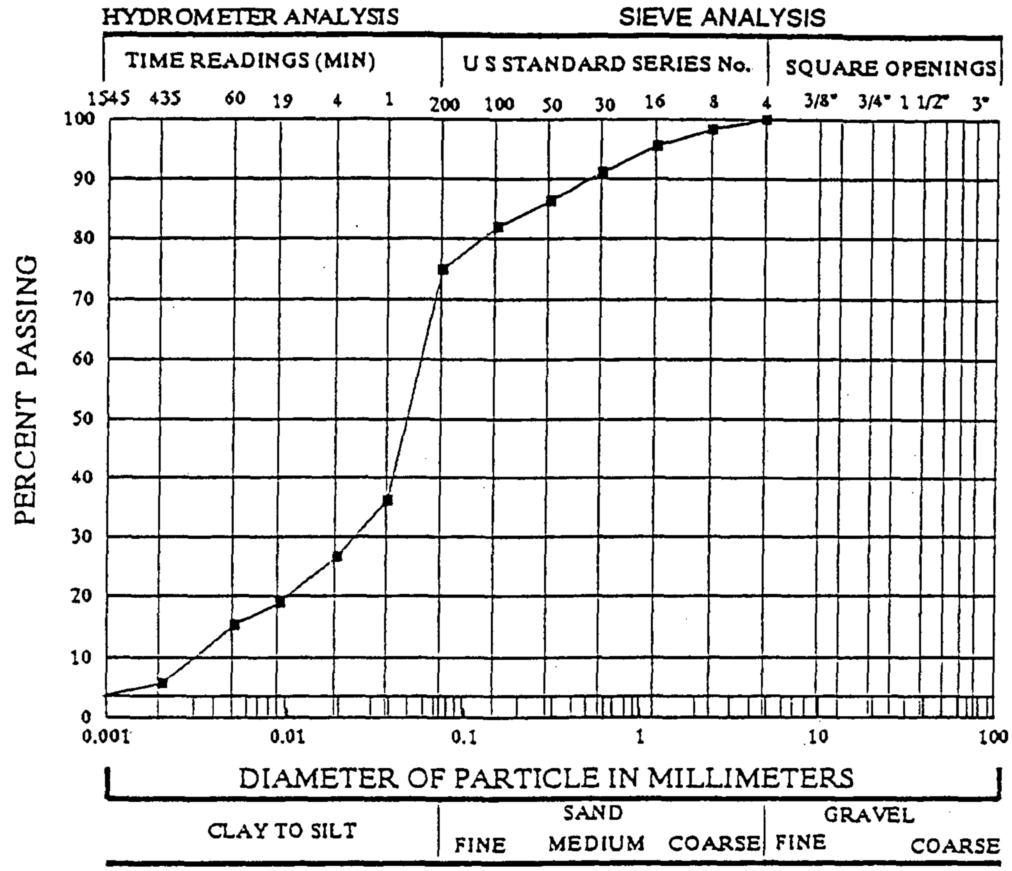
SAMPLE CP-1 DEPTH (ft): 10

SOIL CLASSIFICATION:
SANDY CLAY (CL)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 1A

FIGURE C.2-28. GRADATION RESULTS FOR SAMPLE CP-1 (10').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	25
FINES (SILT AND CLAY)	75

ATTERBERG LIMITS

LIQUID LIMIT	50
PLASTICITY INDEX	26

SAMPLE CP-2 DEPTH (ft): 9

SOIL CLASSIFICATION:
SANDY CLAY (CL)

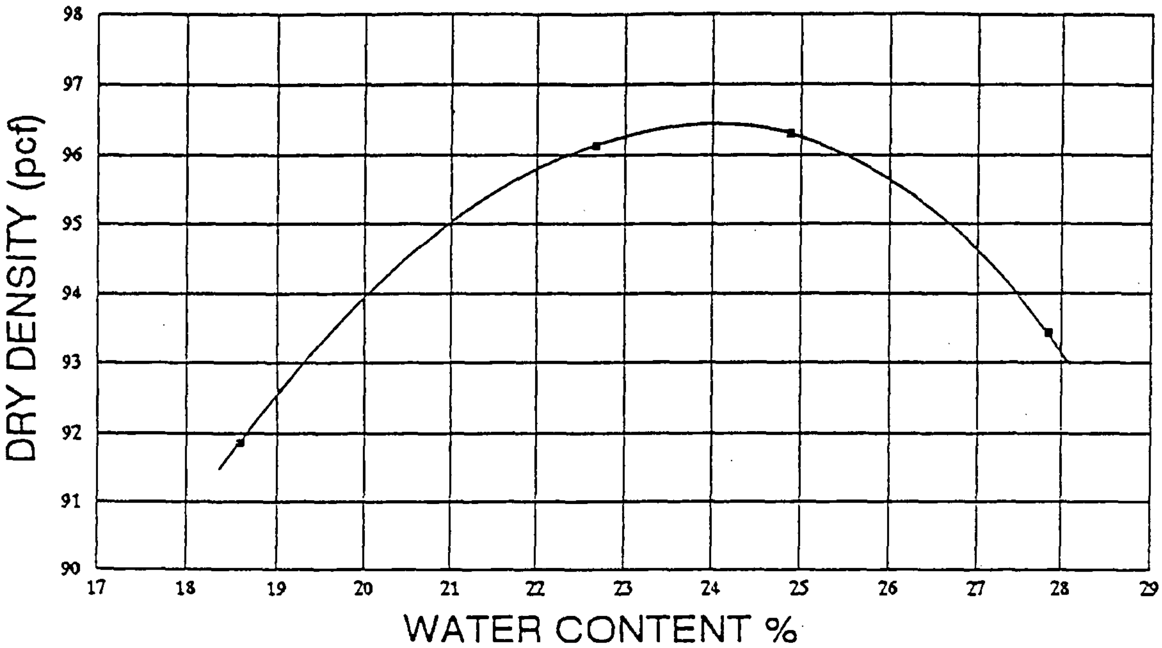
HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 2A

FIGURE C.2-29. STANDARD PROCTOR RESULTS FOR SAMPLE CP-2 (9').

MOISTURE–DENSITY CURVE

ASTM D 698–78 METHOD A



OPTIMUM WATER CONTENT 24.3% MAXIMUM DRY DENSITY 96.4 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	25
FINES (SILT AND CLAY)	75

ATTERBERG LIMITS

LIQUID LIMIT	50
PLASTICITY INDEX	26

SAMPLE CP–2 DEPTH (ft): 9

SOIL CLASSIFICATION:
SANDY CLAY (CL)

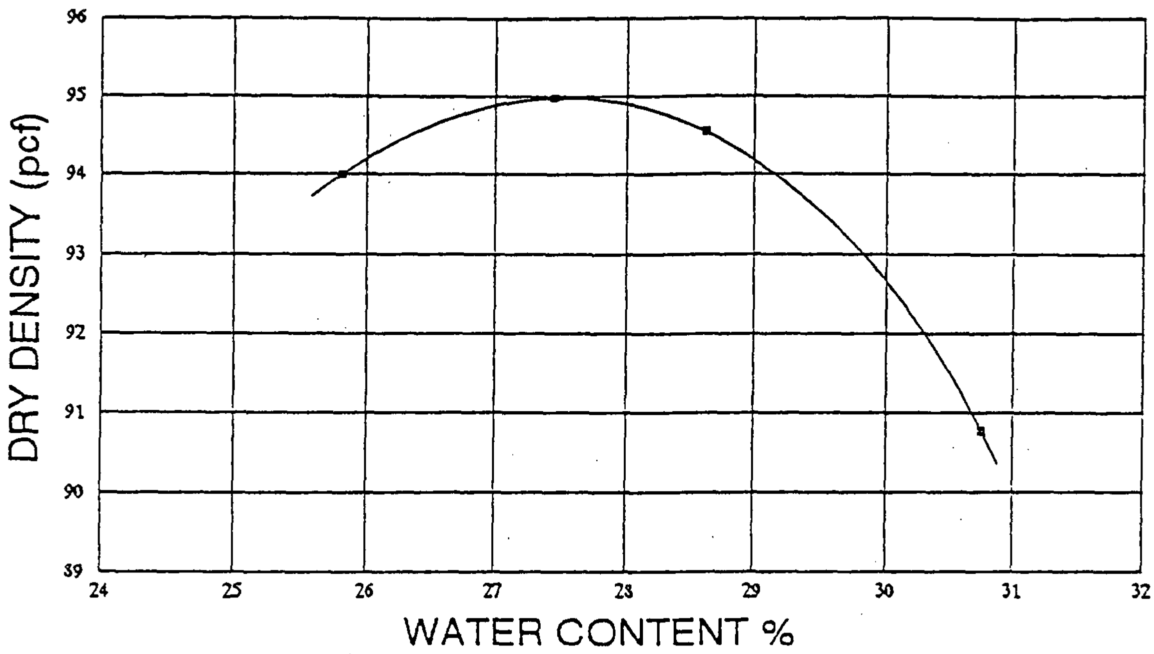
HYDRO–ENGINEERING

93–4511	HUNTINGDON CHEN–NORTHERN, INC.	MOISTURE–DENSITY RELATIONSHIP	Fig. 2

FIGURE C.2-30. GRADATION RESULTS FOR SAMPLE CP-2 (9').

MOISTURE–DENSITY CURVE

ASTM D 698–78 METHOD A



OPTIMUM WATER CONTENT 27.5% MAXIMUM DRY DENSITY 94.9 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	23
FINES (SILT AND CLAY)	77

ATTERBERG LIMITS

LIQUID LIMIT	52
PLASTICITY INDEX	27

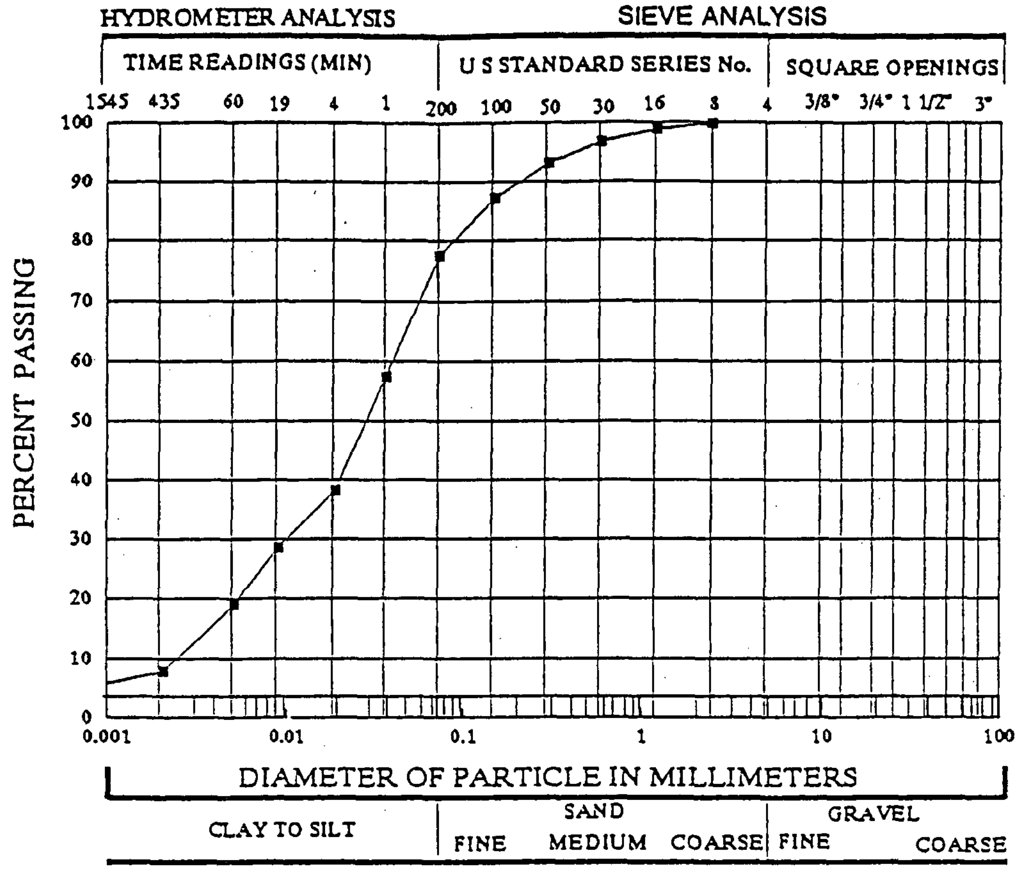
SAMPLE CP–3 DEPTH (ft): 9

SOIL CLASSIFICATION:
SANDY CLAY (CL)

HYDRO–ENGINEERING

93–4511	HUNTINGDON CHEN–NORTHERN, INC.	MOISTURE–DENSITY RELATIONSHIP	Fig. 3

FIGURE C.2-31. STANDARD PROCTOR RESULTS FOR SAMPLE CP-3 (9').



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	23
FINES (SILT AND CLAY)	77

ATTERBERG LIMITS

LIQUID LIMIT	52
PLASTICITY INDEX	27

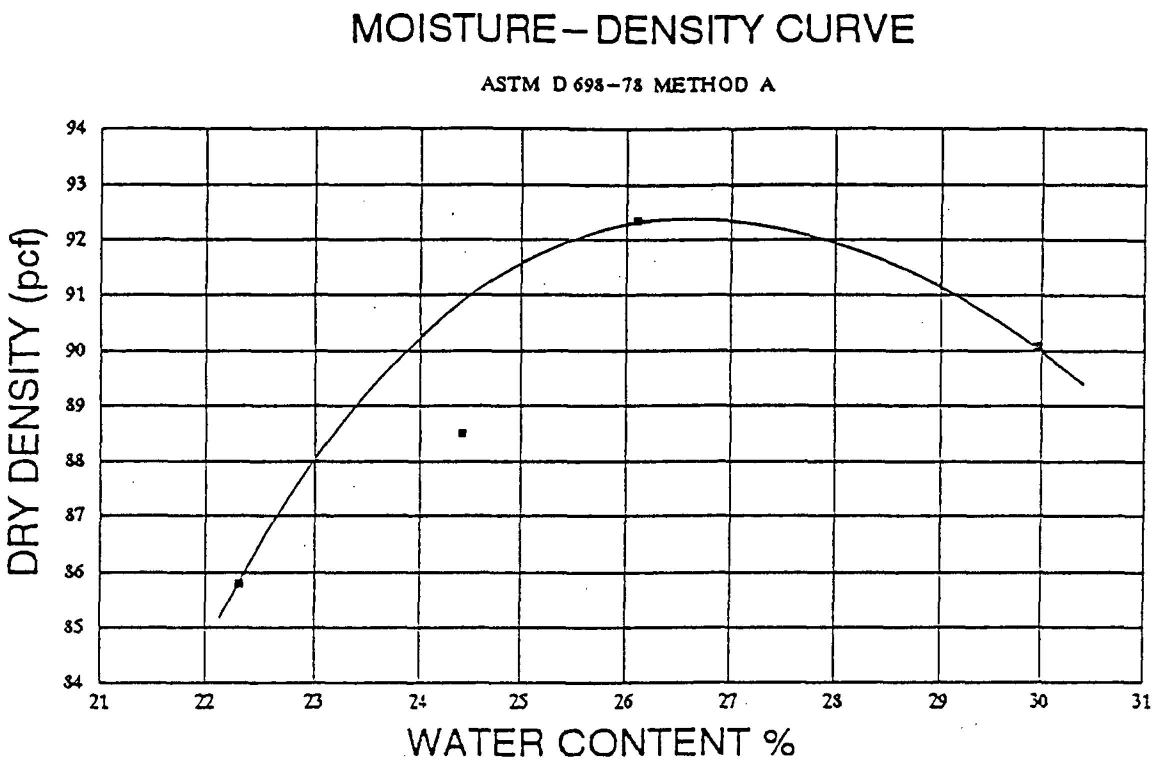
SAMPLE CP-3 DEPTH (ft): 9

SOIL CLASSIFICATION:
SANDY CLAY (CL)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 3A

FIGURE C.2-32. GRADATION RESULTS FOR SAMPLE CP-3 (9').



OPTIMUM WATER CONTENT 26.3% MAXIMUM DRY DENSITY 92.4 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	1
SAND	22
FINES (SILT AND CLAY)	77

ATTERBERG LIMITS

LIQUID LIMIT	59
PLASTICITY INDEX	33

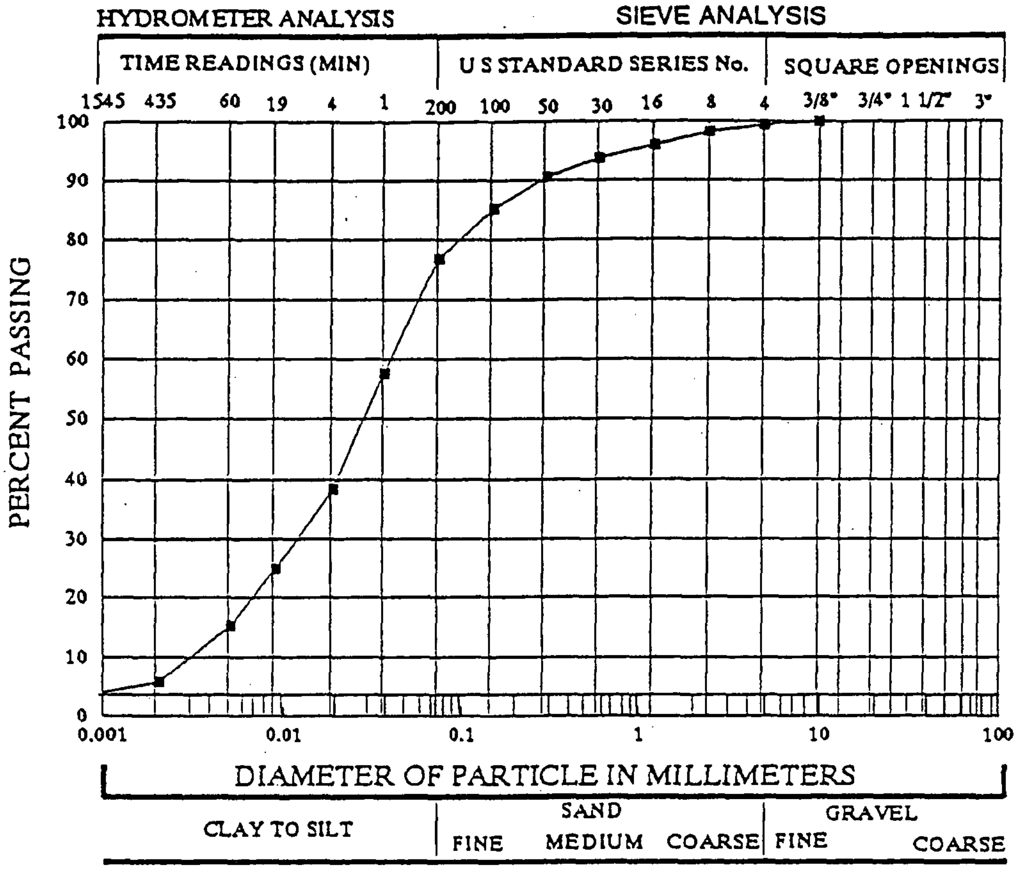
SAMPLE ND-1

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	MOISTURE-DENSITY RELATIONSHIP	Fig. 4

FIGURE C.2-33. STANDARD PROCTOR RESULTS FOR SAMPLE ND-1 .



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	1
SAND	22
FINES (SILT AND CLAY)	77

ATTERBERG LIMITS

LIQUID LIMIT	59
PLASTICITY INDEX	33

SAMPLE ND-1

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

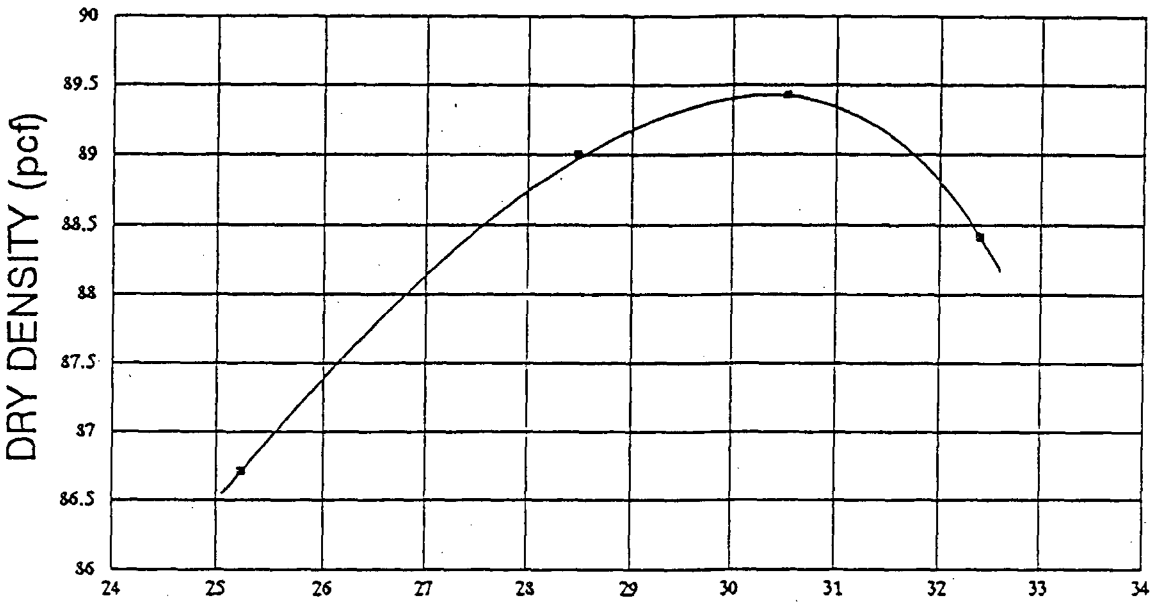
HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 4A

FIGURE C.2-34. GRADATION RESULTS FOR SAMPLE ND-1.

MOISTURE–DENSITY CURVE

ASTM D 698–78 METHOD A



OPTIMUM WATER CONTENT 30.3% MAXIMUM DRY DENSITY 89.4 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	27
FINES (SILT AND CLAY)	73

ATTERBERG LIMITS

LIQUID LIMIT	64
PLASTICITY INDEX	36

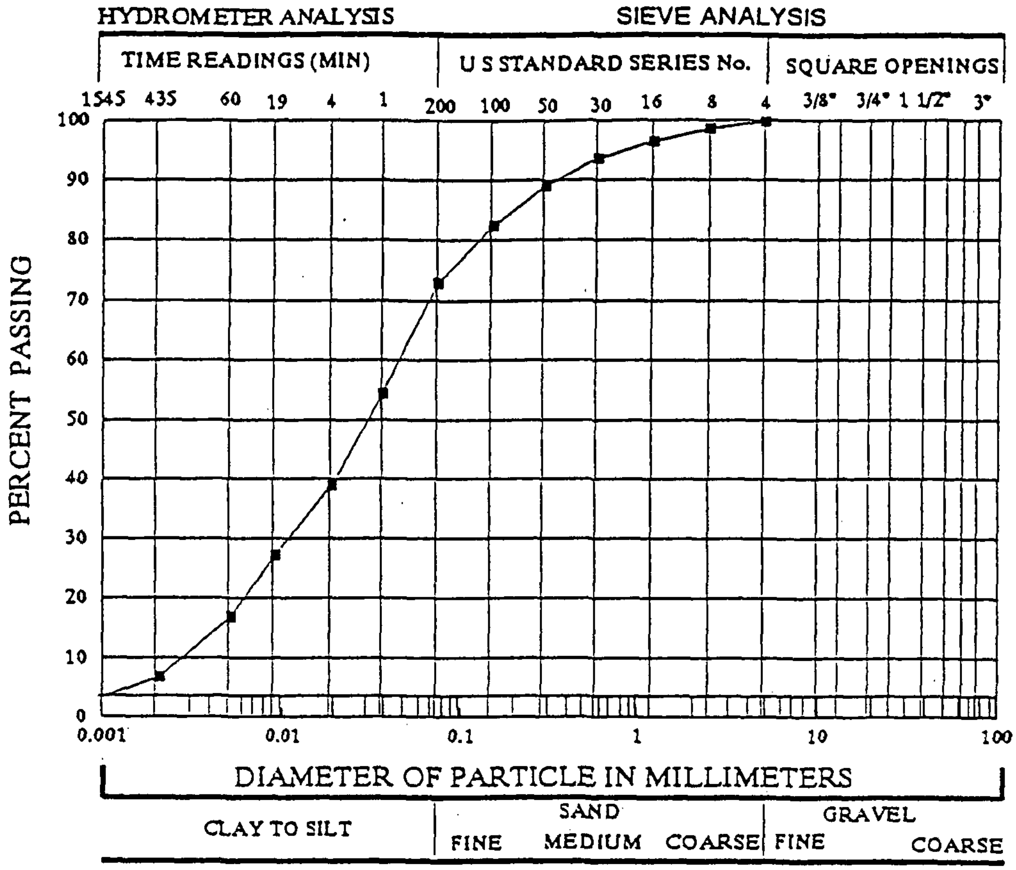
SAMPLE ND–2

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

HYDRO–ENGINEERING

93–4511	HUNTINGDON CHEN–NORTHERN, INC.	MOISTURE–DENSITY RELATIONSHIP	Fig. 5

FIGURE C.2-35. STANDARD PROCTOR RESULTS FOR SAMPLE ND-2.



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	27
FINES (SILT AND CLAY)	73

ATTERBERG LIMITS

LIQUID LIMIT	64
PLASTICITY INDEX	36

SAMPLE ND-2

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

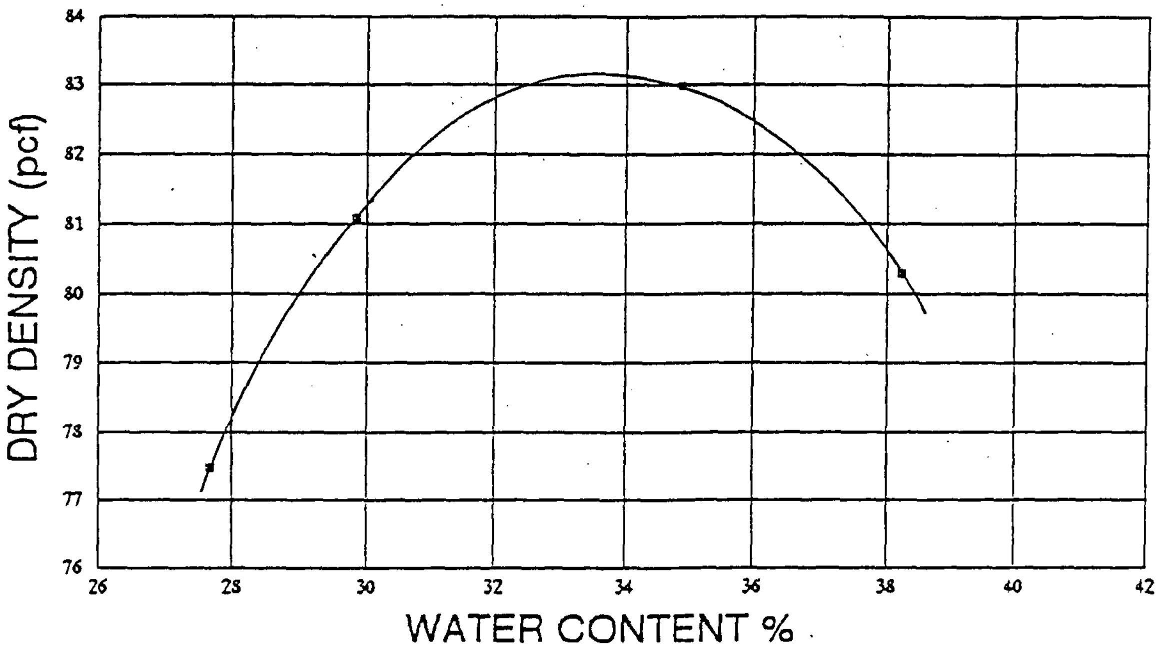
HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 5A

FIGURE C.2-36. GRADATION RESULTS FOR SAMPLE ND-2.

MOISTURE – DENSITY CURVE

ASTM D 698–78 METHOD A



OPTIMUM WATER CONTENT 33.5% MAXIMUM DRY DENSITY 83.2 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	1
SAND	23
FINES (SILT AND CLAY)	76

ATTERBERG LIMITS

LIQUID LIMIT	75
PLASTICITY INDEX	40

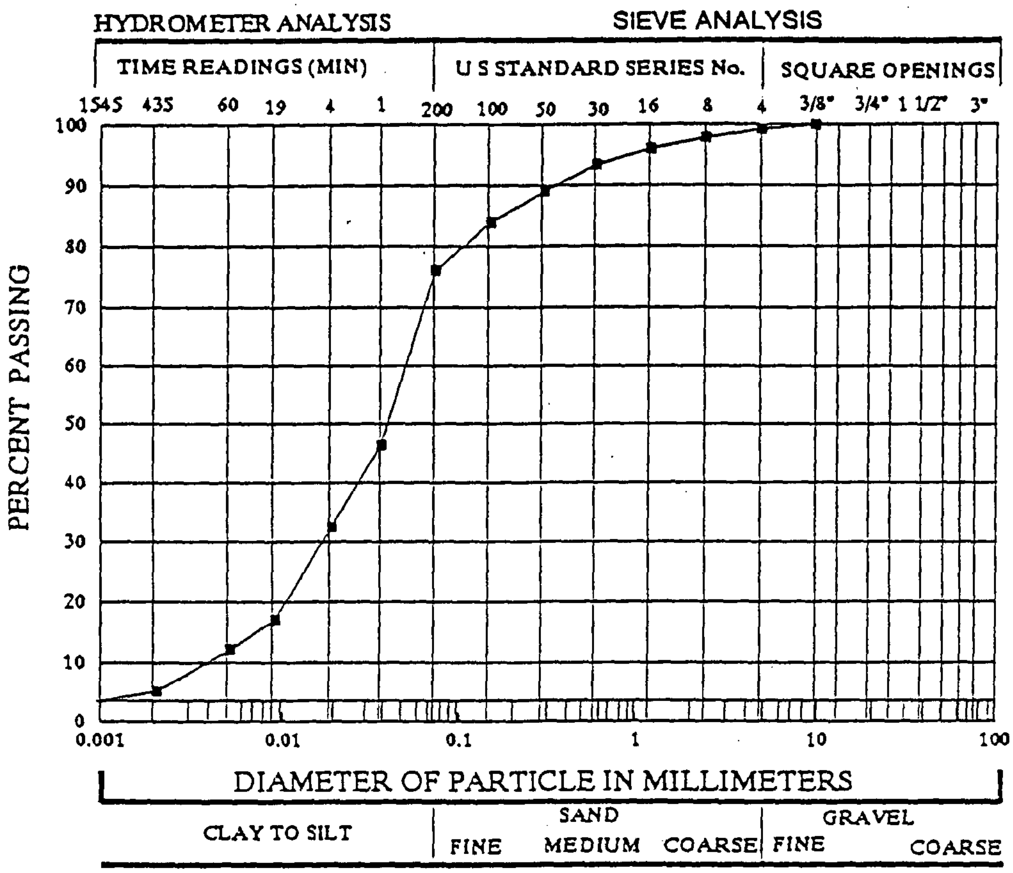
SAMPLE ND–3

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

HYDRO–ENGINEERING

93–4511	HUNTINGDON CHEN–NORTHERN, INC.	MOISTURE–DENSITY RELATIONSHIP	Fig. 6

FIGURE C.2-37. STANDARD PROCTOR RESULTS FOR SAMPLE ND-3.



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	1
SAND	23
FINES (SILT AND CLAY)	76

ATTERBERG LIMITS

LIQUID LIMIT	75
PLASTICITY INDEX	40

SAMPLE ND-3

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

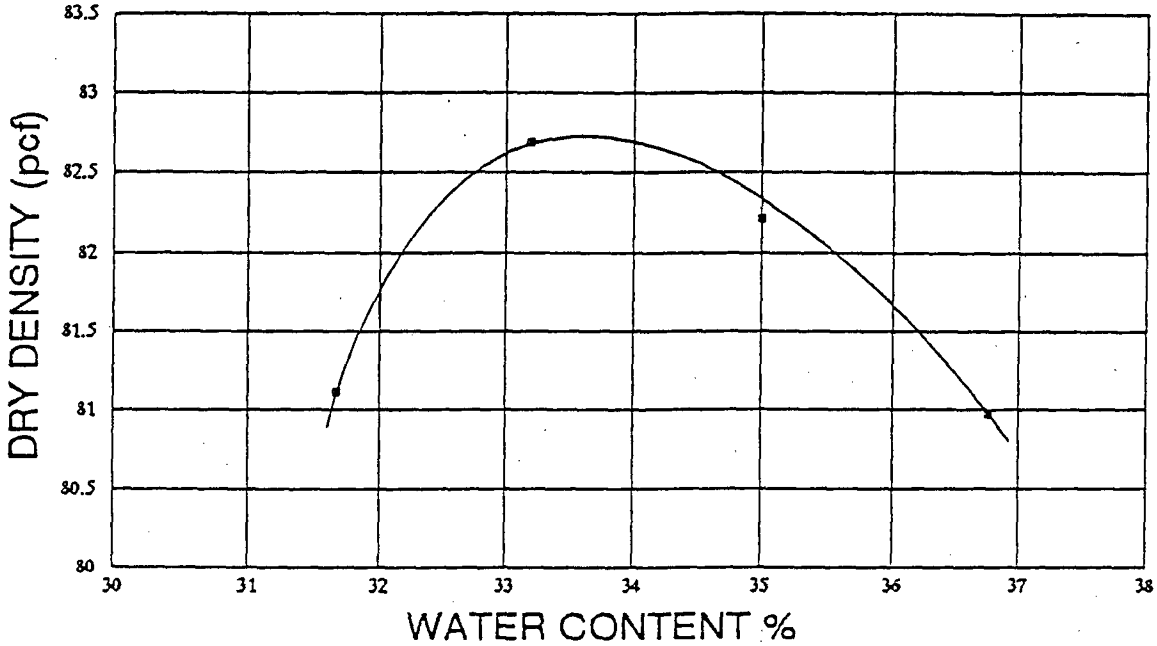
HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 6A

FIGURE C.2-38. GRADATION RESULTS FOR SAMPLE ND-3.

MOISTURE–DENSITY CURVE

ASTM D 698–78 METHOD A



OPTIMUM WATER CONTENT 33.6% MAXIMUM DRY DENSITY 82.7 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	25
FINES (SILT AND CLAY)	75

ATTERBERG LIMITS

LIQUID LIMIT	69
PLASTICITY INDEX	36

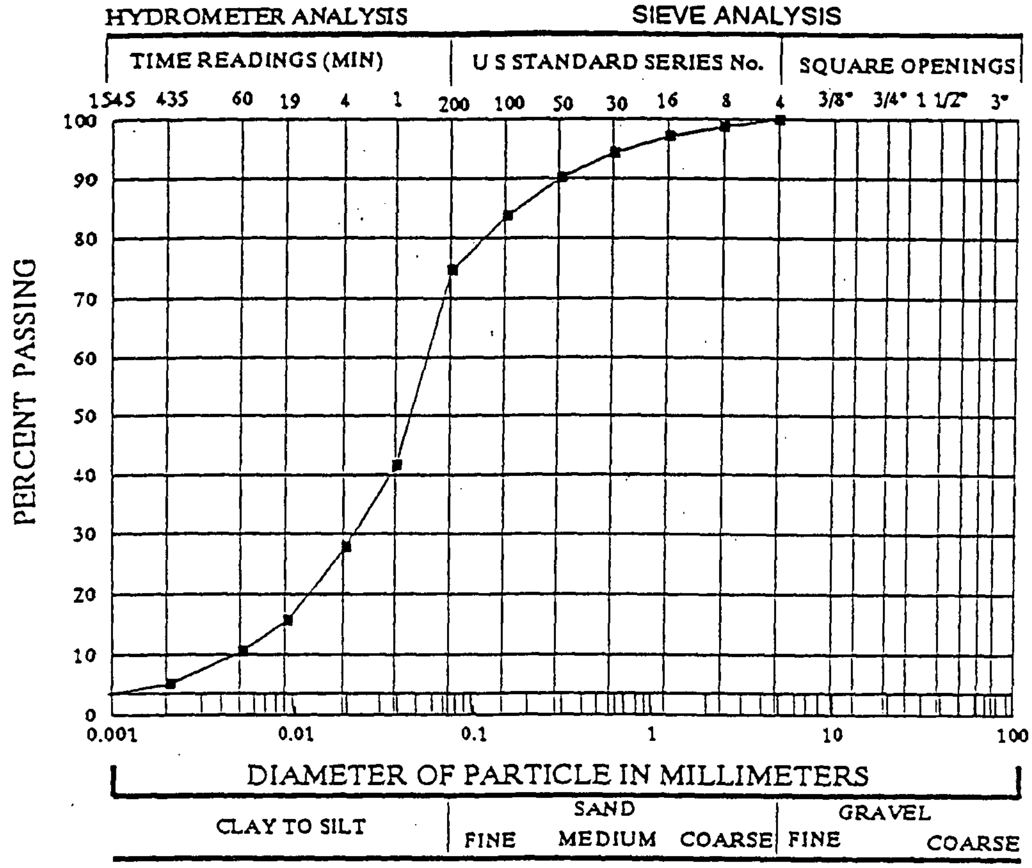
SAMPLE ND–4

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

HYDRO–ENGINEERING

93–4511	HUNTINGDON CHEN–NORTHERN, INC.	MOISTURE–DENSITY RELATIONSHIP	Fig. 7

FIGURE C.2-39. STANDARD PROCTOR RESULTS FOR SAMPLE ND-4.



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	25
FINES (SILT AND CLAY)	75

ATTERBERG LIMITS

LIQUID LIMIT	69
PLASTICITY INDEX	36

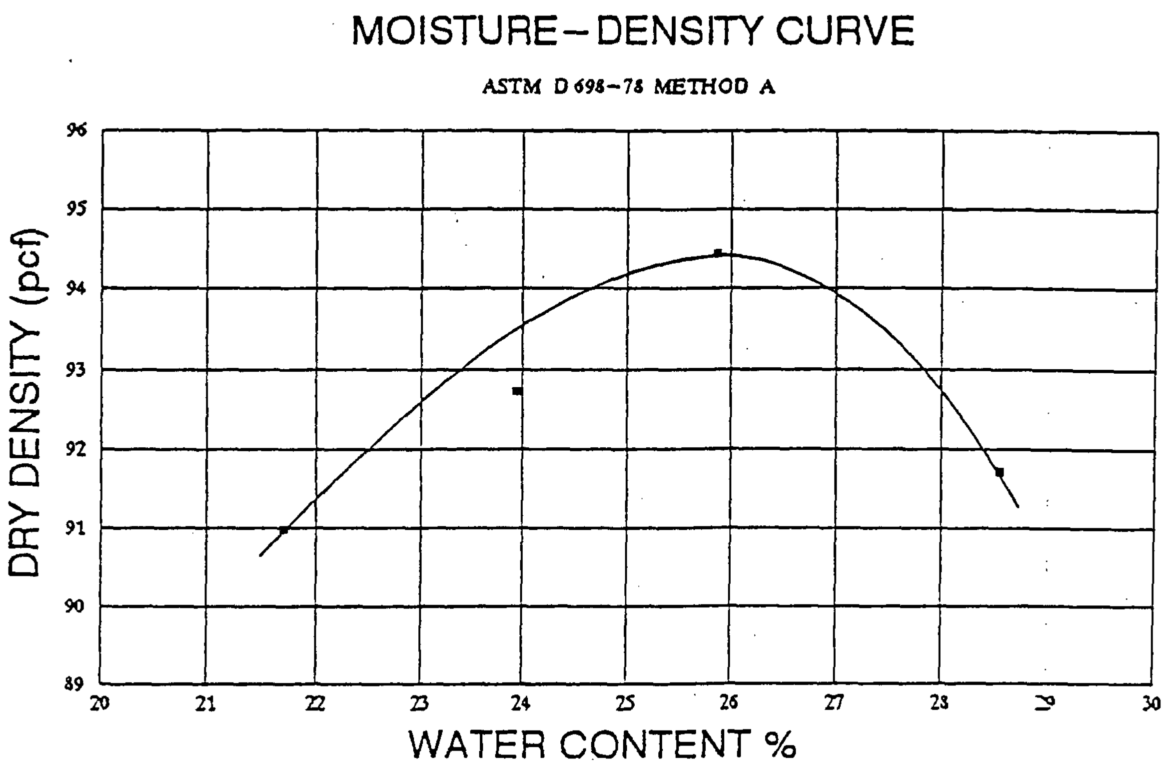
SAMPLE ND-4

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 7A

FIGURE C.2-40. GRADATION RESULTS FOR SAMPLE ND-4.



OPTIMUM WATER CONTENT 25.8% MAXIMUM DRY DENSITY 94.5 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	14
FINES (SILT AND CLAY)	86

ATTERBERG LIMITS

LIQUID LIMIT	61
PLASTICITY INDEX	33

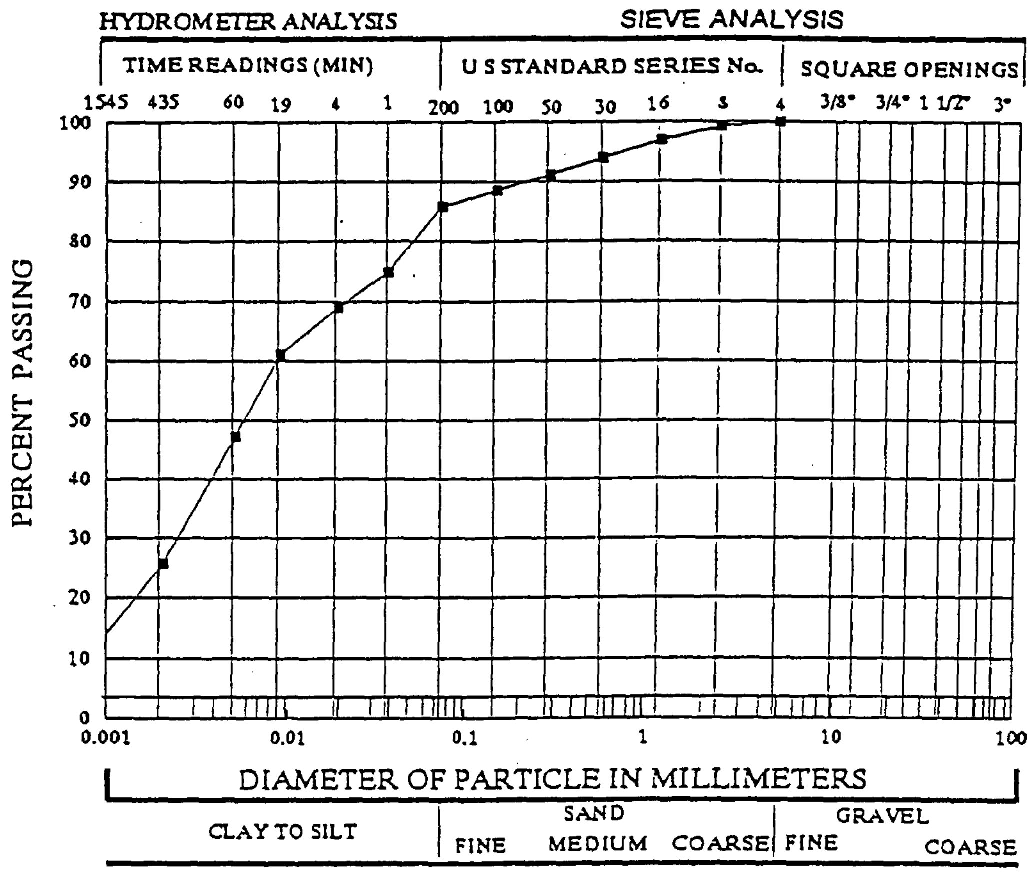
SAMPLE ND-5

SOIL CLASSIFICATION:
LEAN CLAY (CL)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	MOISTURE-DENSITY RELATIONSHIP	Fig. 8

FIGURE C.2-41. STANDARD PROCTOR RESULTS FOR SAMPLE ND-5.



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	14
FINES (SILT AND CLAY)	86

ATTERBERG LIMITS

LIQUID LIMIT	61
PLASTICITY INDEX	33

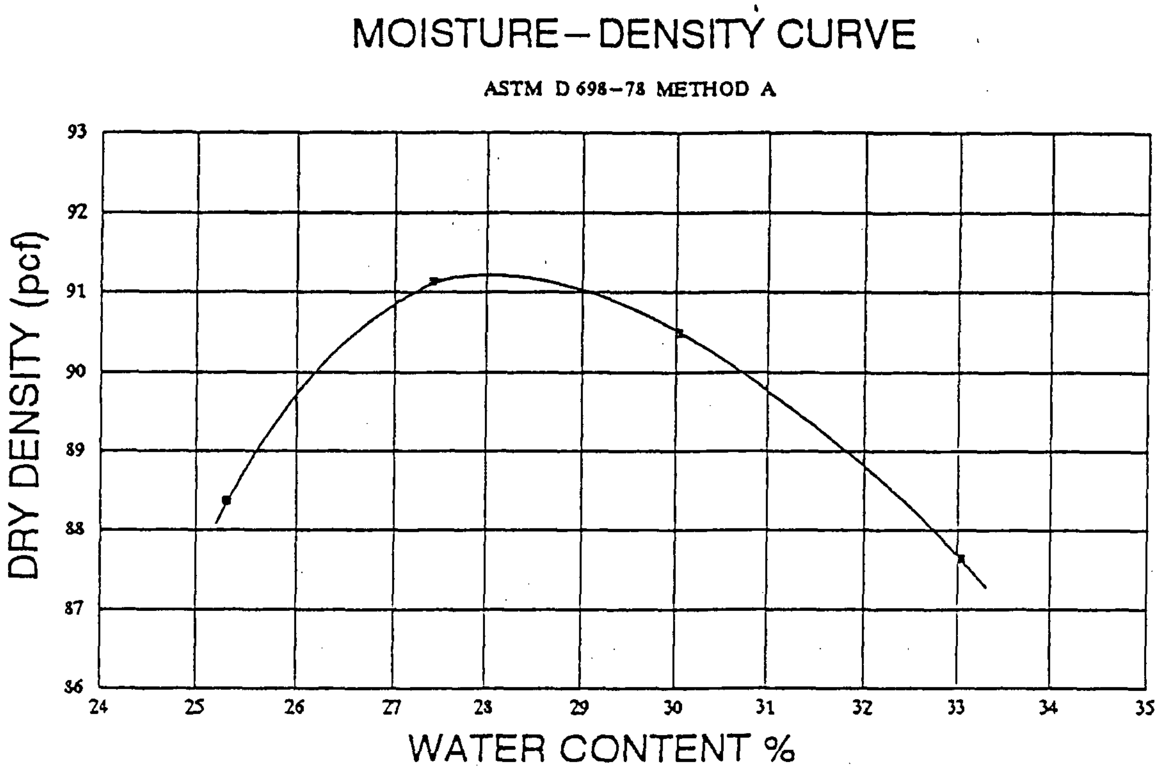
SAMPLE ND-5

SOIL CLASSIFICATION:
LEAN CLAY (CL)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 8A

FIGURE C.2-42. GRADATION RESULTS FOR SAMPLE ND-5.



OPTIMUM WATER CONTENT 28.0% MAXIMUM DRY DENSITY 91.2 pcf

PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	1
SAND	27
FINES (SILT AND CLAY)	72

ATTERBERG LIMITS

LIQUID LIMIT	65
PLASTICITY INDEX	34

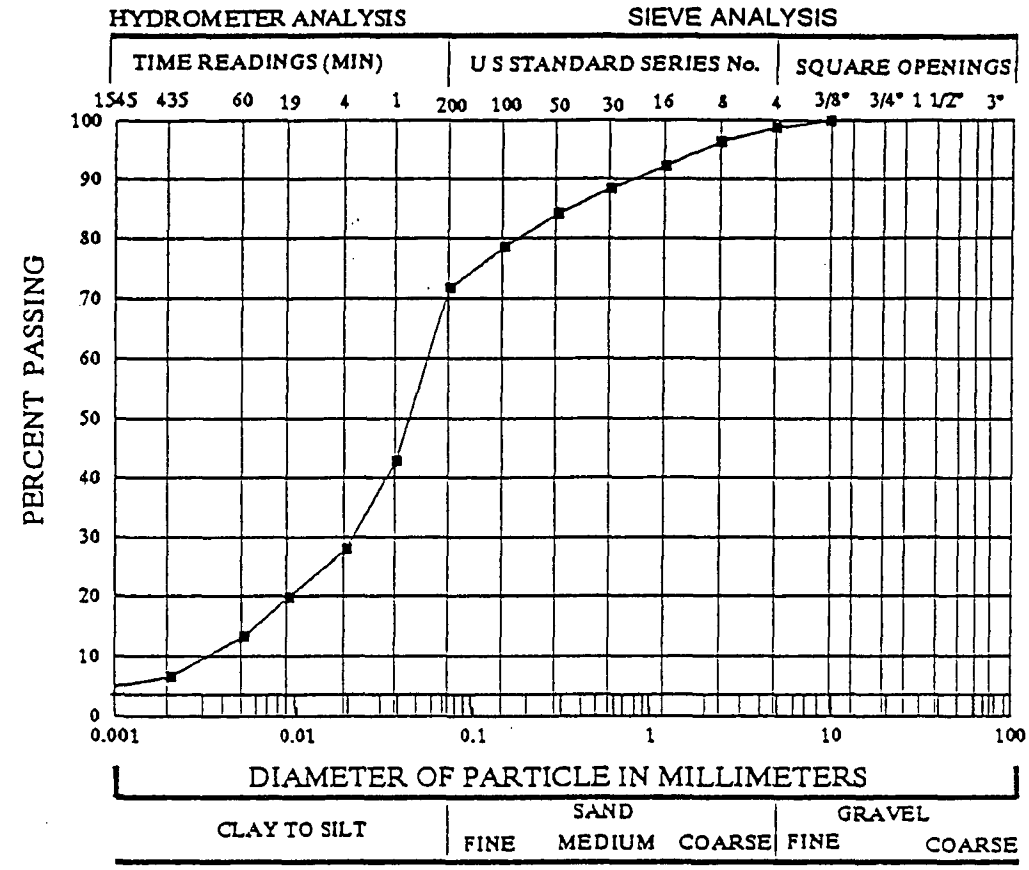
SAMPLE ND–6

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

HYDRO–ENGINEERING

93–4511	HUNTINGDON CHEN–NORTHERN, INC.	MOISTURE–DENSITY RELATIONSHIP	Fig. 9

FIGURE C.2-43. STANDARD PROCTOR RESULTS FOR SAMPLE ND-6.



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	1
SAND	27
FINES (SILT AND CLAY)	72

ATTERBERG LIMITS

LIQUID LIMIT	65
PLASTICITY INDEX	34

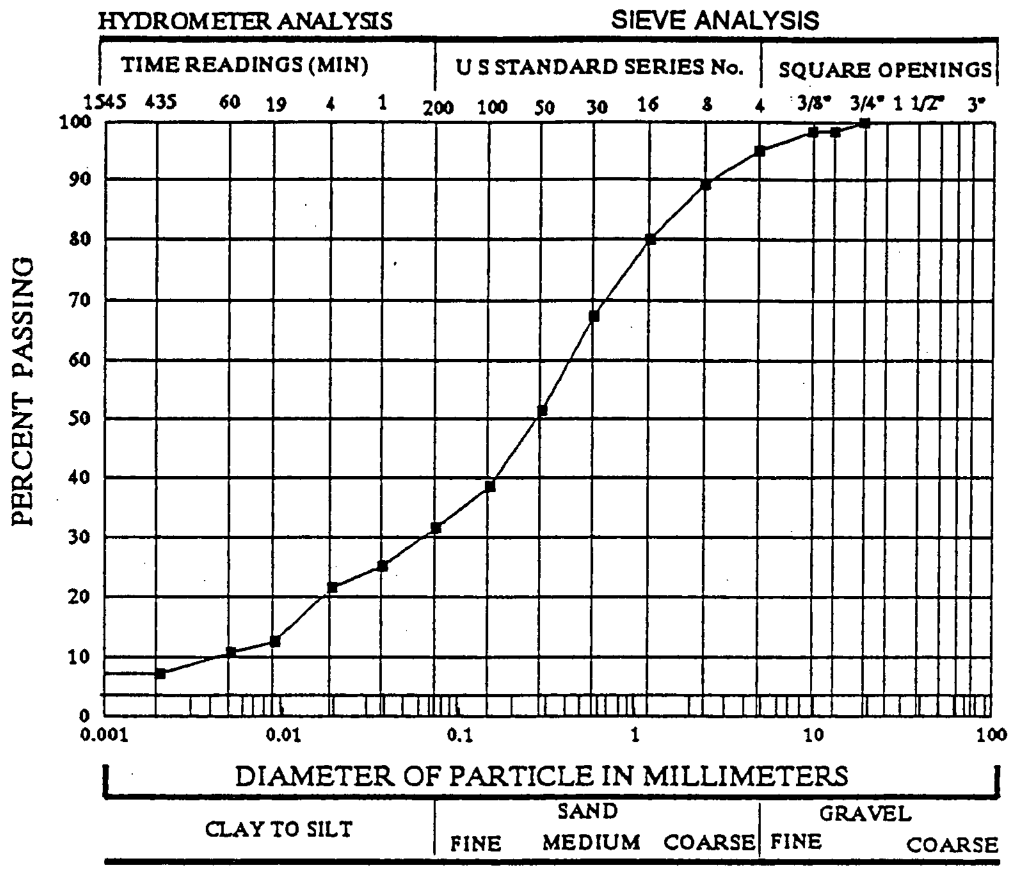
SAMPLE ND-6

SOIL CLASSIFICATION:
LEAN CLAY WITH SAND (CL)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 9A

FIGURE C.2-44. GRADATION RESULTS FOR SAMPLE ND-6.



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	5
SAND	63
FINES (SILT AND CLAY)	32

ATTERBERG LIMITS

LIQUID LIMIT	50
PLASTICITY INDEX	31

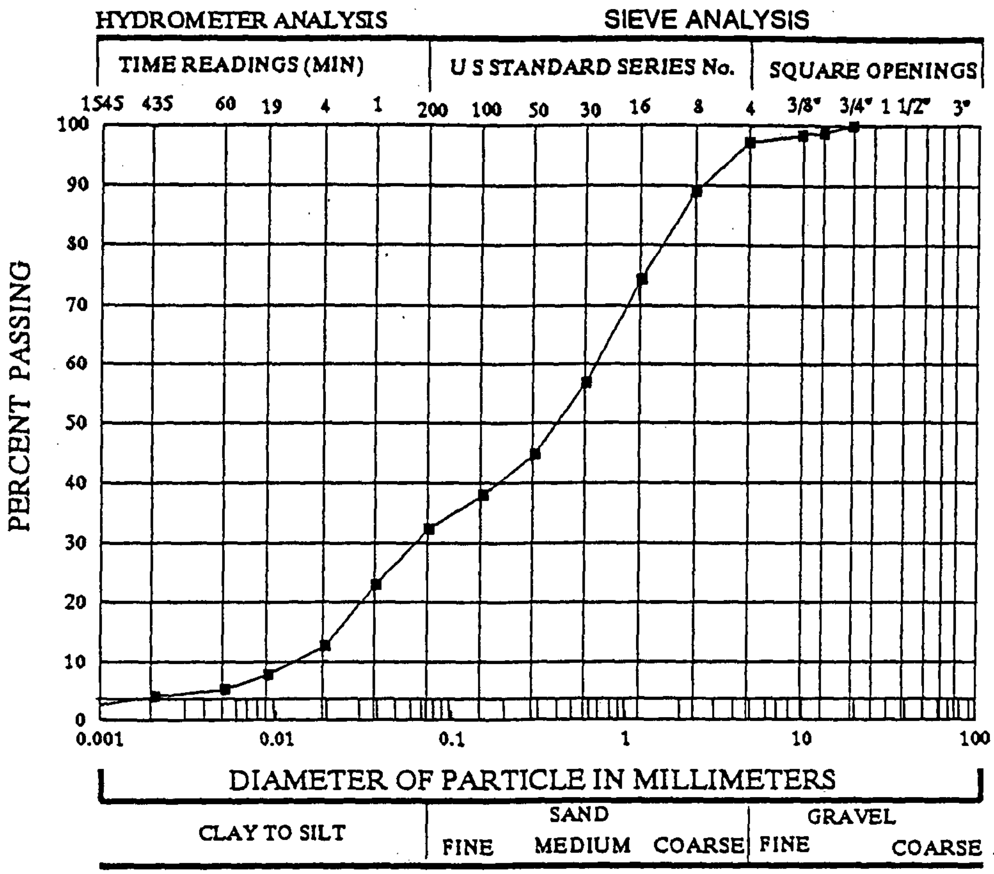
SAMPLE TS-1

SOIL CLASSIFICATION:
SILTY SAND (SM)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS

FIGURE C.3-1. GRADATION RESULTS FOR TOPSOIL SAMPLE TS-1.



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	3
SAND	65
FINES (SILT AND CLAY)	32

ATTERBERG LIMITS

LIQUID LIMIT	37
PLASTICITY INDEX	21

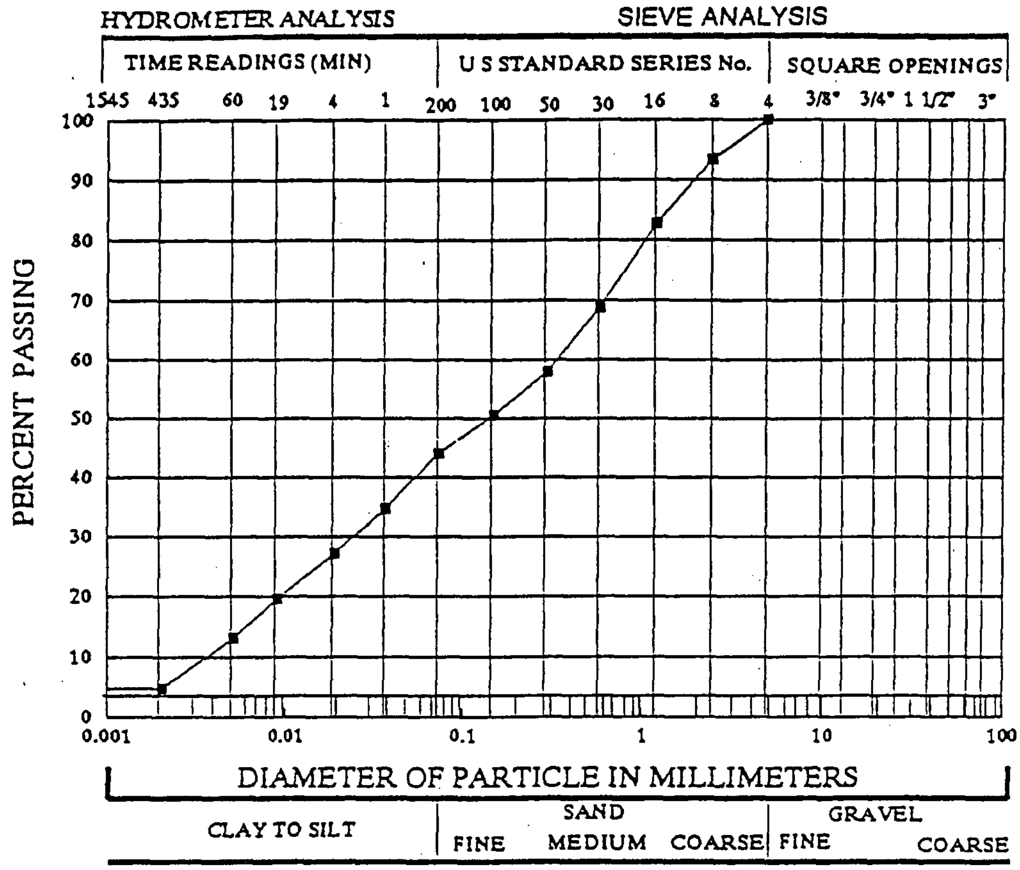
SAMPLE TS-2

SOIL CLASSIFICATION:
SILTY SAND (SM)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS

FIGURE C.3-2. GRADATION RESULTS FOR TOPSOIL SAMPLE TS-2.



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	56
FINES (SILT AND CLAY)	44

ATTERBERG LIMITS

LIQUID LIMIT	48
PLASTICITY INDEX	25

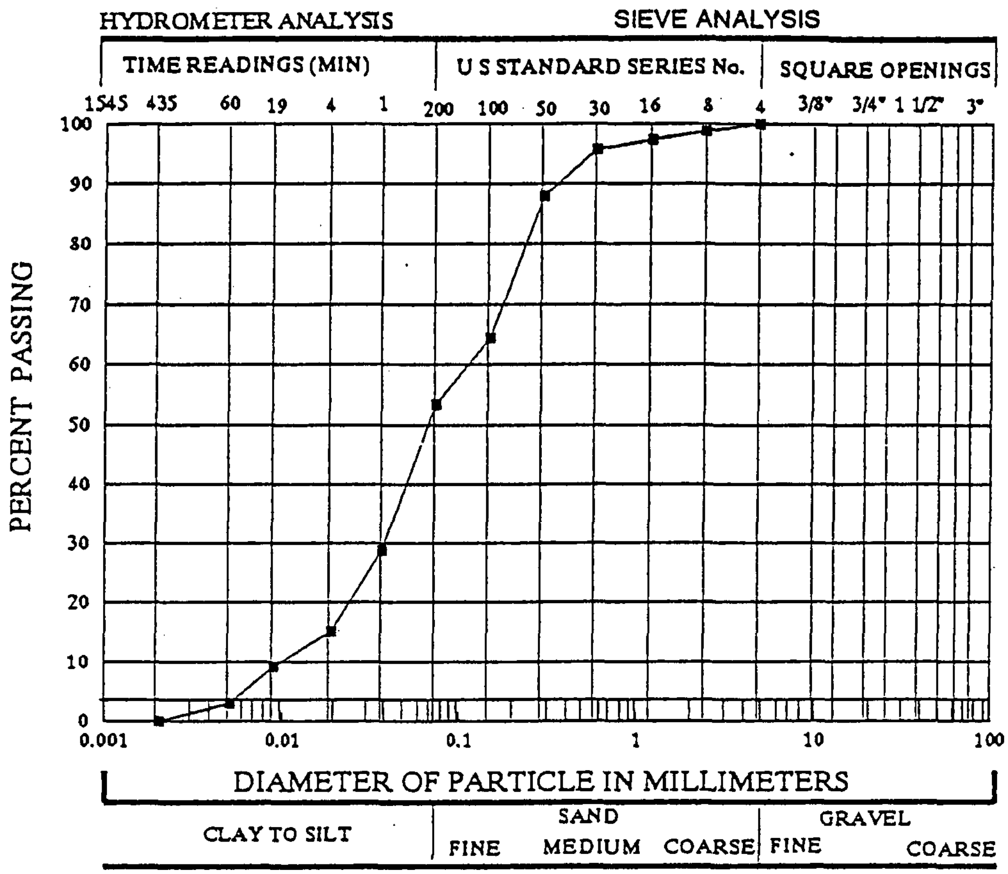
SAMPLE TS-3

SOIL CLASSIFICATION:
CLAYEY SAND (SC)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 4

FIGURE C.3-3. GRADATION RESULTS FOR TOPSOIL SAMPLE TS-3.



PARTICLE SIZE	FRACTION OF SAMPLE (%)
GRAVEL	0
SAND	47
FINES (SILT AND CLAY)	53

ATTERBERG LIMITS

LIQUID LIMIT	52
PLASTICITY INDEX	19

SAMPLE TS-4

SOIL CLASSIFICATION:
SANDY LEAN CLAY (CL)

HYDRO-ENGINEERING

93-4511	HUNTINGDON CHEN-NORTHERN, INC.	GRADATION ANALYSIS	Fig. 5

FIGURE C.3-4. GRADATION RESULTS FOR TOPSOIL SAMPLE TS-4.

TABLE C.4-1. SUMMARY OF ROCK DURABILITY TESTING.

LABORATORY TESTING SUMMARY
HYDRO ENGINEERING

	GRANITE	GRANITE	GRANITE	SANDSTONE
TEST TYPE	ROCK A	ROCK B	ROCK C	ROCK D
Bulk Specific Gravity ASTM C 127-88	2.64	2.64	2.65	2.59
Apparent Specific Gravity ASTM C 127-88	2.65	2.65	2.66	2.76
Bulk SSD Specific Gravity ASTM C 127-88	2.64	2.64	2.65	2.65
Absorption, % ASTM C 127-88	0.12	0.14	0.08	2.47
L.A. Abrasion, 100 Revolutions ASTM C 535-87 Grading 1	2.2	2.8	2.8	4.2
Sulfate Soundness (5 days) ASTM C 88-83	0.04	0.11	0.08	0.18

TABLE C.4-2. PETROGRAPHIC ANALYSIS.

THEODORE P. PASTER, Ph.D.
Consultant
11425 East Cimmarron Drive
Englewood, Colorado 80111
(303) 771-8219

October 15, 1992

Attn:
Thomas G. Michel
Hydro-Engineering
770 East Magnolia
Casper, WY. 82604
FAX: (307) 266-6597

RE: Petrographic Analyses of Two Rock Samples to be used as Riprap Protection on a Uranium Tailings Impoundment.

CONCLUSIONS

TABLE 1 gives a summary of the petrographic ratings of the two samples according to the NRC document excerpts supplied to this investigator:

TABLE 1
Petrographic Rock Sample NRC Ratings

Rock Type	Bulk Composition	Secondary Minerals and Weathering
Granite	Good*, Group 1	Good**, No clays, no weathering rinds.
Sandstone	Not listed	Fair or Poor, clay must be tested further.

* = Table 6.1, NRC document supplied.
** = Table 6.4, NRC document supplied.

There is no question that the granite, sample no. SH-1, has a good rating.

The sandstone, sample no. SH-2, requires further testing if it is even considered for use. A list of the tests follows with a clay mineral identification at the top of the list because the NRC rules clearly state that a smectite-bearing rock is unacceptable:

List of Further Sandstone Tests

1) Identification of clay. (Which is 2.9 ± 1.1% of the sample.)
2) Bulk specific gravity. (The sample contains 5.7 ± 1.5% air.)
3) Absorbtion. (The sample may absorb up to 2% by weight of water because of its nearly 6% porosity.)
4) Freeze-thaw weight loss. (Water saturation may be high due to the 6% porosity.

The quality of the sandstone is highly questionable and not recommended for further testing unless an alternate source is unavailable.

Respectfully submitted:

MINERAL PERCENTAGES IN PROPOSED RIPRAP SAMPLES

TABLE 2
Mineral Percentage of Granite
Sample HE-1
(By 2mm spaced point counting.)

Mineral Phase	counts	%
Quartz	142	30.5 ± 4.2
Microcline	137	29.4 ± 4.2
Plagioclase	160	34.3 ± 4.4
Biotite	26	5.6 ± 1.5
Zircon	0	<0.2
Magnetite	1	0.2
Apatite	0	<0.2
Totals	466	100.0

TABLE 3
Mineral Percentages of Sandstone
Sample HE-2
(By 0.5 mm spaced point counting.)

Mineral Phase	counts	%
Quartz	596	68.6 ± 3.1
Hematite	187	21.5 ± 2.7
Voids	50	5.7 ± 1.5
Clay	25	2.9 ± 1.1
Chert	10	1.1 ± 0.6
Other	2	0.2
Totals	870	100.0

PETROGRAPHIC DESCRIPTIONS

HE-1; Nearly Fresh, Medium-grained Granite with Trace Microfractures.

Granite (99+%):

30.5% Quartz (Q)	1.4-8mm	Strained, amoeboid anhedra with sutured boundaries. Smaller, minor, 0.12mm, rounded blebs encapsulated or included in feldspars.
29.4% Microcline	0.6-4mm	Fresh anhedra have sutured boundaries with surrounding minerals which are predominately Q and finer-grained biotite, feldspars and Q. Contain small euhedral inclusions of sodic plagioclase.
34.3% Plagioclase (Pl, An_{25})	1-5mm	Oligoclase. Tabular subhedra with irregular edges are larger and interstitial to other minerals. Minor, smaller, 0.04-0.5mm, sub-rounded crystals are included in microcline. Slightly composition-zoned as evidenced by selective concentric alteration. Alteration is about 15% disseminated fine-grained sericite > epidote + Q ± chlorite.
5.6% Biotite (Bt)	0.2-2.5mm long	Ragged brown subhedral books usually in clumps interstitial to other silicates. Altered to green variety in some areas of thin section.
0.2% Magnetite (Mt)	0.04-0.6mm	Subhedra associated with Bt and zircon interstitial to larger silicates. Rarely partly replaced by sphene.
tr Zircon(?)	0.3-1mm	Brown, growth-zoned euhedra associated with Bt and Mt along boundaries of larger silicate crystals.
tr Apatite	0.08mm	Stubby prisms in Pl.
tr Hematite	<0.04mm	Red flakes and stain concentrated in altered Pl and along feldspar grain boundaries. Gives pink color to rock.

Microfractures (tr):

Discontinuous, sub-parallel fractures spaced about 1.5 mm and about 1 mm in length. Thickness <0.01mm and appears to contain sericite.

The alteration mentioned in this sample is hydrothermal and not due to weathering. It is not deleterious with regards to the intended use of the rock.

No measurable weathering rind was found on this sample.

<u>HE-2; Quartz Sandstone with Hematite Cement.</u>

Clastic Grains (64%):			
68.6%	Quartz	0.12-0.5mm	Rounded to sub-rounded well-sorted grains.
1.1%	Chert + Chalcedony	0.12-0.4mm	Rounded to sub-rounded grains.
Matrix (30.3%):			
21.5%	Hematite	-	Deep red-brown to red-orange 5u coating on all clastic grains and occasionally fills 0.03mm interstitial areas. may be mixed with minor clay. Cements Q grains together.
5.7%	Voids	0.01-0.4mm	Unfilled areas between clastic grains.
2.9%	Clay	-	Fills some interstitial areas up to 0.2mm in some areas of section - may reflect bedding.
0.2%	Other	0.08mm	Dark green cement grades to hematite which may be chamosite.

This rock has no recognizable weathering rind. It is thin if present. The clay in this rock did not come from weathering of the rock itself. It appears to be derived from outside the rock which suggests some degree of permeability in the rock.

The clay type may be smectite though even if it is, the rock appears to be too porous for the clay to cause any expansive damage. For the same reason (porosity) freeze-thaw damage in the rock is doubtful.

The void content of the rock is 6% by volume which, if filled with water, could cause a weight increase of 2%.

TABLE C.5-1. CRUMB TEST RESULTS
SAMPLE STH-5 (40'-47').

Initial Moisture Condition - Allowed to air dry for 48 hours.

Date	Time	Elapsed Time	pH	Conductivity umho/cm	Temp. °C	Grading & Comments
9/30/93	14:45	0 min.	7.15	6	25°	Sample inserted
	14:47	2 min.	7.70		19.8°	Grade 2 Slight reaction
	15:00	15 min.	7.65		19.5°	Grade 2 Slight reaction
	15:45	60 min.	7.6		19°	Grade 2 Slight reaction
10/1/93	14:45	24 hrs.	7.35	230	19.5°	Grade 1 No reaction

TABLE C.5-2. CRUMB TEST RESULTS
SAMPLE STH-4 (30'-37').

Initial Moisture Condition - Allowed to air dry for 48 hours.

Date	Time	Elapsed Time	pH	Conductivity µmho/cm	Temp. °C	Grading & Comments
9/30/93	14:15	0 min.	7.15	6	25°	Sample inserted
	14:17	2 min.	7.75		20°	Grade 2 Slight reaction
	14:30	15 min.	8.0		19.8°	Grade 2 Slight reaction
	15:15	60 min.	7.71		19°	Grade 2 Slight reaction
10/1/93	14:15	24 hrs.	7.35	225	19°	Grade 1 No reaction

TABLE C.5-3. CRUMB TEST RESULTS
SAMPLE STH-2 (60'-67').

Initial Moisture Condition - Allowed to air dry for 48 hours.

Date	Time	Elapsed Time	pH	Conductivity umho/cm	Temp. °C	Grading & Comments
9/30/93	14:00	0 min.	7.15	6	25°	Sample inserted
	14:02	2 min.	7.75		24°	Grade 1 No reaction
	14:15	15 min.	7.55		20°	Grade 1 No reaction
	15:00	60 min.	7.5		19.5°	Grade 1 No reaction
10/1/93	14:00	24 hrs.	7.35	200	19.5°	Grade 1 No reaction

TABLE C.5-4. CRUMB TEST RESULTS
SAMPLE STH-6 (20'-27').

Initial Moisture Condition - Allowed to air dry for 48 hours.

Date	Time	Elapsed Time	pH	Conductivity umho/cm	Temp. °C	Grading & Comments
9/30/93	14:30	0 min.	7.15	6	25°	Sample inserted
	14:32	2 min.	7.70		19.8°	Grade 3 Moderate reaction
	14:45	15 min.	7.82		19.8°	Grade 3 Moderate reaction
	15:30	60 min.	7.7		19°	Grade 2 Slight reaction
10/1/93	14:30	24 hrs.	7.4	185	19°	Grade 2 Slight reaction

APPENDIX D

LABORATORY REPORTS - RADIOLOGICAL AND RADON EMANATION PROPERTIES

APPENDIX D

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D.1 APPENDIX D TEXT

This appendix contains copies of laboratory analysis results provided by the analyzing laboratory. Emanation coefficient results are also included. Emanation coefficients were analyzed by Energy Laboratories Inc. of Casper, Wyoming under the direction of Roger Garling. The procedure used is that described in Nielson and others (1982), and was summarized by lab personnel as follows:

> Samples were initially placed in a vacuum for removal of Rn-222. Initial counts were made after allowing unsupported Rn-222 daughters to decay out of the sealed sample. Final counts were preformed after allowing sufficient time for the Ra-226, Rn-222 and daughters to reach secular equilibrium.

TABLE D-1. SOIL ANALYSIS FOR TEST HOLES TW4-2C (40'-42'), TW4-1B (25'-27'), TW4-5B (5.5'-8'), TW5-2B (3'), TW5-1B (4'-6'), TW4-1B (3'-5'), TW4-4B (5'-7'), AND TW4-1C (3'-5').

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SOIL ANALYSIS REPORT - PATHFINDER MINES CORP

Project: Shirley Basin

SOIL ANALYSIS REPORT - PATHFINDER MINES CORPORATION

Project: Shirley Basin

Report Date: 04/01/93

LAB I.D.	SAMPLE/ I.D.	DEPTH, FT.	U-Nat pCi/g	Ra226 (Chemical) pCi/g	Net CPM 1 A°	Net CPM 2 A∞	(A∞ - A°)/A∞ 3
93-7679	TW4-2C	40'-42'	0.6	1557 ± 3.0	3299	3312	0.0041
93-7680	TW4-1B	25'-27'	0.6	728 ± 2.1	2827	2874	0.0166
93-7681	TW4-5B	5-1/2'-8'	0.6	172 ± 1.0	383	475	0.1934
93-7682	TW5-2B	3'	0.6	20 ± 0.3	89	96	0.0699
93-7683	TW5-1B	4'-6'	0.6	47 ± 0.5	192	214	0.1005
93-7684	TW4-1B	3'-5'	0.7	63.3 ± 0.6	474	553	0.1423
93-7685	TW4-4B	5'-7'	0.7	58 ± 0.6	419	444	0.0552
93-7686	TW4-1C	3'-5'	0.6	53.6 ± 0.6	449	513	0.1246

[1] A° - Net CPM after de-emanation - (Initial Activity)
[2] A∞ - Net CPM after full ingrowth - (Final Activity)
[3] (A∞ - A°)/A∞ Radon Emanation Coefficient

Report Approved By: R.A. Searling
kmk

TABLE D-2. SOIL RECHECK FOR TEST HOLES TW4-2C (40'-42'), TW4-1B (25'-27'), TW4-5B (5.5'-8'), AND TW5-2B (3').

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SOIL ANALYSIS REPORT - PATHFINDER MINES CORP

Project: Shirley Basin

SOIL ANALYSIS REPORT - PATHFINDER MINES CORPORATION

Project: Shirley Basin

Report Date: 06/10/93

LAB I.D.	SAMPLE/ I.D.	DEPTH, FT.	U-Nat pCi/g	Ra226 (Chemical) pCi/g	Net CPM 1 A°	Net CPM 2 A∞	(A∞ - A°)/A∞ 3
93-7679	TW4-2C	40'-42'	0.6	1557 ± 3.0	3299	3312	0.0041
	Recheck - 06-10-93 20% Moisture - R.E.C.				2664	2918	0.0870
93-7680	TW4-1B	25'-27'	0.6	728 ± 2.1	2827	2874	0.0166
	Recheck - 06-10-93 20% Moisture - R.E.C.				1924	2267	0.1513
93-7681	TW4-5B	5-1/2'-8'	0.6	172 ± 1.0	383	475	0.1934
	Recheck - 06-10-93 6% Moisture - R.E.C.				330	367	0.0990
93-7682	TW5-2B	3'	0.6	20 ± 0.3	89	96	0.0699
	Recheck - 06-10-93 6% Moisture - R.E.C.				64.9	64.9	0.0000
93-7683	TW5-1B	4'-6'	0.6	47 ± 0.5	192	214	0.1005
93-7684	TW4-1B	3'-5'	0.7	63.3 ± 0.6	474	553	0.1423
93-7685	TW4-4B	5'-7'	0.7	58 ± 0.6	419	444	0.0552
93-7686	TW4-1C	3'-5'	0.6	53.6 ± 0.6	449	513	0.1246

1 A° - Net CPM after de-emanation - (Initial Activity)
2 A∞ - Net CPM after full ingrowth - (Final Activity)
3 (A∞ - A°)/A∞ Radon Emanation Coefficient

R.E.C. = Radon Emanation Coefficient

Report Approved By: R.A. Lealing
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TABLE D-3. SOIL ANALYSIS FOR TEST HOLES TW5-3B (6'-8').AND TW5-1B (6'-8').

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SOIL ANALYSIS REPORT - PATHFINDER MINES CORPORATION

Project: Shirley Basin

Report Date: 04/19/93

LAB I.D.	SAMPLE/ I.D.	DEPTH, FT.	Ra226 (Chemical) pCi/g	Net CPM 1 A°	Net CPM 2 $A\infty$	$(A\infty - A^\circ)/A\infty$ 3
93-8403	TW5-3	6'- 8'	54.7 ± 0.6	165	169	0.0254
93-8404	TW5-1B	6'- 8'	51.8 ± 0.6	136	152	0.1084

1 A° - Net CPM after de-emanation - (Initial Activity)
2 $A\infty$ - Net CPM after full ingrowth - (Final Activity)
3 $(A\infty - A^\circ)/A\infty$ Radon Emanation Coefficient

Report Approved By: R.A. Sarling
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TABLE D-4. SOIL ANALYSIS FOR TAILINGS SAMPLES BP-1 THROUGH BP-12.

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SOIL ANALYSIS REPORT - PATHFINDER MINES - SHIRLEY BASIN

Report Date: 08/17/93

LAB I.D.	SAMPLE I.D.	Ra226 (Chemical)	Net CPM [1] A°	Net CPM [2] A∞	(A∞ - A°)/A∞ [3]	% Moisture
93-24405	BP-1	214 ± 1.6				
93-24406	BP-2	34.6 ± 0.7				
93-24407	BP-3	66.0 ± 1.2				
93-24408	BP-4	102 ± 1.1	252.2	257.9	0.0221	24.14
93-24409	BP-5	55.0 ± 0.8				
93-24410	BP-6	438 ± 2.3				
93-24411	BP-7	206 ± 1.6				
93-24412	BP-8	481 ± 2.5				
93-24413	BP-9	394 ± 2.2	867.5	1039.9	0.1658	19.68
93-24414	BP-10	414 ± 2.3				
93-24415	BP-11	737 ± 3.0	1683.5	1689.2	0.0034	19.15
93-24416	BP-12	565 ± 2.6				

[1] A° - Net CPM after de-emanation
[2] A∞ - Net CPM after full ingrowth
[3] (A∞ - A°)/A∞ Radon Emanation Coefficient @ 20% Moisture Content

Report Approved By: *[signature]*
kmk e324405.pmc

TABLE D-5. SOIL ANALYSIS FOR PIT SAMPLES P4-12B (18"-24"), P4-12B (78"-84"), P4-12C (24"-30"), P4-10A (0"-6"), P4-10A (78"-84"), P4-6A (60"), P4-8A (24"-30"), P4-5D (42"-48"), P4-12B (36"-42"), P4-12C (6"-12"), P4-12C (48"-54"), P4-12A (36"-42"), P4-8B (48"), P4-8A (0"-6"), P4-5D (36"-42"), P4-4D (36"-42"), P4-12B (48"-54"), P4-12B (72"-78"), O-1 (90"-96"), O-2 (108"-114"), O-2 (66"-72), P4-12C (72"-78"), P3-1 (0"-6"), AND P3-1 (48"-54").

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PATHFINDER MINES CORPORATION - SHIRLEY BASIN
SOIL ANALYSIS REPORT

Date Submitted: 11-24-92
Date Received: 11-24-92
Report Date: 01-19-92
Analyst: DB

LAB I.D.	Sample I.D.	Sample Depth	Corr.	U-Nat pCi/g	Ra226 pCi/g	Ra226 Prec.+/-	A° Initial Activity	A∞ Final Activity	Radon Emanation (A∞ - A°)/A∞
92-46510	P4-12B	18-24"			1.7	0.1			
92-46511	P4-12B	78-84"			0.3	0.1			
92-46512	P4-12C	24-30"			30.9	0.6			
92-46513	P4-10A	0-6"			29.9	0.6			
92-46514	P4-10A	78-84"			1.9	0.1			
92-46515	P4-6A	60"			1.0	0.1			
92-46516	P4-8A	24-30"			40.0	0.7			
92-46517	P4-5D	42-48"			4.7	0.1			
92-46518	P4-12B	36-42"			9.6	0.4			
92-46519	P4-12C	6-12"			4.2	0.1			
92-46520	P4-12C	48-54"			23.8	0.5			
92-46521	P4-12A	36-42"			93.5	1.0			
92-46522	P4-8B	48"			105	1.1			
92-46523	P4-8A	0-6"			65.8	0.9			
92-46524	P4-5D	36-42"			1157	3.4			
92-46525	P4-4D	36-42"			68.7	0.9			
92-46526	P4-12B	48-54"		20.4	2.1	0.1			
92-46527	P4-12B	72-78"		2.3	4.2	0.2			
92-46528	O-1	90-96"	7.40	43.5	15.0	0.4	38.2	45.1	0.153
92-46529	O-2	108-114"	2.97	158	194	1.4	144	173	0.166
92-46530	O-2	66-72"			32.2	0.6	115	130	0.113
92-46531	P4-12C	72-78"		11.9	1.8	0.1			
92-46532	P3-1	0-6"		1.2	14.9	0.4			
92-46533	P3-1	48-54"		1.6	1.9	0.1			

REPORT APPROVED BY: R.A. Leaning
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TABLE D-6. SOIL ANALYSIS FOR PIT SAMPLES P4-8A (48"-54"), P4-8A (60"-66"), AND P4-8A (78"-84").

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SOIL ANALYSIS - PATHFINDER MINES - SHIRLEY BASIN

Sample I.D.:	P4 8A 48-54	P4 8A 60-66	P4 8A 78-84
Sample Date:	12-92	12-92	12-92
Report Date:	01-10-93	01-10-93	01-10-93
Sample Number:	93-47270	92-47271	92-47272

RADIOMETRIC pCi/g:

Ra226	1.0	0.4	0.3
Ra Prec. +/-	0.2	0.1	0.1

Report Approved By: R.A. [signature]
kmk

TABLE D-7. SOIL ANALYSIS FOR CLAY BORROW AND GAMMA SURVEY SAMPLES STH-6 (20'-27'), NTH-1 (60'-67'), STH-5 (40'-47'), AND G5-1 THROUGH G5-14.

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SOIL ANALYSIS REPORT - PATHFINDER MINES - SHIRLEY BASIN MINE

Date Submitted: 06-18-93
Date Received: 06-18-93
Report Date: 07-12-93

LAB I.D.	Sample Date	Sample Identification	Ra226 Gamma pCi/g	Ra226 Prec.+/-
93-23065	---	STH-6 20-27'	2.05	0.13
93-23066	---	NTH-1 60-67'	2.99	0.15
93-23067	---	STH-5 40-47'	2.26	0.14
93-23068	---	G5 - 1	1.06	0.10
93-23069	---	G5 - 2	12.2	0.31
93-23070	---	G5 - 3	5.20	0.21
93-23071	---	G5 - 4	7.63	0.33
93-23072	---	G5 - 5	140	1.09
93-23073	---	G5 - 6	68.8	0.77
93-23074	---	G5 - 7	11.0	0.38
93-23075	---	G5 - 8	9.66	0.40
93-23076	---	G5 - 9	20.2	0.57
93-23077	---	G5 - 10	19.8	0.56
93-23078	---	G5 - 11	3.61	0.24
93-23079	---	G5 - 12	2.18	0.19
93-23080	---	G5 - 13	52.5	1.59
93-23081	---	G5 - 14	140	1.49

** G5 prefix corresponds to GS prefix throughout text.

Report Approved by: R.A. Leaching

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TABLE D-8. SOIL ANALYSIS FOR BACKGROUND SAMPLES BGS-1 THROUGH BGS-4.

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SOIL ANALYSIS REPORT - HYDRO ENGINEERING

Project: PMC - SB

Sample I.D.:	BGS-1	BGS-2	BGS-3	BGS-4	
Sample Date:	NSD	NSD	NSD	NSD	
Report Date:	07-19-93	07-19-93	07-19-93	07-19-93	
Sample Number:	93-23760	93-23761	93-23762	93-23763	Det.Limit
RADIOMETRIC pCi/g:					
Ra226	0.32	0.35	0.43	0.48	0.2
Ra Prec. +/-	0.04	0.04	0.04	0.04	

REPORT APPROVED BY: R.A. Lading

tld s323760.he

APPENDIX E

HYDROGRAPHS

APPENDIX E

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TABLE E-1. HEC-1 INPUT AND FLOW PATH FOR TAILINGS DISCHARGING TO AREA 2/8 AND SOUTH DRAINAGES.

```
ID PATHFINDER, TAILINGS ROUTED TO 2/8 RESERVOIR THROUGH CONTROL
ID BASED UPON PMF- RAINFALL OF 9.03 IN. COMPUTATION OF 1.0 MINUTE INCREMENTS
ID DATE=4-18-96
*FREE
*DIAGRAM
IT 1.0,,,300,,
IO 5,1
IN 1,,
PG HMR55
PC .0000,.0321,.0658,.1011,.1381,.1766,.2167,.2585,.3041,.3499,
PC .3959,.4423,.4900,.5400,.5939,.6535,.7211,.7994,.8913,1.0003,
PC 1.1301,1.2848,1.4691,1.6878,1.9462,2.2499,2.6051,3.0181,3.4957,4.2583,
PC 5.1498,5.7341,6.1786,6.5618,6.8905,7.1708,7.4087,7.6095,7.7784,7.9202,
PC 8.0390,8.1390,8.2237,8.2963,8.3597,8.4162,8.4679,8.5166,8.5635,8.6096,
PC 8.6555,8.7012,8.7467,8.7876,8.8269,8.8647,8.9008,8.9353,8.9682,8.9995,
PC 9.0300
KK DM-2
KO 0,,,,21,1,100
BA .043
PR HMR55
LS 0,91
UD .1805
KK DM-3
KO 0,,,,21,1,100
BA .029
PR HMR55
LS 0,91
UD .1243
KK DM-4
KO 0,,,,21,1,100
BA .034
PR HMR55
LS 0,91
UD .1019
KK DM-6
KO 0,,,,21,1,100
BA .0078
PR HMR55
LS 0,91
UD .0788
KK DM-6A
KO 0,,,,21,1,100
BA .010
PR HMR55
LS 0,91
UD .0731
KK INDUST_POND
KO 0,,,,21,1,300
HC 5
KK IND_POND_CONTROL
KO 0,,,,21,1,300
RS 1,STOR,0,0
SA 3.03 3.51 3.95 4.42 4.92 5.45 6.23 7.09 7.90
SQ 0 15.5 57 126 273 438 710 1002 1358
SE 0 1 2 3 4 5 6 7 8
KK DM-5
```

TABLE E-1. HEC-1 INPUT AND FLOW PATH FOR TAILINGS DISCHARGING TO AREA 2/8 AND SOUTH DRAINAGES (continued).

```
KO 0,,,,21,1,100
BA .035
PR HMR55
LS 0,91
UD .0777
KK INDUST_POND_AREA
KO 0,,,,21,1,300
HC 2
KK BELOW_IND_POND
KO 0,,,,21,1,300
RS 1,STOR,0,0
SA 0 0.77 1.31 2.88 3.86 5.10 6.52
SQ 0 21.7 68 143 280 478 763
SE 0 1.2 2.2 3.2 4.2 5.2 6.2
KK DM-1
KO 0,,,,21,1,100
BA .017
PR HMR55
LS 0,91
UD .0376
KK SOUTH_DRAIN
KO 0,,,,21,1,300
HC 2
KK DM-8
KO 0,,,,21,1,100
BA .007
PR HMR55
LS 0,91
UD .1295
KK DM-7
KO 0,,,,21,1,100
BA .012
PR HMR55
LS 0,91
UD .1425
KK DM-7+DM-8
KO 0,,,,21,1,300
HC 2
KK D4-5
KO 0,,,,21,1,100
BA .038
PR HMR55
LS 0,87
UD .1280
KK DM-7_D4-5
KO 0,,,,21,1,300
HC 2
KK ROUTE_D4-5
KO 0,,,,21,1,300
RS 1,STOR,0,0
SA 0 0.80 1.5
SQ 0 50 200
SE 0 0.5 1.0
KK D4-3
KO 0,,,,21,1,100
BA .045
```

TABLE E-1. HEC-1 INPUT AND FLOW PATH FOR TAILINGS DISCHARGING TO AREA 2/8 AND SOUTH DRAINAGES (continued).

```
PR HMR55
LS 0,86
UD .1954
KK INT_COLL
KO 0,,,,21,1,300
HC 2
KK D5-2A
KO 0,,,,21,1,100
BA .026
PR HMR55
LS 0,91
UD .098
KK BASIN D5-2 CONTROL
KO 0,,,,21,1,180
RS 1,STOR,0,0
SA 0 0.82 3.20 3.62 3.78 3.95
SQ 0 2 4 9.9 25 114
SE 0 1 2 3 4 5
KK D5-2B
KO 0,,,,21,1,150
BA .008
PR HMR55
LS 0,87
UD .057
KK TOTAL D5-2
KO 0,,,,21,1,150
HC 2
KK D4-1
KO 0,,,,21,1,150
BA .039
PR HMR55
LS 0,91
UD .2774
KK D4-2
KO 0,,,,21,1,150
BA .0210
PR HMR55
LS 0,85
UD .1021
KK D4-1&2
KO 0,,,,21,1,150
HC 2
KK D4-4
KO 0,,,,21,1,150
BA .044
PR HMR55
LS 0,91
UD .0497
KK D4-6
KO 0,,,,21,1,150
BA .051
PR HMR55
LS 0,91
UD .0953
KK D3-1
KO 0,,,,21,1,150
```

TABLE E-1. HEC-1 INPUT AND FLOW PATH FOR TAILINGS DISCHARGING TO AREA 2/8 AND SOUTH DRAINAGES (continued).

```
BA .051
PR HMR55
LS 0,89
UD .1121
KK WEST_TAILS
KO 0,,,,21,1,300
HC 6
KK AREA-28-CONTROL
KO 0,,,,21,1,300
RS 1,STOR,0,0
SA 1 4.09 7.26 10.06 13.25 16.83 19.41 22.40 25.23
SQ 0 2.25 14.1 41.7 90 163 265 400 570
SE 0 1 2 3 4 5 6 7 8
ZZ
```

TABLE E-1. HEC-1 INPUT AND FLOW PATH FOR TAILINGS DISCHARGING TO AREA 2/8 AND SOUTH DRAINAGES.

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW
LINE
NO.       (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

 15       DM-2
             .
             .
 21          .        DM-3
             .           .
             .           .
 27          .           .        DM-4
             .           .           .
             .           .           .
 33          .           .           .        DM-6
             .           .           .           .
             .           .           .           .
 39          .           .           .           .       DM-6A
             .           .           .           .           .
             .           .           .           .           .
 45   INDUST_POND.............................................
             V
             V
 48   IND_POND_CONTROL
             .
             .
 54          .        DM-5
             .           .
             .           .
 60   INDUST_POND_AREA....
             V
             V
 63   BELOW_IND_POND
             .
             .
 69          .        DM-1
             .           .
             .           .
 75   SOUTH_DRAIN.........
             .
             .
 78          .        DM-8
             .           .
             .           .
 84          .           .        DM-7
             .           .           .
             .           .           .
 90          .   DM-7+DM-8............
             .           .
             .           .
 93          .           .        D4-5
             .           .           .
             .           .           .
```

 (Revised 05/20/96)

TABLE E-1. HEC-1 INPUT AND FLOW PATH FOR TAILINGS DISCHARGING TO AREA 2/8 AND SOUTH DRAINAGES.

```
 99       .   DM-7_D4-5...........
          .         V
          .         V
102       .   ROUTE_D4-5
          .         .
          .         .
108       .         .          D4-3
          .         .             .
          .         .             .
114       .   INT_COLL............
          .         .
          .         .
117       .         .         D5-2A
          .         .             V
          .         .             V
123       .         .         BASIN D5-2 CONTROL
          .         .             .
          .         .             .
129       .         .             .       D5-2B
          .         .             .           .
          .         .             .           .
135       .         .         TOTAL D5-2.......
          .         .             .
          .         .             .
138       .         .             .        D4-1
          .         .             .           .
          .         .             .           .
144       .         .             .           .        D4-2
          .         .             .           .           .
          .         .             .           .           .
150       .         .             .      D4-1&2............
          .         .             .           .
          .         .             .           .
153       .         .             .           .        D4-4
          .         .             .           .           .
          .         .             .           .           .
159       .         .             .           .           .        D4-6
          .         .             .           .           .           .
          .         .             .           .           .           .
165       .         .             .           .           .           .        D3-1
          .         .             .           .           .           .           .
          .         .             .           .           .           .           .
171       .      WEST_TAILS.......................................................
          .         V
          .         V
174       .   AREA-28-CONTROL
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

TABLE E-2. HEC-1 INPUT AND FLOW PATH FOR TAILINGS DISCHARGING TO THE EAST.

```
ID PATHFINDER, TAILINGS ROUTED TO EAST THROUGH CONTROL
ID BASED UPON PMF- RAINFALL OF 9.03 IN. COMPUTATION OF 1.0 MINUTE INCREMENTS
ID DATE=9-1-93
*FREE
*DIAGRAM
IT 1.0,,,300,,
IO 5,1
IN 1,,
PG HMR55
PC .0000,.0321,.0658,.1011,.1381,.1766,.2167,.2585,.3041,.3499,
PC .3959,.4423,.4900,.5400,.5939,.6535,.7211,.7994,.8913,1.0003,
PC 1.1301,1.2848,1.4691,1.6878,1.9462,2.2499,2.6051,3.0181,3.4957,4.2583,
PC 5.1498,5.7341,6.1786,6.5618,6.8905,7.1708,7.4087,7.6095,7.7784,7.9202,
PC 8.0390,8.1390,8.2237,8.2963,8.3597,8.4162,8.4679,8.5166,8.5635,8.6096,
PC 8.6555,8.7012,8.7467,8.7876,8.8269,8.8647,8.9008,8.9353,8.9682,8.9995,
PC 9.0300
KK D5-1
KO 0,,,,21,1,100
BA .1359
PR HMR55
LS 0,85
UD .323
KK POND5-CONTROL
KO 0,,,,21,1,300
RS 1,STOR,0,0
SA 0 1.11 5.4 8.5 15.2 31.7
SQ 0 9.9 29.2 62 114 279
SE 0 2 3 4 5 7
KK D5-5
KO 0,,,,21,1,100
BA .0104
PR HMR55
LS 0,87
UD .055
KK POND5-NORTH
KO 0,,,,21,1,100
HC 2
KK D5-4
KO 0,,,,21,1,100
BA .0519
PR HMR55
LS 0,87
UD .0226
KK DM-9
KO 0,,,,21,1,100
BA .046
PR HMR55
LS 0,90
UD .0811
KK SOUTH-UPPER-CONTROL
KO 0,,,,21,1,300
RS 1,STOR,0,0
SA .76 1.2 1.79 2.13 4.22
SQ 0 9.9 63 114 185
SE 0 2 4 5 6
KK D5-3
```

TABLE E-2. HEC-1 INPUT AND FLOW PATH FOR TAILINGS DISCHARGING TO THE EAST (continued).

```
KO 0,,,,21,1,100
BA .0439
PR HMR55
LS 0,91
UD .234
KK D5-7
KO 0,,,,21,1,100
BA .0099
PR HMR55
LS 0,87
UD .090
KK POND5-SOUTH
KO 0,,,,21,1,100
HC 2
KK POND5-SOUTH & MILL
KO 0,,,,21,1,100
HC 2
KK SOUTH-LOWER-CONTROL
KO 0,,,,21,1,300
RS 1,STOR,0,0
SA .102 .14 .27 .35 1.2 2.11
SQ 0 9.9 63 114 399 723
SE 0 2 4 5 8 10
KK DM-10
KO 0,,,,21,1,100
BA .0148
PR HMR55
LS 0,91
UD .072
KK CROSS-SECTION HC-12
KO 0,,,,21,1,100
HC 2
KK D5-6
KO 0,,,,21,1,100
BA .0114
PR HMR55
LS 0,87
UD .060
KK SOUTH-BOTTOM-CONTROL
KO 0,,,,21,1,300
RS 1,STOR,0,0
SA .14 .30 .99
SQ 0 29 114
SE 0 3 5
KK POND5-AREA3
KO 0,,,,21,1,100
HC 2
ZZ
```

TABLE E-2. HEC-1 INPUT AND FLOW PATH FOR TAILINGS DISCHARGING TO THE EAST (continued).

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW
LINE
NO.        (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

 15        D5-1
              V
              V
 21    POND5-CONTROL
              .
              .
 27           .         D5-5
              .            .
              .            .
 33    POND5-NORTH.........
              .
              .
 36           .         D5-4
              .            .
              .            .
 42           .            .       DM-9
              .            .          V
              .            .          V
 48           .            .    SOUTH-UPPER
              .            .          .
              .            .          .
 54           .            .          .        D5-3
              .            .          .           .
              .            .          .           .        D5-7
 60           .            .          .           .           .
              .            .          .           .           .
              .            .          .           .           .
 66           .            .          .    POND5-SOUTH.........
              .            .          .           .
              .            .          .           .
 69           .            .    POND5-SOUTH & MILL..
              .            .          V
              .            .          V
 72           .            .    SOUTH-LOWER-CONTROL
              .            .          .
              .            .          .
 78           .            .          .       DM-10
              .            .          .           .
              .            .          .           .
 84           .            .    CROSS-SECTION HC-12.
              .            .          .
              .            .          .
 87           .            .          .       D5-6
              .            .          .          V
              .            .          .          V
 93           .            .          .    SOUTH-BOTTOM-CONTROL
              .            .          .           .
              .            .          .           .
 99           .            .    POND5-AREA 3........
```

TABLE E-3. HEC-1 INPUT AND FLOW PATH FOR NORTH DRAINAGE.

```
ID PATHFINDER, NORTH DRAINAGE ROUTED TO 2/8 RESERVOIR THROUGH CONTROL
ID BASED UPON PMF- RAINFALL OF 9.03 IN. COMPUTATION OF 1.0 MINUTE INCREMENTS
ID DATE=4-18-96
*FREE
*DIAGRAM
IT 1.0,,,300,,
IO 5,1
IN 1,,
PG HMR55
PC .0000,.0321,.0658,.1011,.1381,.1766,.2167,.2585,.3041,.3499,
PC .3959,.4423,.4900,.5400,.5939,.6535,.7211,.7994,.8913,1.0003,
PC 1.1301,1.2848,1.4691,1.6878,1.9462,2.2499,2.6051,3.0181,3.4957,4.2583,
PC 5.1498,5.7341,6.1786,6.5618,6.8905,7.1708,7.4087,7.6095,7.7784,7.9202,
PC 8.0390,8.1390,8.2237,8.2963,8.3597,8.4162,8.4679,8.5166,8.5635,8.6096,
PC 8.6555,8.7012,8.7467,8.7876,8.8269,8.8647,8.9008,8.9353,8.9682,8.9995,
PC 9.0300
KK N5
KO 0,,,,21,1,100
BA .036
PR HMR55
LS 0,91
UD .2236
KK N5-SURGE
KO 0,,,,21,1,200
RS 1,STOR,0,0
SA 0 0.69 2.39 4.78
SQ 0 70 200 500
SE 0 1 2 3
KK N7
KO 0,,,,21,1,150
BA .021
PR HMR55
LS 0,91
UD .1124
KK N6
KO 0,,,,21,1,100
BA .047
PR HMR55
LS 0,91
UD .1055
KK N6-SURGE
KO 0,,,,21,1,300
RS 1,STOR,0,0
SA 0 1.56 2.81
SQ 0 70 200
SE 0 1 2
KK N8
KO 0,,,,21,1,150
BA .060
PR HMR55
LS 0,91
UD .2769
KK UPPER_NORTH
KO 0,,,,21,1,300
HC 4
KK UP_NORTH_CON
KO 0,,,,21,1,300
```

TABLE E-3. HEC-1 INPUT AND FLOW PATH FOR NORTH DRAINAGE. (continued).

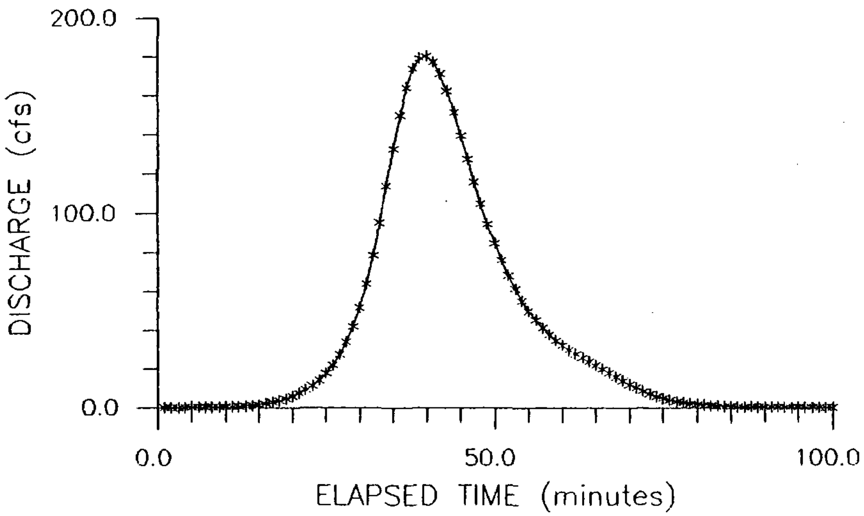
```
RS 1,STOR,0,0
SA 0 .20 .50 .89 1.32 1.89 2.58 3.40 4.89
SQ 0 2.25 14.1 41.7 90 163 265 400 570
SE 0 1 2 3 4 5 6 7 8
KK N9
KO 0,,,,21,1,100
BA .037
PR HMR55
LS 0,91
UD .1005
KK N11
KO 0,,,,21,1,100
BA .013
PR HMR55
LS 0,91
UD .0356
KK N9+N11+UPPER_NORTH
KO 0,,,,21,1,300
HC 3
KK N10
KO 0,,,,21,1,100
BA .003
PR HMR55
LS 0,91
UD .0260
KK N12
KO 0,,,,21,1,100
BA .018
PR HMR55
LS 0,91
UD .1235
KK N13
KO 0,,,,21,1,100
BA .013
PR HMR55
LS 0,91
UD .01
KK LOWER_NORTH
KO 0,,,,21,1,300
HC 4
KK LOW_NORTH_CON
KO 0,,,,21,1,300
RS 1,STOR,0,0
SA 0 7.61 7.98 8.13 8.26
SQ 0 2.25 14.1 41.7 90
SE 0 1 2 3 4
ZZ
```

TABLE E-3. HEC-1 INPUT AND FLOW PATH FOR NORTH DRAINAGE. (continued).

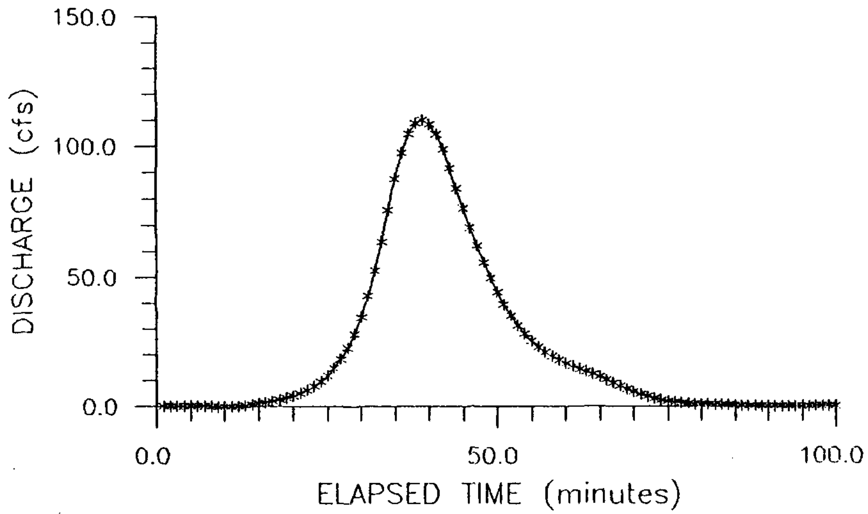
SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW
LINE
NO.       (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

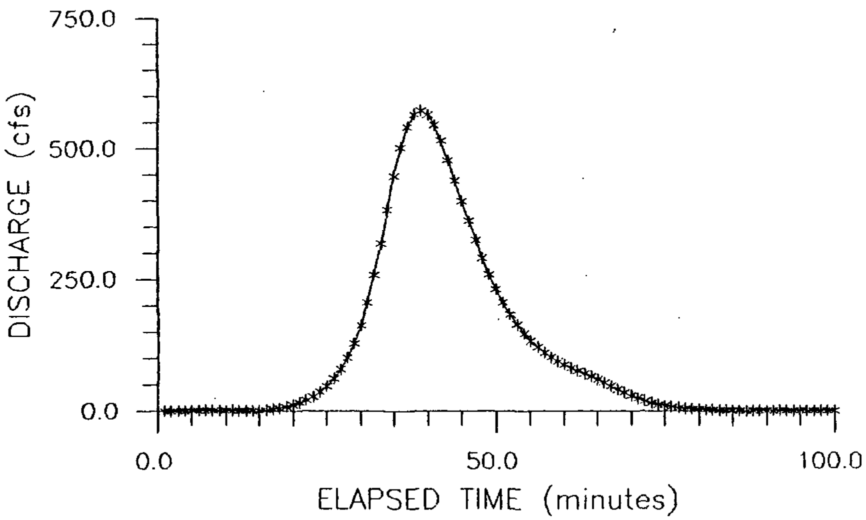
 15            N5
                V
                V
 21      N5-SURGE
                .
                .
 27             .           N7
                .            .
                .            .
 33             .            .           N6
                .            .            V
                .            .            V
 39             .            .     N6-SURGE
                .            .            .
                .            .            .
 45             .            .            .           N8
                .            .            .            .
                .            .            .            .
 51      UPPER_NORTH...................................
                V
                V
 54      UP_NORTH_CON
                .
                .
 60             .           N9
                .            .
                .            .
 66             .            .          N11
                .            .            .
                .            .            .
 72      N9+N11+UPPER_NORTH...............
                .
                .
 75             .          N10
                .            .
                .            .
 81             .            .          N12
                .            .            .
                .            .            .
 87             .            .            .          N13
                .            .            .            .
                .            .            .            .
 93      LOWER_NORTH...................................
                V
                V
 96      LOW_NORTH_CON
```



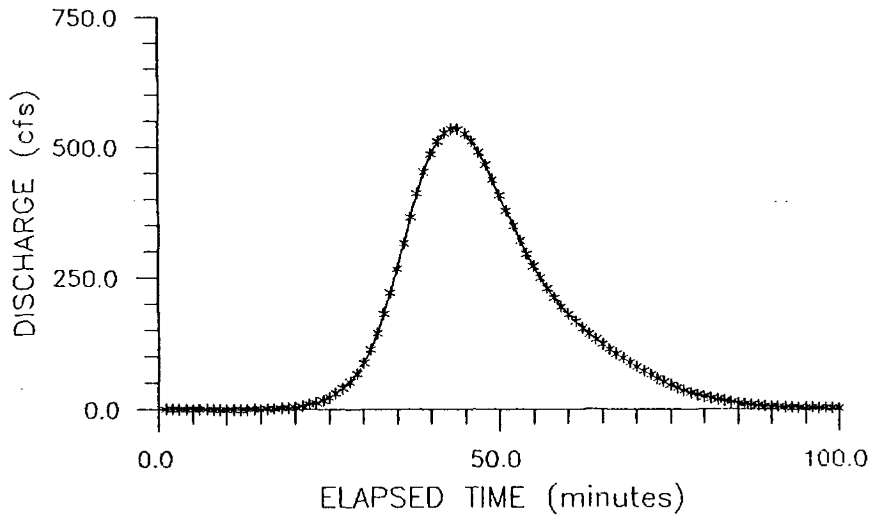
PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-7.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-8.



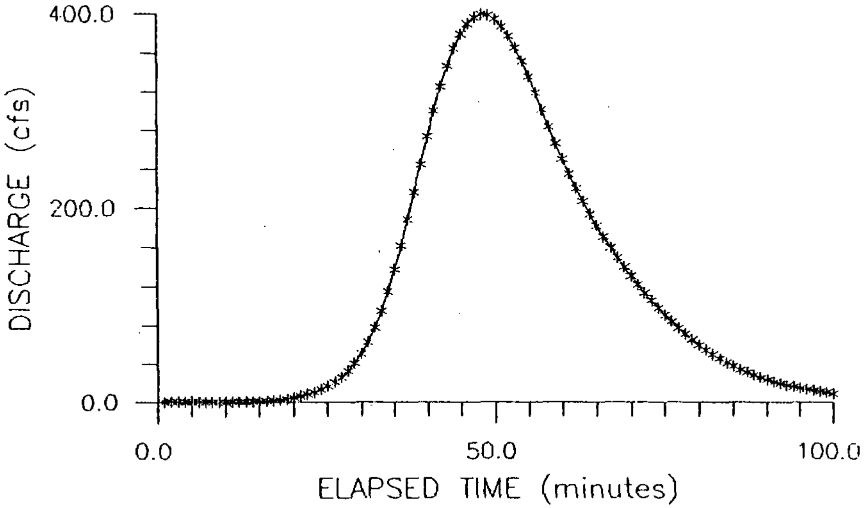
PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D4-5.



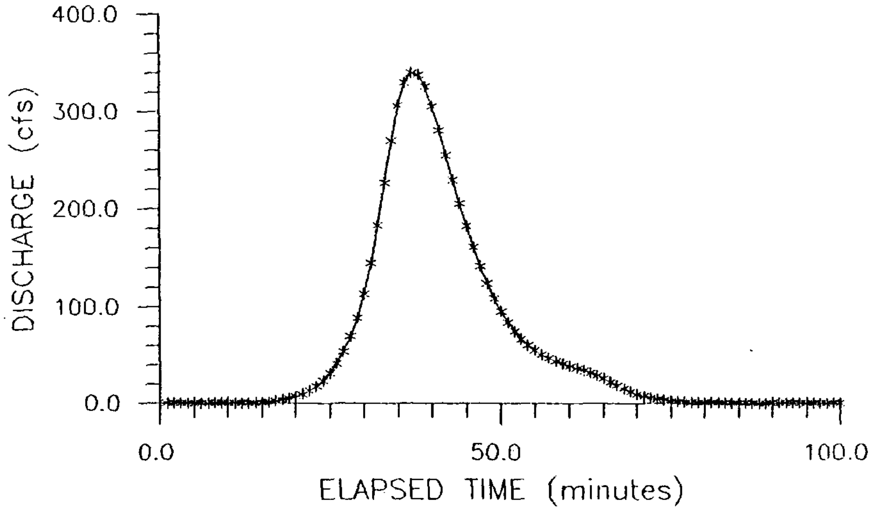
PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D4-3.

FIGURE E-1. HYDROGRAPHS FOR SUBBASINS DM-7, DM-8, D4-5 AND D4-3.

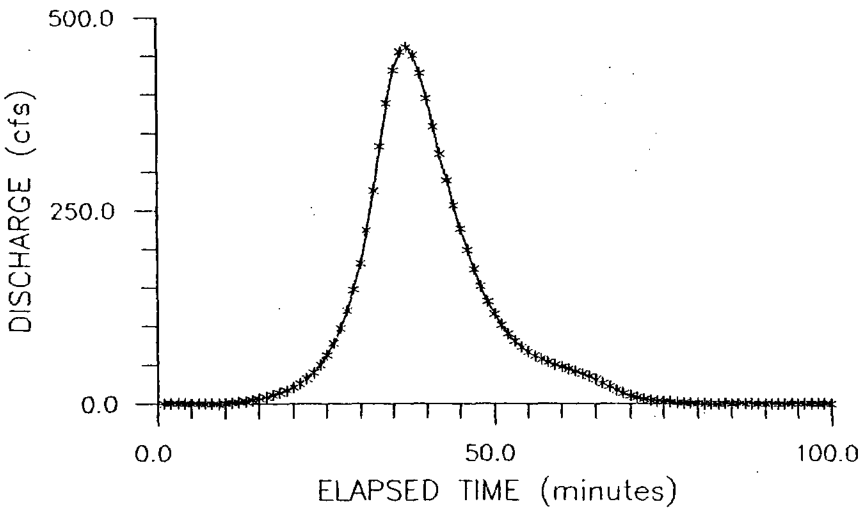
(Revised 05/20/96)



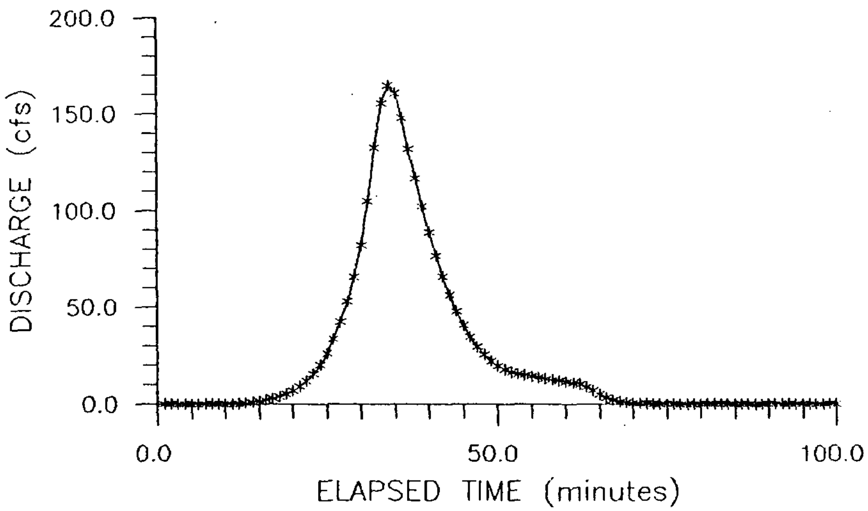
PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D4-1.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D4-2.

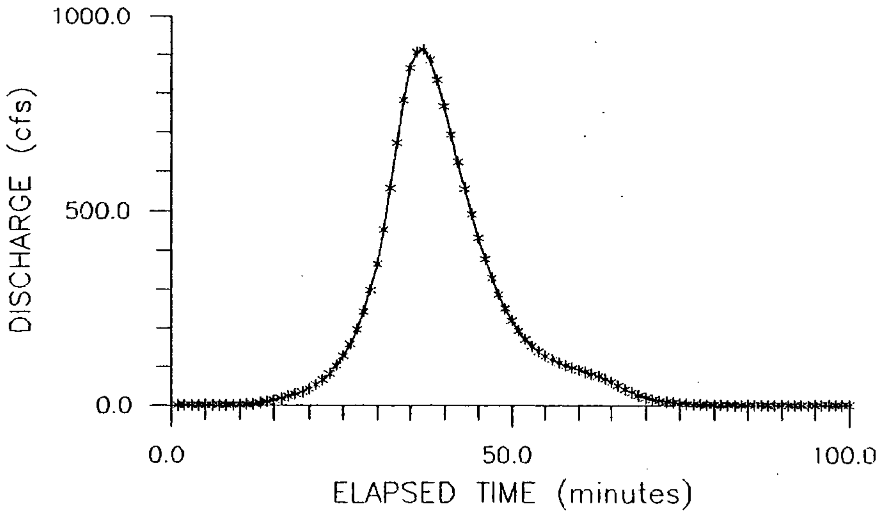


PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D5-2A.

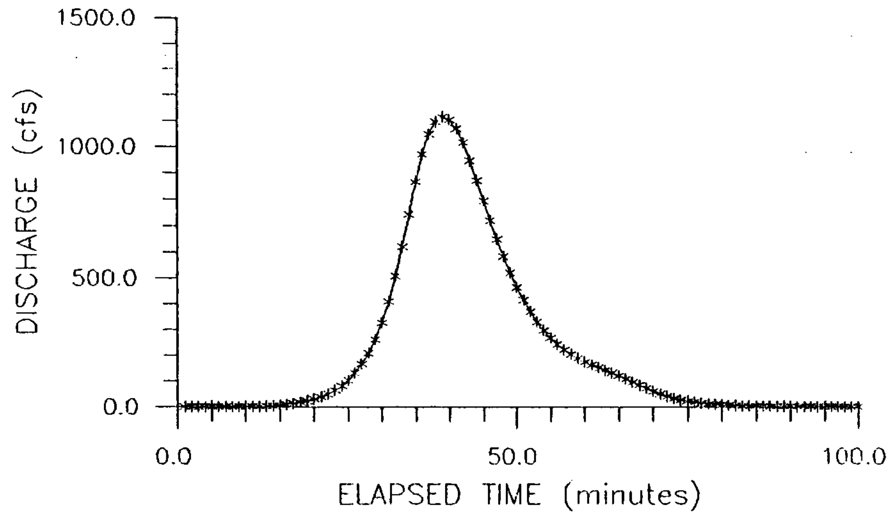


PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D5-2B.

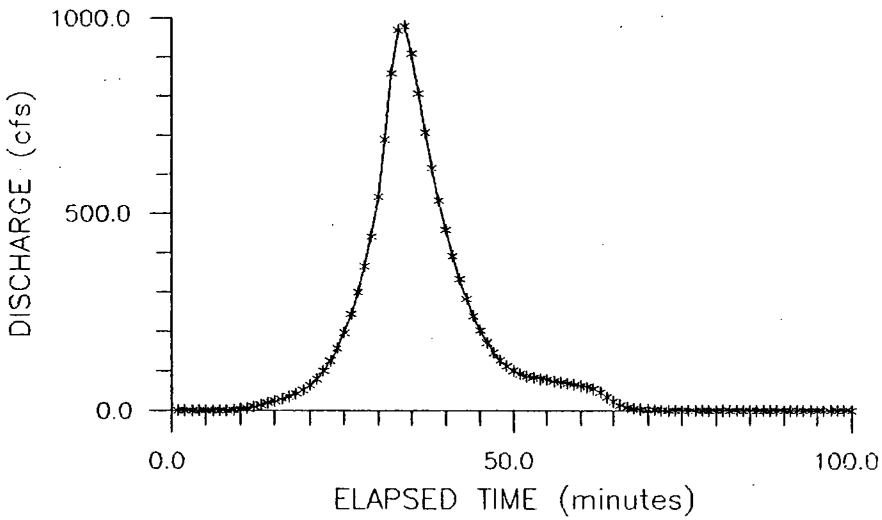
FIGURE E-2. HYDROGRAPHS FOR S[illegible]SINS D4-1, D4-2, D5-2A AND D5-2B.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D4-6.

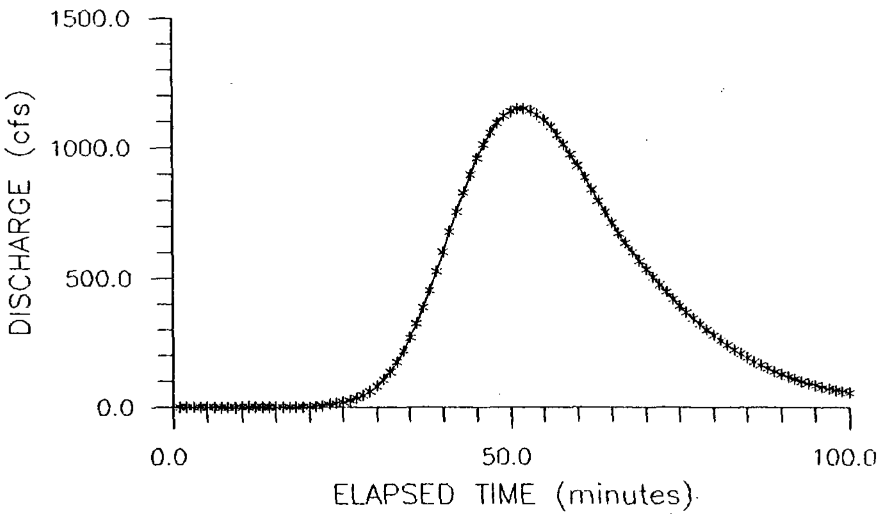


PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D3-1.

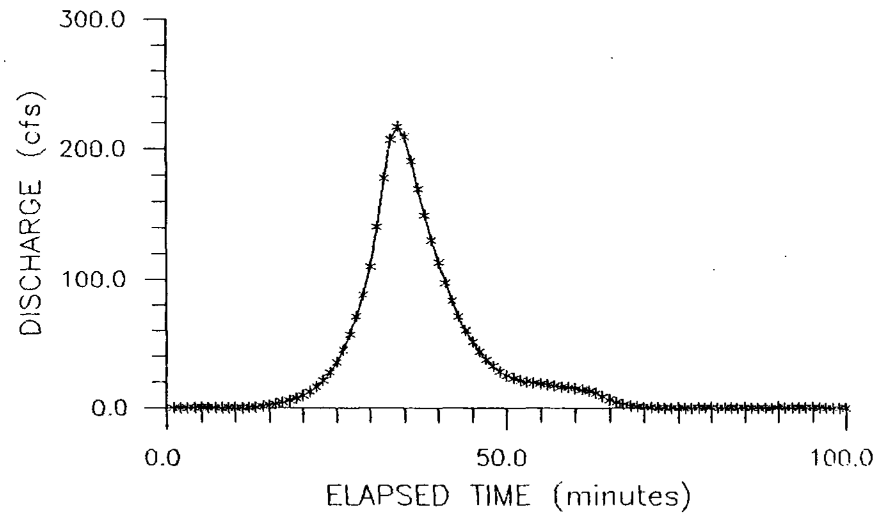


PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D4-4.

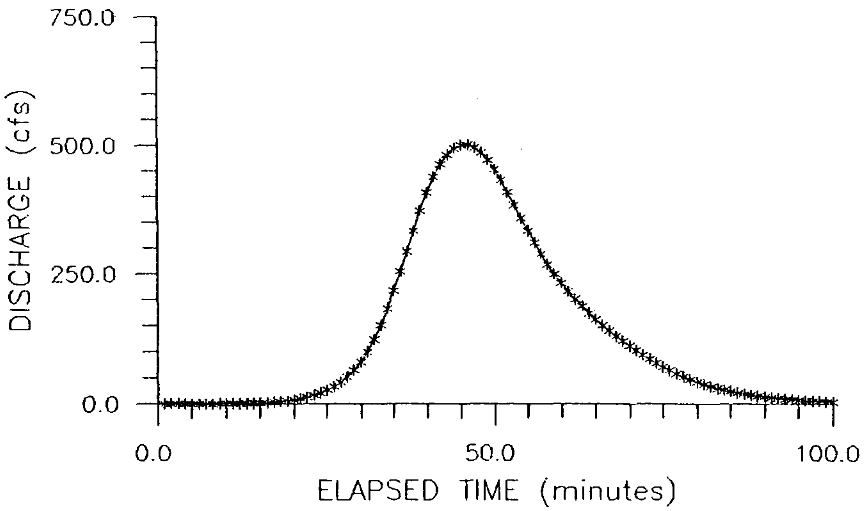
FIGURE E-3. HYDROGRAPHS FOR SUBBASINS D4-6, D3-1 AND D4-4.



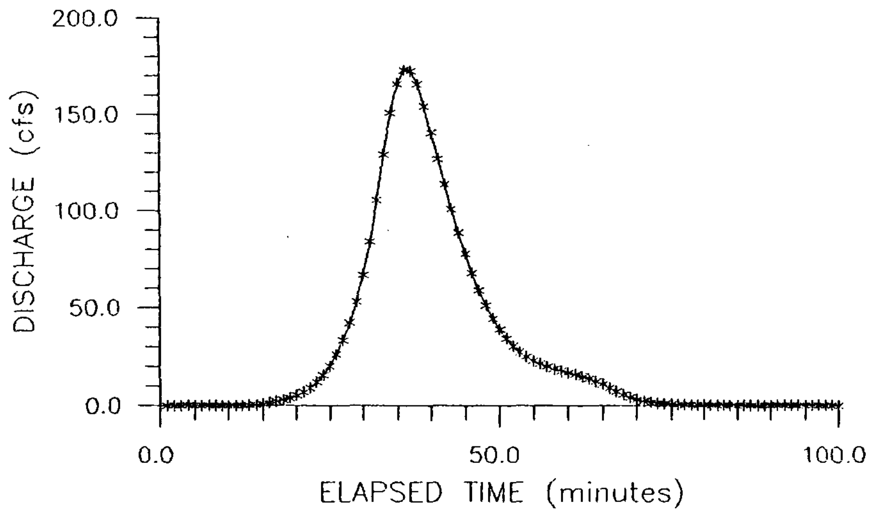
PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D5-1.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D5-5.

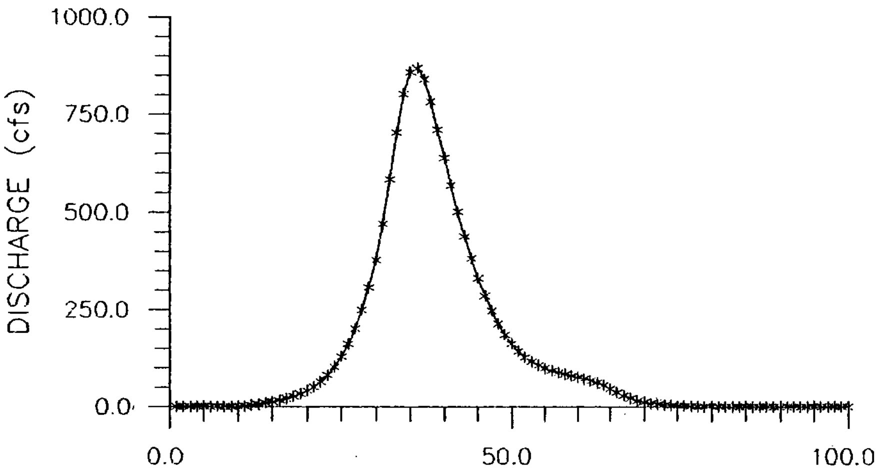


PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D5-3.

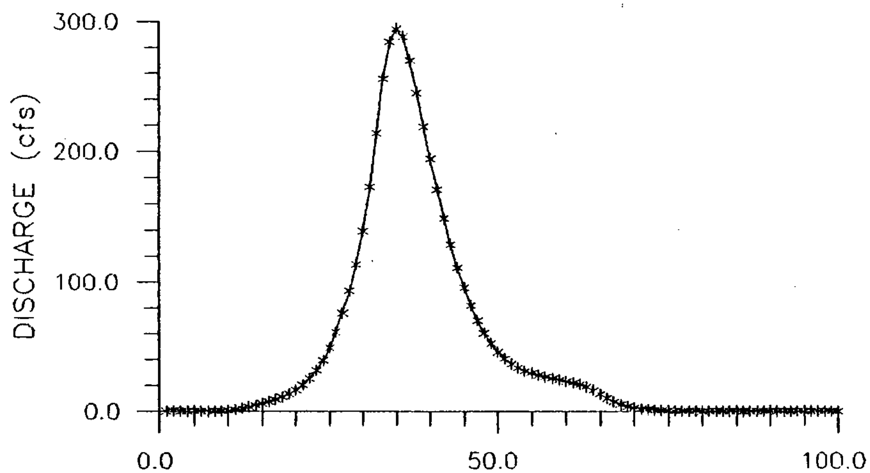


PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D5-7.

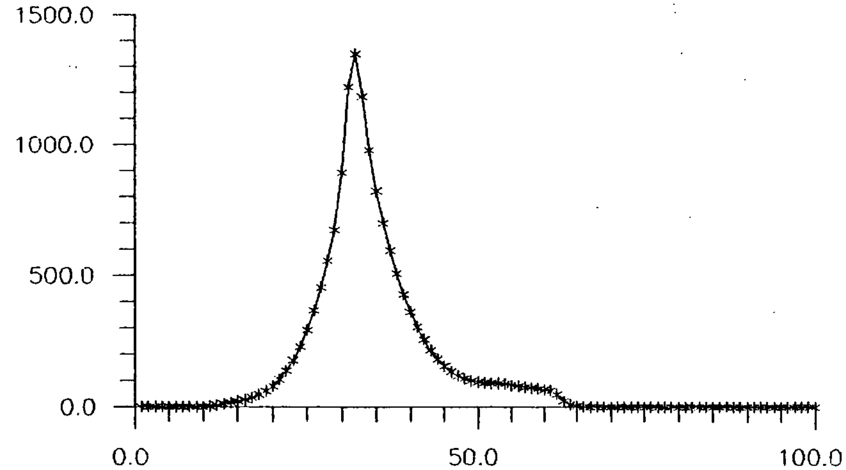
FIGURE E-4. HYDROGRAPHS FOR [illegible]ASINS D5-1, D5-5, D5-3 AND D5-7.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-9.

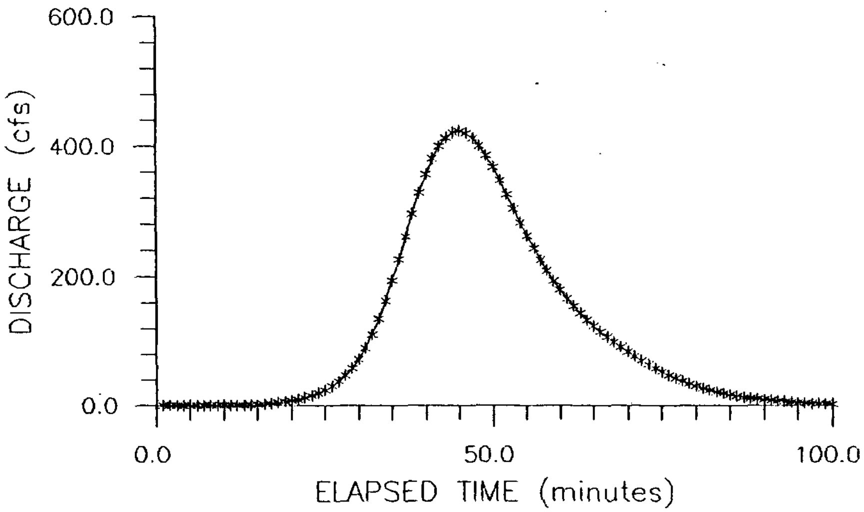


PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-10.

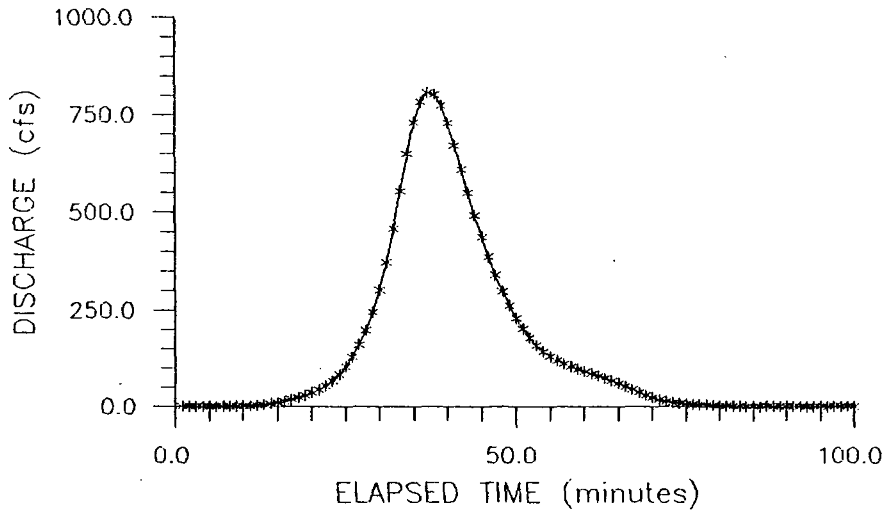


PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN D5-4.

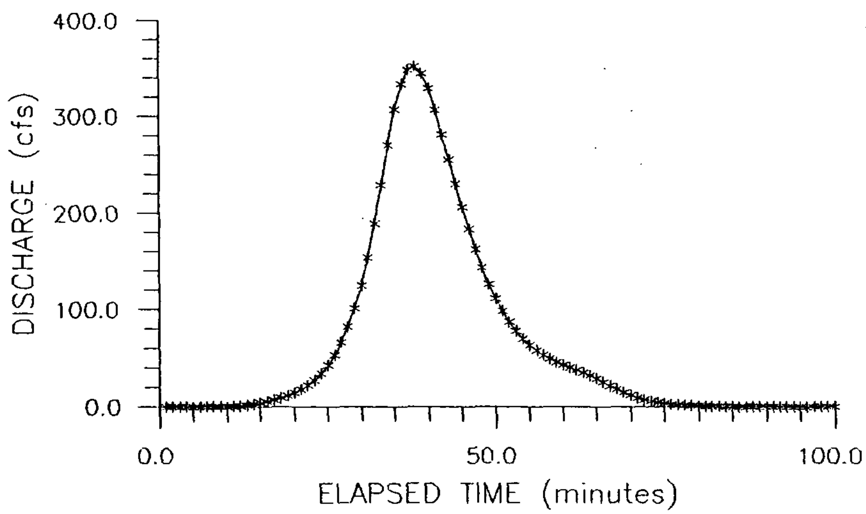
FIGURE E-5. HYDROGRAPHS FOR SUBBASINS DM-9, DM-10 AND D5-4.



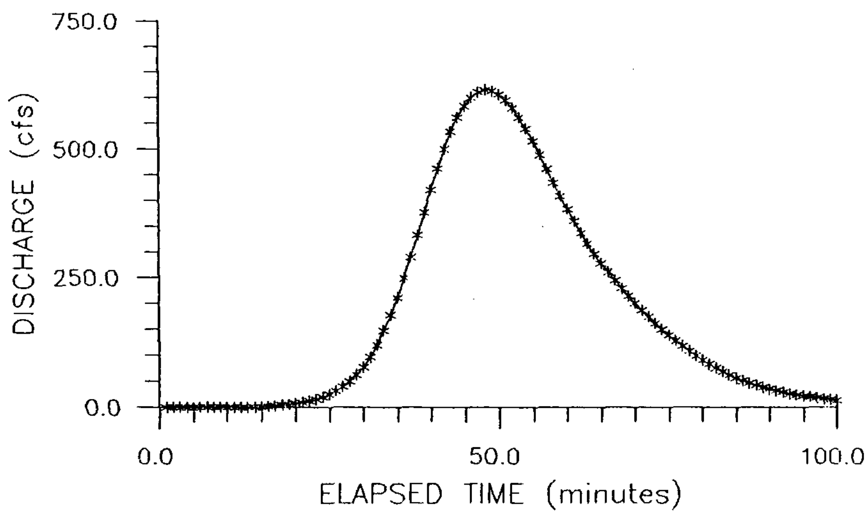
PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN N-5.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN N-6.

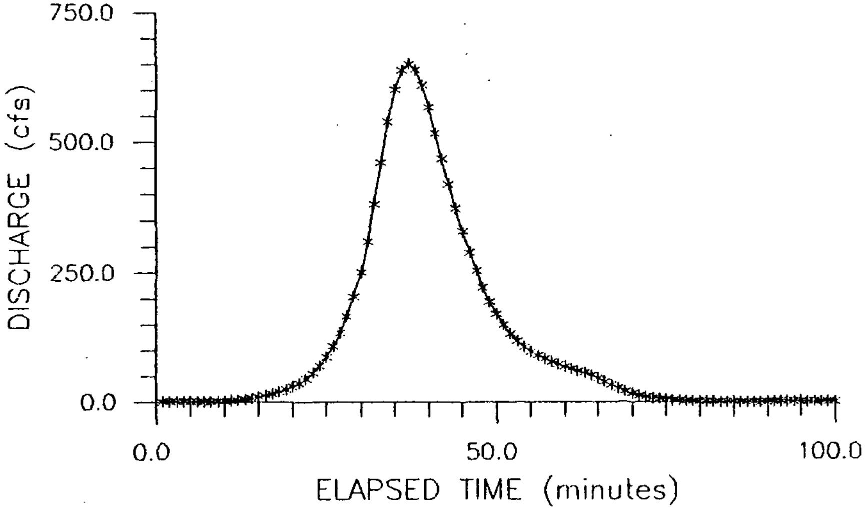


PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN N-7.

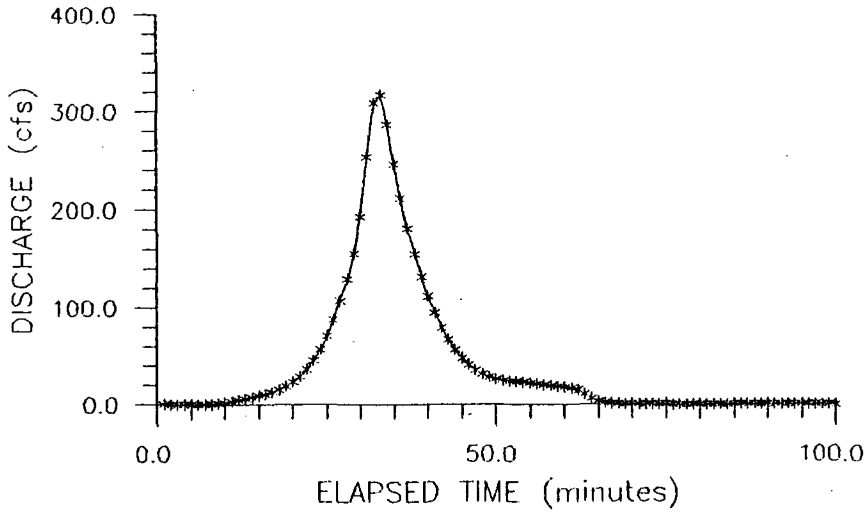


PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN N-8.

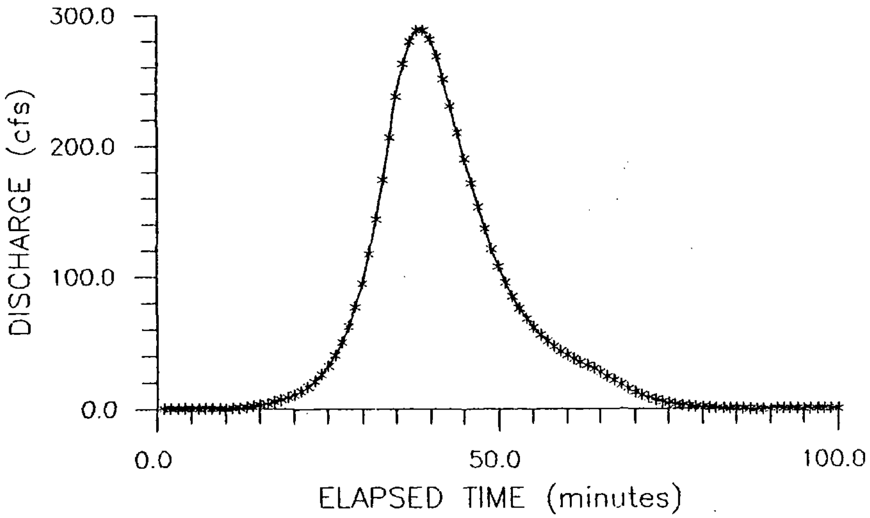
FIGURE E-6. HYDROGRAPHS FO[illegible]BBASINS N-5, N-6, N-7 AND N-8.



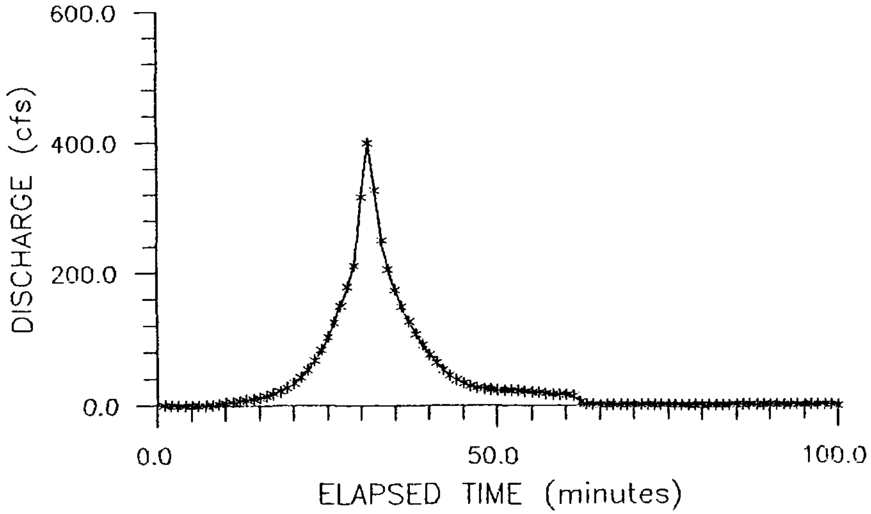
PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN N-9.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN N-11.



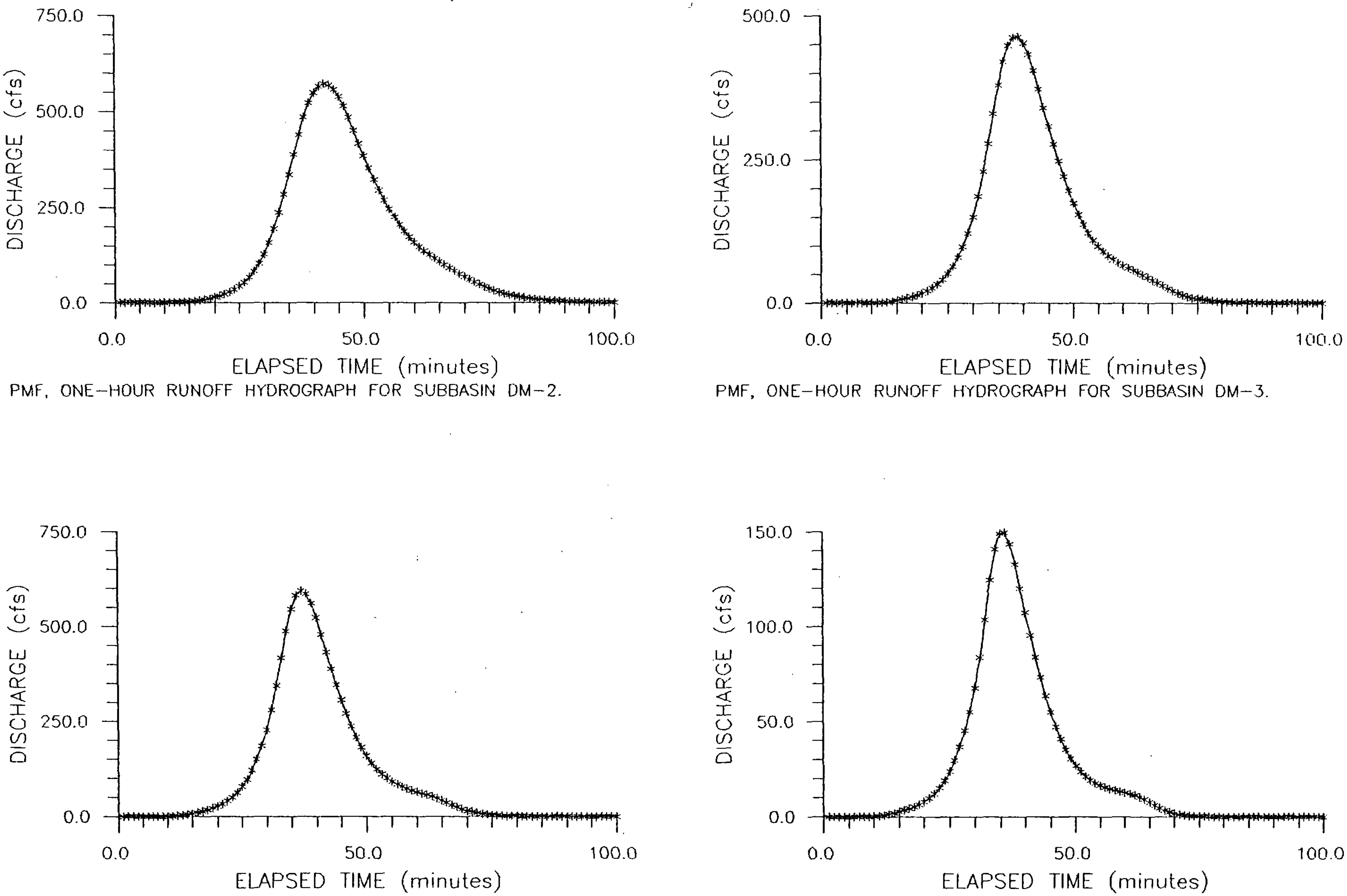
PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN N-12.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN N-13.

FIGURE E-7. HYDROGRAPHS FOR SUBBASINS N-9, N-11, N-12 AND N-13.

(Revised 05/20/96)



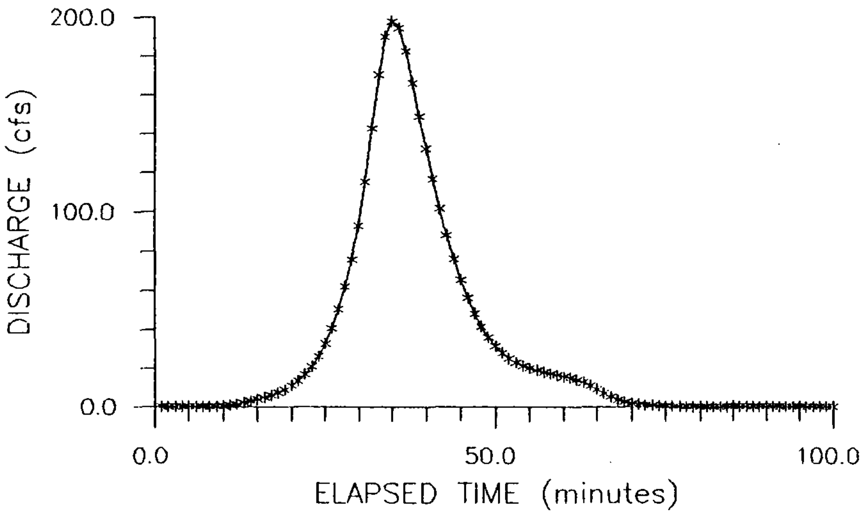
PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-2.

PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-3.

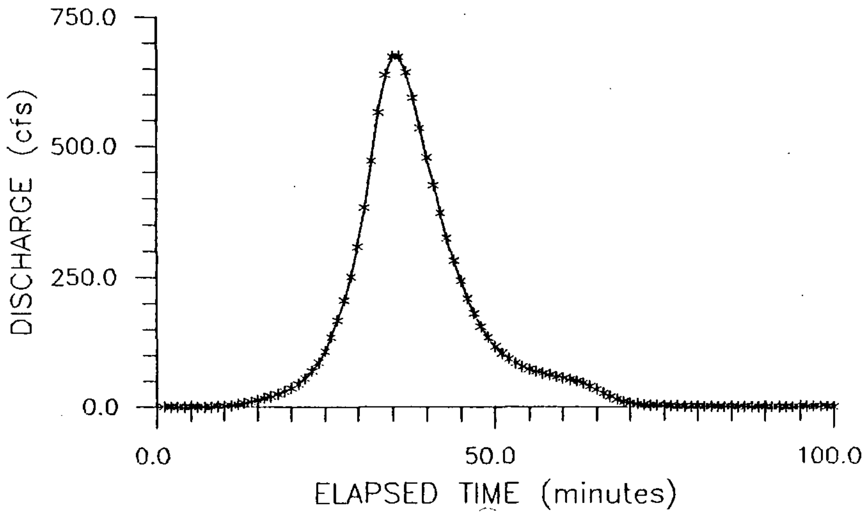
PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-4.

PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-6.

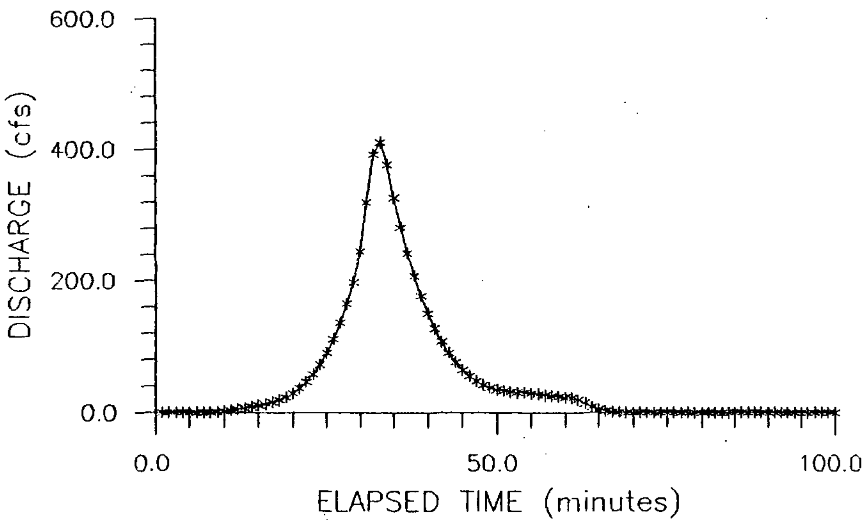
FIGURE E-8. HYDROGRAPHS FOR SUBBASINS DM-2, DM-3, DM-4 AND DM-6.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-6A.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-5.



PMF, ONE-HOUR RUNOFF HYDROGRAPH FOR SUBBASIN DM-1.

FIGURE E-9. HYDROGRAPHS FOR SUBBASINS DM6-6A, DM-5 AND DM-1.

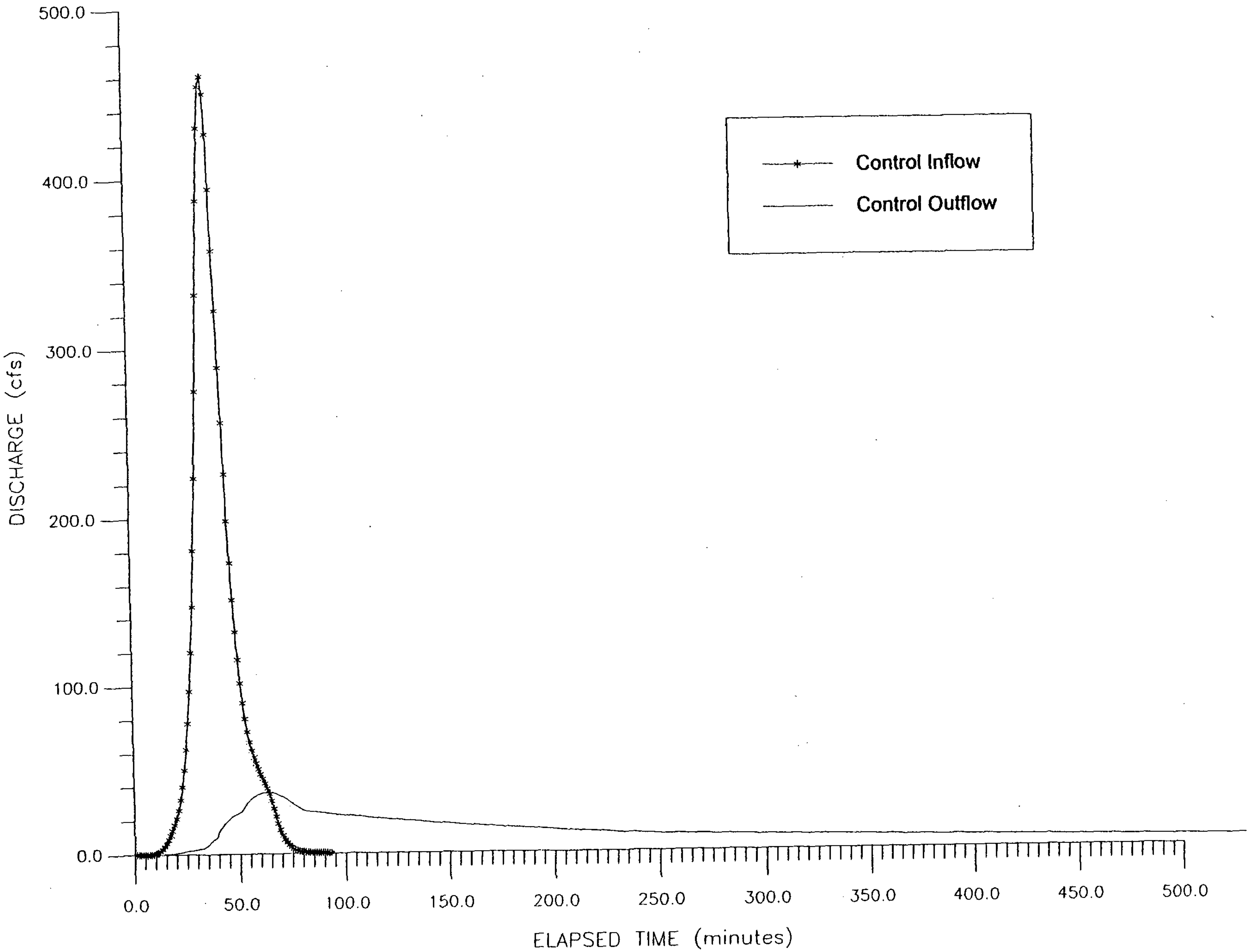


FIGURE E-10. RUNOFF HYDROGRAPH FOR THE BASIN 5-2A CONTROL

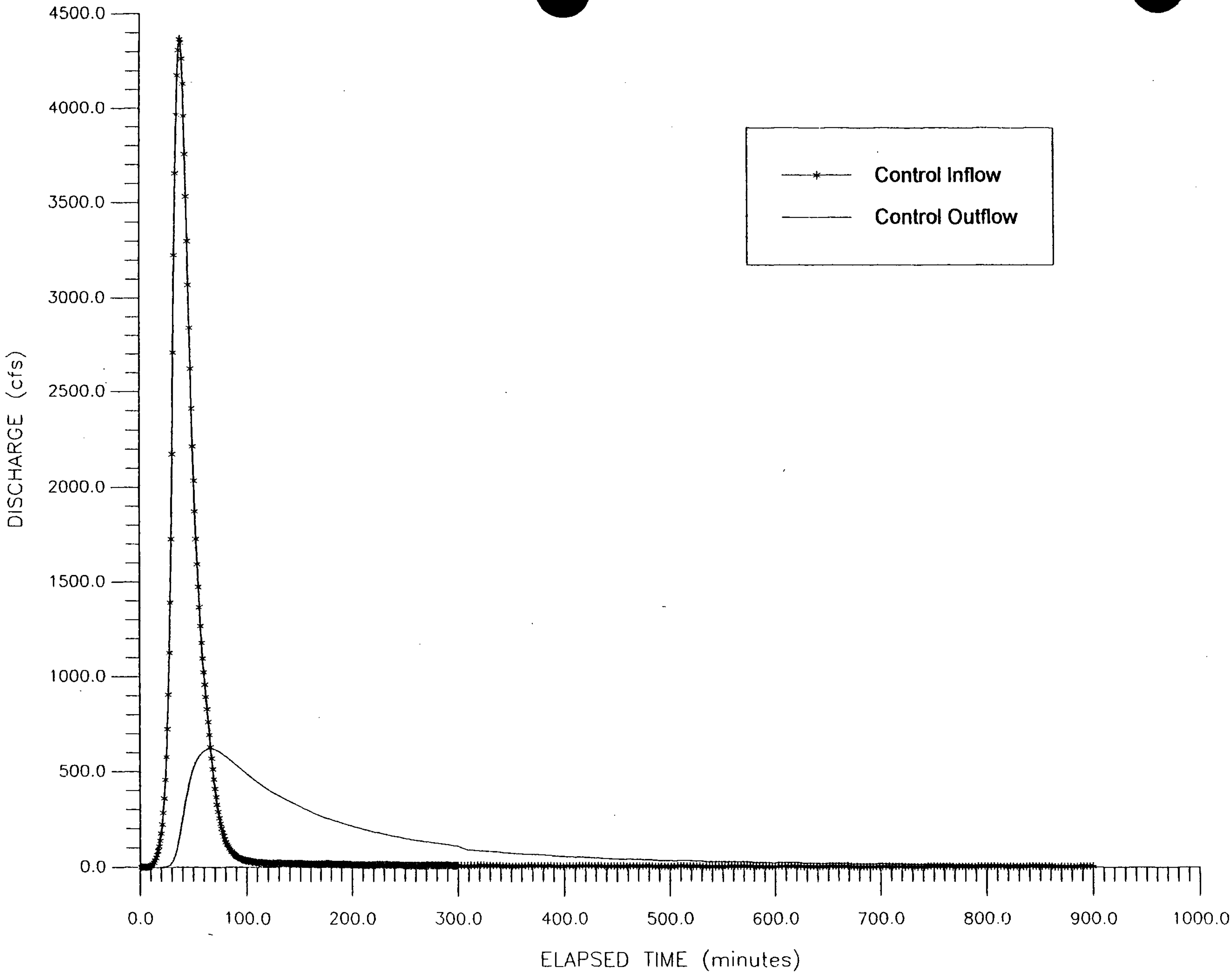


FIGURE E-11. RUNOFF HYDROGRAPH FOR CONTROL SECTION HCT-1

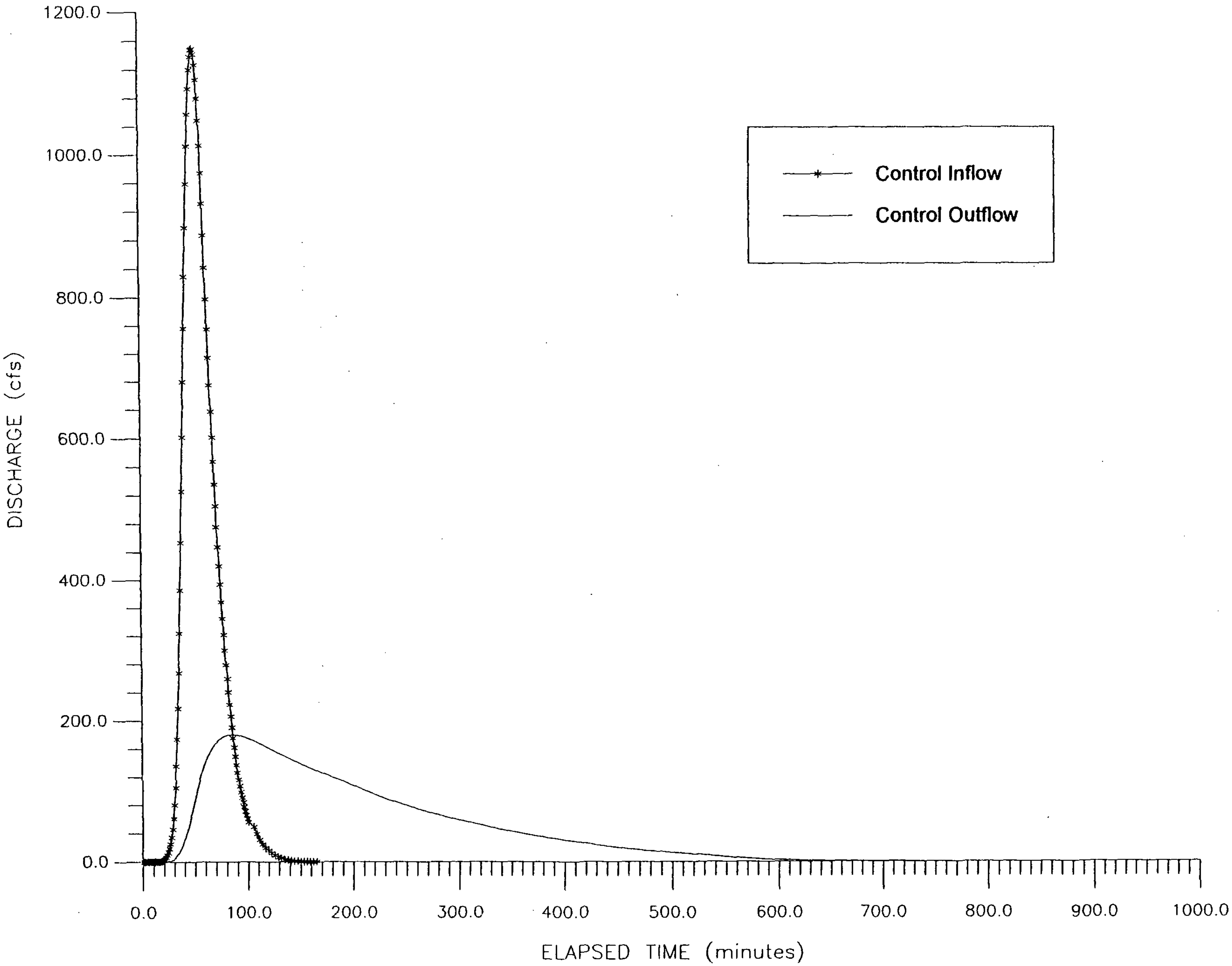


FIGURE E-12. RUNOFF HYDROGRAPH FOR THE POND NO. 5 NORTH CONTROL

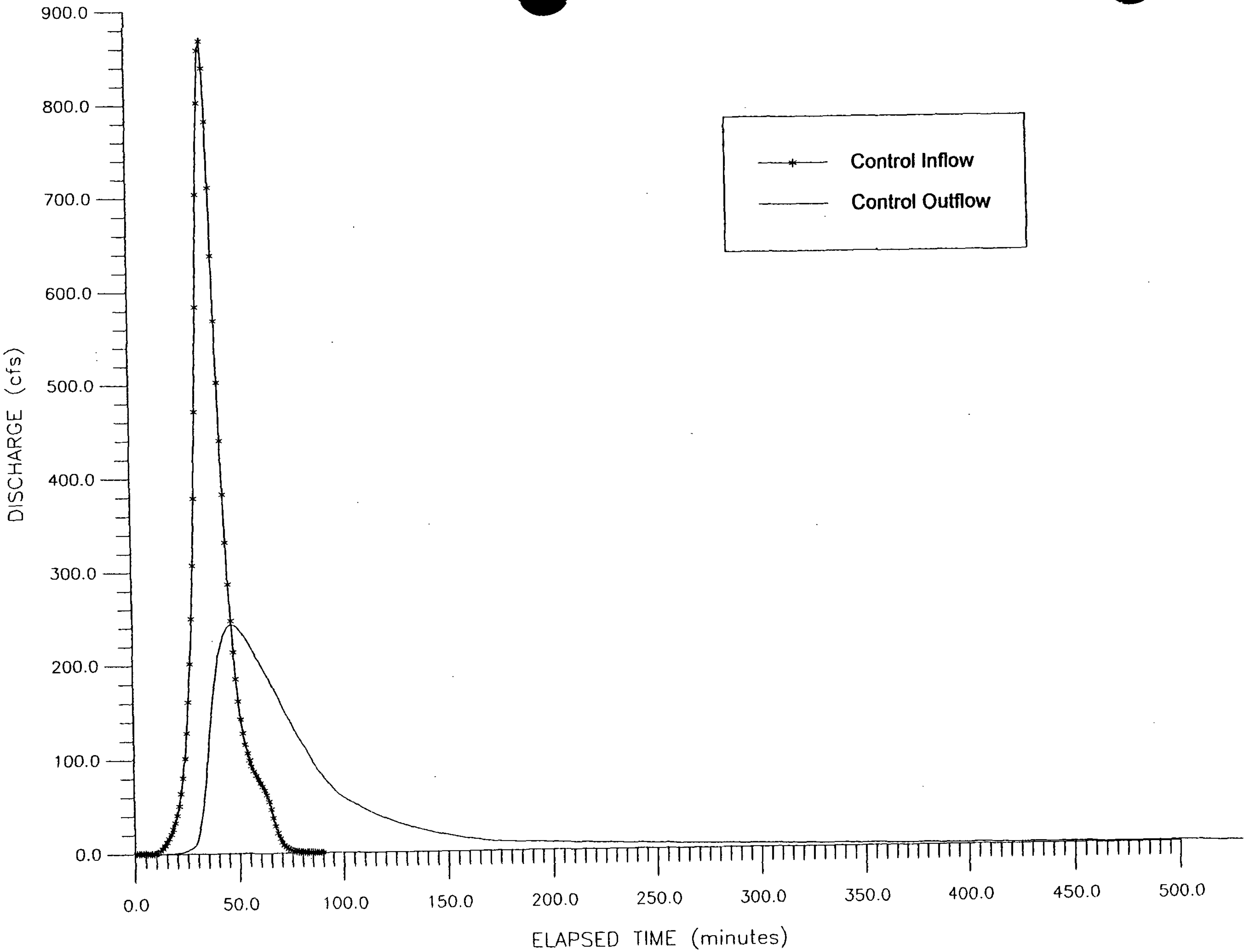


FIGURE E-13. RUNOFF HYDROGRAPH FOR THE CROSS-SECTION HC5-10 CONTROL

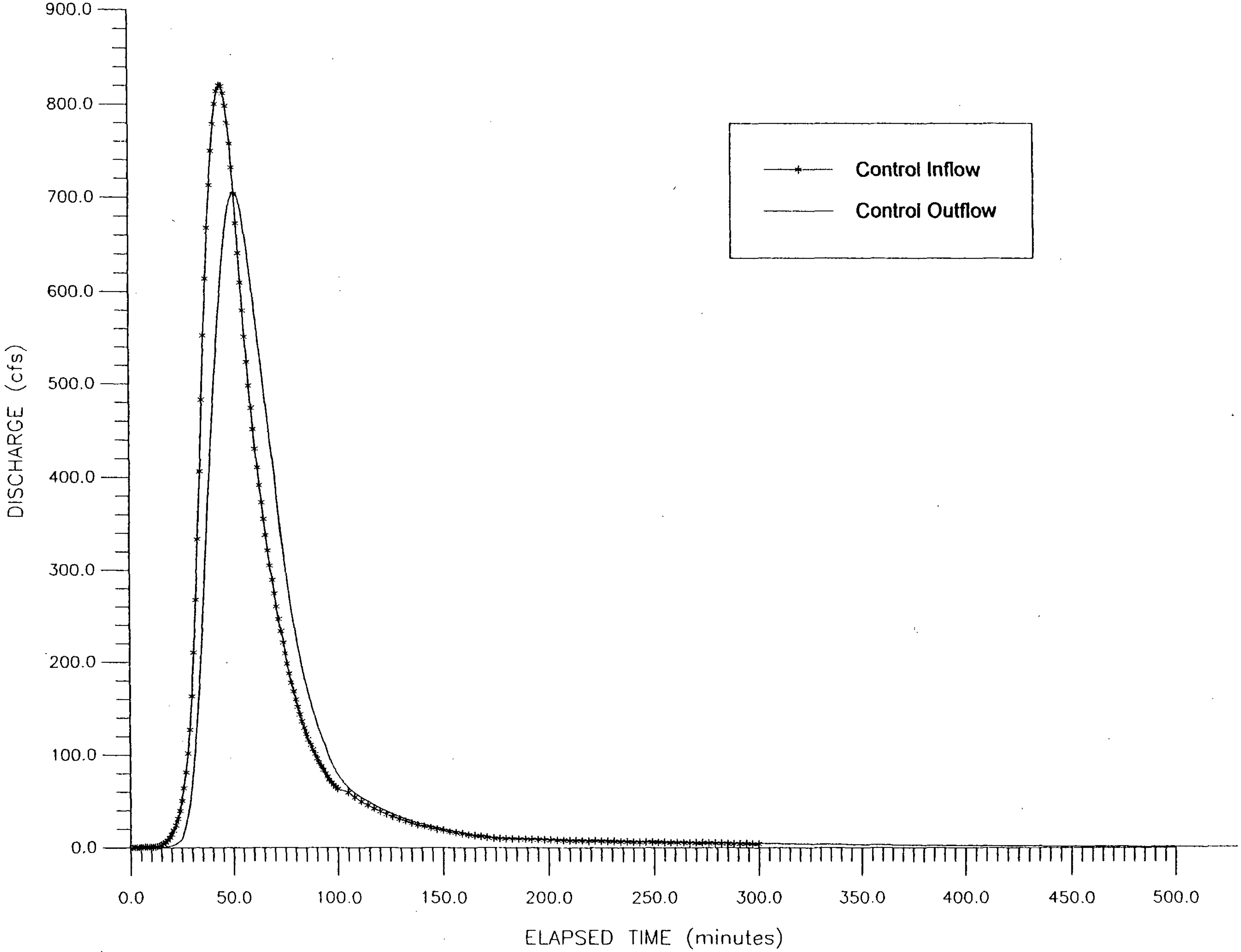


FIGURE E-14. RUNOFF HYDROGRAPH FOR THE CROSS-SECTION HC5-11 CONTROL

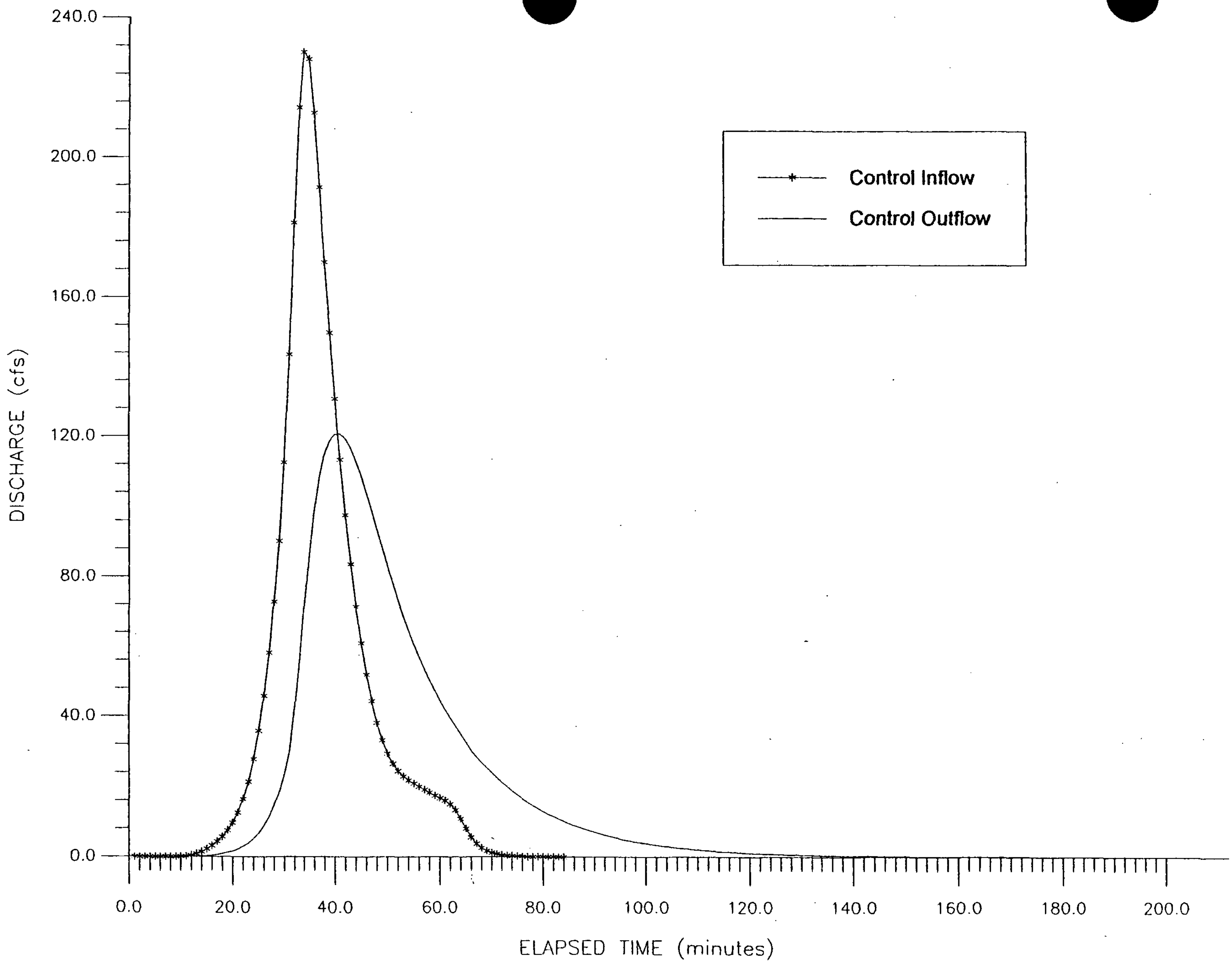


FIGURE E-15. RUNOFF HYDROGRAPH FOR THE CROSS-SECTION HC5-13 CONTROL

APPENDIX F

HEC-2 INPUT FILES

APPENDIX F

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TABLE F-1. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL A.

```
T1       PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2       CHANNEL A
T3       PMF - SUBCRITICAL
J1                                   -1.0                     180.0  7128.0
J2   -1         0     -1.0
NC 0.035   0.035   0.035     0.1      0.3
X180        4.0     0.01    36.00
X2 180.0
GR7128.0    0.01 7126.00    8.00 7126.00   28.00 7128.00   36.00
X190        4.0     0.01    36.00   10.00   10.00   10.00
X2 180.0
GR7128.4    0.01 7126.40    8.00 7126.40   28.00 7128.40   36.00
X1100       4.0     0.01    36.00   10.00   10.00   10.00
X2 180.0
GR7128.8    0.01 7126.80    8.00 7126.80   28.00 7128.80   36.00
X1200       4.0     0.01    36.00  100.00  100.00  100.00
X2 170.0
GR7130.8    0.01 7128.80    8.00 7128.80   28.00 7130.80   36.00
X1 220      4.0     0.01    36.00   20.00   20.00   20.00
X2 165.0
GR7131.4    0.01 7129.40    8.00 7129.40   28.00 7131.40   36.00
X1240       4.0     0.01    36.00   20.00   20.00   20.00
X2 160.0
GR7132.0    0.01 7130.00    8.00 7130.00   28.00 7132.00   36.00
X1 260      4.0     0.01    36.00   20.00   20.00   20.00
X2 153.3
GR7133.2    0.01 7131.20    8.00 7131.20   28.00 7133.20   36.00
X1 280      4.0     0.01    36.00   20.00   20.00   20.00
X2 146.7
GR7134.4    0.01 7132.40    8.00 7132.40   28.00 7134.40   36.00
X1300       4.0     0.01    36.00   20.00   20.00   20.00
X2 140.0
GR7135.6    0.01 7133.60    8.00 7133.60   28.00 7135.60   36.00
X1400       4.0     0.01    36.00  100.00  100.00  100.00
X2 120.0
GR7137.2    0.01 7135.20    8.00 7135.20   28.00 7137.20   36.00
X1 500      4.0     0.01    36.00  100.00  100.00  100.00
X2 110.0
GR7137.9    0.01 7135.85    8.00 7135.85   28.00 7137.85   36.00
X1600       4.0     0.01    36.00  100.00  100.00  100.00
X2 100.0
GR7138.5    0.01 7136.50    8.00 7136.50   28.00 7138.50   36.00
X1 700      4.0     0.01    36.00  100.00  100.00  100.00
X2  90.0
GR7139.1    0.01 7137.10    8.00 7137.10   28.00 7139.10   36.00
X1800       4.0     0.01    36.00  100.00  100.00  100.00
X2  80.0
GR7139.7    0.01 7137.70    8.00 7137.70   28.00 7139.70   36.00
EJ
ER
```


(Revised 05/20/96)

TABLE F-2. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL A.

```
T1        PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2        CHANNEL A
T3        PMF - SUPERCRITICAL
J1                               1.0     -1.0                          80.0  7138.5
J2    -1        0      -1.0
NC 0.035    0.035     0.035      0.1      0.3
X1800         4.0      0.01     36.00   100.00   100.00   100.00
X2   80.0
GR7139.7     0.01  7137.70      8.00  7137.70    28.00  7139.70     36.00
X1 700        4.0      0.01     36.00   100.00   100.00   100.00
X2   90.0
GR7139.1     0.01  7137.10      8.00  7137.10    28.00  7139.10     36.00
X1600         4.0      0.01     36.00   100.00   100.00   100.00
X2  100.0
GR7138.5     0.01  7136.50      8.00  7136.50    28.00  7138.50     36.00
X1 500        4.0      0.01     36.00   100.00   100.00   100.00
X2  110.0
GR7137.9     0.01  7135.85      8.00  7135.85    28.00  7137.85     36.00
X1400        4.0      0.01     36.00   100.00   100.00   100.00
X2  120.0
GR7137.2     0.01  7135.20      8.00  7135.20    28.00  7137.20     36.00
X1300         4.0      0.01     36.00    20.00    20.00    20.00
X2  140.0
GR7135.6     0.01  7133.60      8.00  7133.60    28.00  7135.60     36.00
X1 280        4.0      0.01     36.00    20.00    20.00    20.00
X2  146.7
GR7134.4     0.01  7132.40      8.00  7132.40    28.00  7134.40     36.00
X1 260        4.0      0.01     36.00    20.00    20.00    20.00
X2  153.3
GR7133.2     0.01  7131.20      8.00  7131.20    28.00  7133.20     36.00
X1240         4.0      0.01     36.00    20.00    20.00    20.00
X2  160.0
GR7132.0     0.01  7130.00      8.00  7130.00    28.00  7132.00     36.00
X1 220        4.0      0.01     36.00    20.00    20.00    20.00
X2  165.0
GR7131.4     0.01  7129.40      8.00  7129.40    28.00  7131.40     36.00
X1200        4.0      0.01     36.00   100.00   100.00   100.00
X2  170.0
GR7130.8     0.01  7128.80      8.00  7128.80    28.00  7130.80     36.00
X1100        4.0      0.01     36.00    10.00    10.00    10.00
X2  180.0
GR7128.8     0.01  7126.80      8.00  7126.80    28.00  7128.80     36.00
X190         4.0      0.01     36.00    10.00    10.00    10.00
X2  180.0
GR7128.4     0.01  7126.40      8.00  7126.40    28.00  7128.40     36.00
X180         4.0      0.01     36.00
X2  180.0
GR7128.0     0.01  7126.00      8.00  7126.00    28.00  7128.00     36.00
EJ
ER
```

TABLE F-3. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL D.

```
T1       PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2       CHANNEL D
T3       PMF - SUBCRITICAL
J1                                     -1.0                      1325.0  7110.0
J2   -1       0     -1.0
NC 0.035   0.035   0.035     0.1       0.3
X1100       4.0     0.01   66.00
X21325.0
GR7109.8    0.01 7107.80    8.00 7107.80   58.00 7109.80   66.00
X1150       4.0     0.01   66.00   50.00   50.00   50.00
X21325.0
GR7085.5    0.01 7083.50    8.00 7083.50   58.00 7085.50   66.00
X1200       4.0     0.01   66.00   50.00   50.00   50.00
X21300.0
GR7087.0    0.01 7085.00    8.00 7085.00   58.00 7087.00   66.00
X1413       4.0     0.01   66.00   15.00   15.00   15.00
X21300.0
GR7087.8    0.01 7085.80    8.00 7085.80   58.00 7087.80   66.00
X1 220      4.0     0.01   66.00    5.00    5.00    5.00
X21297.1
GR7088.1    0.01 7086.06    8.00 7086.06   58.00 7088.06   66.00
X1 240      4.0     0.01   66.00   20.00   20.00   20.00
X21285.3
GR7089.1    0.01 7087.09    8.00 7087.09   58.00 7089.09   66.00
X1 260      4.0     0.01   66.00   20.00   20.00   20.00
X21273.5
GR7090.1    0.01 7088.13    8.00 7088.13   58.00 7090.13   66.00
X1 280      4.0     0.01   66.00   20.00   20.00   20.00
X21261.8
GR7091.2    0.01 7089.17    8.00 7089.17   58.00 7091.17   66.00
X1300       4.0     0.01   66.00   20.00   20.00   20.00
X21250.0
GR7092.2    0.01 7090.20    8.00 7090.20   58.00 7092.20   66.00
X1 320      4.0     0.01   66.00   20.00   20.00   20.00
X21240.0
GR7093.0    0.01 7090.98    8.00 7090.98   58.00 7092.98   66.00
X1 340      4.0     0.01   66.00   20.00   20.00   20.00
X21230.0
GR7093.8    0.01 7091.76    8.00 7091.76   58.00 7093.76   66.00
X1 360      4.0     0.01   66.00   20.00   20.00   20.00
X21220.0
GR7094.5    0.01 7092.54    8.00 7092.54   58.00 7094.54   66.00
X1 380      4.0     0.01   66.00   20.00   20.00   20.00
X21210.0
GR7095.3    0.01 7093.32    8.00 7093.32   58.00 7095.32   66.00
X1400       4.0     0.01   66.00   20.00   20.00   20.00
X21200.0
GR7096.1    0.01 7094.10    8.00 7094.10   58.00 7096.10   66.00
X1 420      4.0     0.01   66.00   20.00   20.00   20.00
X21190.0
GR7096.7    0.01 7094.74    8.00 7094.74   58.00 7096.74   66.00
X1 440      4.0     0.01   66.00   20.00   20.00   20.00
X21180.0
GR7097.4    0.01 7095.38    8.00 7095.38   58.00 7097.38   66.00
X1 460      4.0     0.01   66.00   20.00   20.00   20.00
X21170.0
GR7098.0    0.01 7096.02    8.00 7096.02   58.00 7098.02   66.00
X1 480      4.0     0.01   66.00   20.00   20.00   20.00
X21160.0
GR7098.7    0.01 7096.66    8.00 7096.66   58.00 7098.66   66.00
X1 500      4.0     0.01   66.00   20.00   20.00   20.00
X21150.0
GR7099.3    0.01 7097.30    8.00 7097.30   58.00 7099.30   66.00
X1 520      4.0     0.01   66.00   20.00   20.00   20.00
X21140.0
GR7099.9    0.01 7097.94    8.00 7097.94   58.00 7099.94   66.00
X1 540      4.0     0.01   66.00   20.00   20.00   20.00
X21130.0
GR7100.6    0.01 7098.58    8.00 7098.58   58.00 7100.58   66.00
X1 560      4.0     0.01   66.00   20.00   20.00   20.00
X21120.0
GR7101.2    0.01 7099.22    8.00 7099.22   58.00 7101.22   66.00
X1 580      4.0     0.01   66.00   20.00   20.00   20.00
X21110.0
GR7101.9    0.01 7099.86    8.00 7099.86   58.00 7101.86   66.00
X1600       4.0     0.01   66.00   20.00   20.00   20.00
X21100.0
```

TABLE F-3. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL D (continued).

```
GR7102.5     0.01 7100.50     8.00 7100.50    58.00 7102.50    66.00
X1700        4.0     0.01    66.00  100.00   100.00  100.00
X21000.0
GR7104.9     0.01 7102.90     8.00 7102.90    58.00 7104.90    66.00
X1 800       4.0     0.01    66.00  100.00   100.00  100.00
X2 950.0
GR7105.5     0.01 7103.55     8.00 7103.55    58.00 7105.55    66.00
X1900        4.0     0.01    66.00  100.00   100.00  100.00
X2 900.0
GR7106.2     0.01 7104.20     8.00 7104.20    58.00 7106.20    66.00
X1 1000      4.0     0.01    66.00  100.00   100.00  100.00
X2 875.0
GR7107.2     0.01 7105.15     8.00 7105.15    58.00 7107.15    66.00
X11100       4.0     0.01    66.00  100.00   100.00  100.00
X2 850.0
GR7108.1     0.01 7106.10     8.00 7106.10    58.00 7108.10    66.00
X11200       4.0     0.01    66.00  100.00   100.00  100.00
X2 797.0
GR7109.0     0.01 7107.00     8.00 7107.00    58.00 7109.00    66.00
X1 1220      4.0     0.01    64.00   20.00    20.00   20.00
X2 797.0
GR7109.2     0.01 7107.16     8.00 7107.16    56.00 7109.16    64.00
X1 1240      4.0     0.01    62.00   20.00    20.00   20.00
X2 797.0
GR7109.3     0.01 7107.32     8.00 7107.32    54.00 7109.32    62.00
X1 1260      4.0     0.01    60.00   20.00    20.00   20.00
X2 797.0
GR7109.5     0.01 7107.48     8.00 7107.48    52.00 7109.48    60.00
X1 1280      4.0     0.01    58.00   20.00    20.00   20.00
X2 797.0
GR7109.6     0.01 7107.64     8.00 7107.64    50.00 7109.64    58.00
X11300       4.0     0.01    56.00   20.00    20.00   20.00
X2 797.0
GR7109.8     0.01 7107.80     8.00 7107.80    48.00 7109.80    56.00
X1 1320      4.0     0.01    55.00   20.00    20.00   20.00
X2 797.0
GR7110.0     0.01 7108.04     8.00 7108.04    47.00 7110.04    55.00
X1 1340      4.0     0.01    54.00   20.00    20.00   20.00
X2 797.0
GR7110.3     0.01 7108.28     8.00 7108.28    46.00 7110.28    54.00
X1 1360      4.0     0.01    53.00   20.00    20.00   20.00
X2 797.0
GR7110.5     0.01 7108.52     8.00 7108.52    45.00 7110.52    53.00
X1 1380      4.0     0.01    52.00   20.00    20.00   20.00
X2 797.0
GR7110.8     0.01 7108.76     8.00 7108.76    44.00 7110.76    52.00
X11400       4.0     0.01    51.00   20.00    20.00   20.00
X2 797.0
GR7111.0     0.01 7109.00     8.00 7109.00    43.00 7111.00    51.00
X1 1420      4.0     0.01    49.70   20.00    20.00   20.00
X2 797.0
GR7111.3     0.01 7109.27     8.00 7109.27    41.70 7111.27    49.70
X1 1440      4.0     0.01    48.40   20.00    20.00   20.00
X2 797.0
GR7111.5     0.01 7109.54     8.00 7109.54    40.40 7111.54    48.40
X1 1460      4.0     0.01    47.10   20.00    20.00   20.00
X2 797.0
GR7111.8     0.01 7109.81     8.00 7109.81    39.10 7111.81    47.10
X1 1480      4.0     0.01    45.80   20.00    20.00   20.00
X2 797.0
GR7112.1     0.01 7110.08     8.00 7110.08    37.80 7112.08    45.80
X1 1500      4.0     0.01    44.50   20.00    20.00   20.00
X2 797.0
GR7112.4     0.01 7110.35     8.00 7110.35    36.50 7112.35    44.50
X1 1520      4.0     0.01    43.20   20.00    20.00   20.00
X2 797.0
GR7112.6     0.01 7110.62     8.00 7110.62    35.20 7112.62    43.20
X1 1540      4.0     0.01    41.90   20.00    20.00   20.00
X2 797.0
GR7112.9     0.01 7110.89     8.00 7110.89    33.90 7112.89    41.90
X1 1560      4.0     0.01    40.60   20.00    20.00   20.00
X2 797.0
GR7113.2     0.01 7111.16     8.00 7111.16    32.60 7113.16    40.60
X1 1580      4.0     0.01    39.30   20.00    20.00   20.00
X2 797.0
GR7113.4     0.01 7111.43     8.00 7111.43    31.30 7113.43    39.30
X11600       4.0     0.01    38.00   20.00    20.00   20.00
X2 797.0
GR7113.7     0.01 7111.70     8.00 7111.70    30.00 7113.70    38.00
```

TABLE F-3. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL D (continued).

```
X1 1620      4.0    0.01    37.60   20.00    20.00   20.00
X2 797.0
GR7113.9    0.01 7111.90    8.00 7111.90    29.60 7113.90   37.60
X1 1640      4.0    0.01    37.20   20.00    20.00   20.00
X2 797.0
GR7114.1    0.01 7112.10    8.00 7112.10    29.20 7114.10   37.20
X1 1660      4.0    0.01    36.80   20.00    20.00   20.00
X2 797.0
GR7114.3    0.01 7112.30    8.00 7112.30    28.80 7114.30   36.80
X1 1680      4.0    0.01    36.40   20.00    20.00   20.00
X2 797.0
GR7114.5    0.01 7112.50    8.00 7112.50    28.40 7114.50   36.40
X11700       4.0    0.01    36.00   20.00    20.00   20.00
X2 797.0
GR7114.7    0.01 7112.70    8.00 7112.70    28.00 7114.70   36.00
X11800      4.0    0.01    36.00  100.00  100.00  100.00
X2 797.0
GR7115.6    0.01 7113.60    8.00 7113.60    28.00 7115.60   36.00
X11850      4.0    0.01    36.00   50.00   50.00   50.00
X2 797.0
GR7116.0    0.01 7114.00    8.00 7114.00    28.00 7116.00   36.00
X1 1900      4.0    0.01    43.33   50.00    50.00   50.00
X2 819.0
GR7116.1    0.01 7114.10   15.33 7114.10    35.33 7116.10   43.33
X12000       4.0    0.01    58.00  100.00  100.00  100.00
X2 863.0
GR7116.3    0.01 7114.30   30.00 7114.30    50.00 7116.30   58.00
X1 2100      4.0    0.01    58.00  100.00  100.00  100.00
X2 719.5
GR7116.4    0.01 7114.42   30.00 7114.42    50.00 7116.42   58.00
X1 2200      4.0    0.01    58.00  100.00  100.00  100.00
X2 576.0
GR7116.5    0.01 7114.55   30.00 7114.55    50.00 7116.55   58.00
X1 2300      4.0    0.01    58.00  100.00  100.00  100.00
X2 432.5
GR7116.7    0.01 7114.67   30.00 7114.67    50.00 7116.67   58.00
X1411        4.0    0.01    58.00  100.00  100.00  100.00
X2 289.0
GR7116.8    0.01 7114.80   30.00 7114.80    50.00 7116.80   58.00
X12500      4.0    0.01    58.00  100.00  100.00  100.00
X2 289.0
GR7116.9    0.01 7114.90   30.00 7114.90    50.00 7116.90   58.00
X1 2600      4.0    0.01    47.00  100.00  100.00  100.00
X2 289.0
GR7117.8    0.01 7115.75   19.00 7115.75    39.00 7117.75   47.00
X12700       4.0    0.01    36.00  100.00  100.00  100.00
X2 289.0
GR7118.6    0.01 7116.60    8.00 7116.60    28.00 7118.60   36.00
X1 2800      4.0    0.01    36.00  100.00  100.00  100.00
X2 289.0
GR7120.1    0.01 7118.13    8.00 7118.13    28.00 7120.13   36.00
X1 2900      4.0    0.01    36.00  100.00  100.00  100.00
X2 289.0
GR7121.7    0.01 7119.67    8.00 7119.67    28.00 7121.67   36.00
X13000       4.0    0.01    36.00  100.00  100.00  100.00
X2 289.0
GR7123.2    0.01 7121.20    8.00 7121.20    28.00 7123.20   36.00
X13100      4.0    0.01    36.00  100.00  100.00  100.00
X2 289.0
GR7125.0    0.01 7123.00    8.00 7123.00    28.00 7125.00   36.00
X1 3110      4.0    0.01    36.00   10.00    10.00   10.00
X2 277.1
GR7125.3    0.01 7123.32    8.00 7123.32    28.00 7125.32   36.00
X1 3130      4.0    0.01    36.00   20.00    20.00   20.00
X2 253.2
GR7126.0    0.01 7123.96    8.00 7123.96    28.00 7125.96   36.00
X1 3150      4.0    0.01    36.00   20.00    20.00   20.00
X2 229.3
GR7126.6    0.01 7124.60    8.00 7124.60    28.00 7126.60   36.00
X1 3170      4.0    0.01    36.00   20.00    20.00   20.00
X2 205.5
GR7127.2    0.01 7125.24    8.00 7125.24    28.00 7127.24   36.00
X1 3190      4.0    0.01    36.00   20.00    20.00   20.00
X2 181.6
GR7127.9    0.01 7125.88    8.00 7125.88    28.00 7127.88   36.00
X1 3210      4.0    0.01    36.00   20.00    20.00   20.00
X2 157.7
GR7128.5    0.01 7126.52    8.00 7126.52    28.00 7128.52   36.00
X1 3230      4.0    0.01    36.00   20.00    20.00   20.00
X2 133.9
```

TABLE F-3. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL D (continued).

```
GR7129.2    0.01 7127.16    8.00 7127.16    28.00 7129.16    36.00
X1410       4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7129.8    0.01 7127.80    8.00 7127.80    28.00 7129.80    36.00
X1 3300     4.0     0.01   36.00   50.00    50.00   50.00
X2 110.0
GR7130.8    0.01 7128.80    8.00 7128.80    28.00 7130.80    36.00
X13400      4.0     0.01   36.00  100.00   100.00  100.00
X2 110.0
GR7132.8    0.01 7130.80    8.00 7130.80    28.00 7132.80    36.00
X1 3420     4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7133.5    0.01 7131.50    8.00 7131.50    28.00 7133.50    36.00
X1 3440     4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7134.2    0.01 7132.20    8.00 7132.20    28.00 7134.20    36.00
X1 3460     4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7134.9    0.01 7132.90    8.00 7132.90    28.00 7134.90    36.00
X1 3480     4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7135.6    0.01 7133.60    8.00 7133.60    28.00 7135.60    36.00
X1 3500     4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7136.3    0.01 7134.30    8.00 7134.30    28.00 7136.30    36.00
X1 3520     4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7137.0    0.01 7135.00    8.00 7135.00    28.00 7137.00    36.00
X1 3540     4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7137.7    0.01 7135.70    8.00 7135.70    28.00 7137.70    36.00
X1 3560     4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7138.4    0.01 7136.40    8.00 7136.40    28.00 7138.40    36.00
X1 3580     4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7139.1    0.01 7137.10    8.00 7137.10    28.00 7139.10    36.00
X13600      4.0     0.01   36.00   20.00    20.00   20.00
X2 110.0
GR7139.8    0.01 7137.80    8.00 7137.80    28.00 7139.80    36.00
EJ
ER
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TABLE F-4. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL D.

```
T1      PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2      CHANNEL D
T3      PMF - SUPERCRITICAL
J1                              1.0    -1.0                      110.0  7138.5
J2   -1         0     -1.0
NC 0.035   0.035   0.035    0.1     0.3
X13600       4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7139.8    0.01 7137.80    8.00 7137.80   28.00 7139.80   36.00
X1 3580      4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7139.1    0.01 7137.10    8.00 7137.10   28.00 7139.10   36.00
X1 3560      4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7138.4    0.01 7136.40    8.00 7136.40   28.00 7138.40   36.00
X1 3540      4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7137.7    0.01 7135.70    8.00 7135.70   28.00 7137.70   36.00
X1 3520      4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7137.0    0.01 7135.00    8.00 7135.00   28.00 7137.00   36.00
X1 3500      4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7136.3    0.01 7134.30    8.00 7134.30   28.00 7136.30   36.00
X1 3480      4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7135.6    0.01 7133.60    8.00 7133.60   28.00 7135.60   36.00
X1 3460      4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7134.9    0.01 7132.90    8.00 7132.90   28.00 7134.90   36.00
X1 3440      4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7134.2    0.01 7132.20    8.00 7132.20   28.00 7134.20   36.00
X1 3420      4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7133.5    0.01 7131.50    8.00 7131.50   28.00 7133.50   36.00
X13400       4.0    0.01   36.00  100.00  100.00  100.00
X2 110.0
GR7132.8    0.01 7130.80    8.00 7130.80   28.00 7132.80   36.00
X1 3300      4.0    0.01   36.00   50.00   50.00   50.00
X2 110.0
GR7130.8    0.01 7128.80    8.00 7128.80   28.00 7130.80   36.00
X1410        4.0    0.01   36.00   20.00   20.00   20.00
X2 110.0
GR7129.8    0.01 7127.80    8.00 7127.80   28.00 7129.80   36.00
X1 3230      4.0    0.01   36.00   20.00   20.00   20.00
X2 133.9
GR7129.2    0.01 7127.16    8.00 7127.16   28.00 7129.16   36.00
X1 3210      4.0    0.01   36.00   20.00   20.00   20.00
X2 157.7
GR7128.5    0.01 7126.52    8.00 7126.52   28.00 7128.52   36.00
X1 3190      4.0    0.01   36.00   20.00   20.00   20.00
X2 181.6
GR7127.9    0.01 7125.88    8.00 7125.88   28.00 7127.88   36.00
X1 3170      4.0    0.01   36.00   20.00   20.00   20.00
X2 205.5
GR7127.2    0.01 7125.24    8.00 7125.24   28.00 7127.24   36.00
X1 3150      4.0    0.01   36.00   20.00   20.00   20.00
X2 229.3
GR7126.6    0.01 7124.60    8.00 7124.60   28.00 7126.60   36.00
X1 3130      4.0    0.01   36.00   20.00   20.00   20.00
X2 253.2
GR7126.0    0.01 7123.96    8.00 7123.96   28.00 7125.96   36.00
X1 3110      4.0    0.01   36.00   10.00   10.00   10.00
X2 277.1
GR7125.3    0.01 7123.32    8.00 7123.32   28.00 7125.32   36.00
X13100      4.0    0.01   36.00  100.00  100.00  100.00
X2 289.0
GR7125.0    0.01 7123.00    8.00 7123.00   28.00 7125.00   36.00
X13000       4.0    0.01   36.00  100.00  100.00  100.00
X2 289.0
GR7123.2    0.01 7121.20    8.00 7121.20   28.00 7123.20   36.00
X1 2900      4.0    0.01   36.00  100.00  100.00  100.00
X2 289.0
GR7121.7    0.01 7119.67    8.00 7119.67   28.00 7121.67   36.00
X1 2800      4.0    0.01   36.00  100.00  100.00  100.00
X2 289.0
GR7120.1    0.01 7118.13    8.00 7118.13   28.00 7120.13   36.00
X12700       4.0    0.01   36.00  100.00  100.00  100.00
X2 289.0
```

TABLE F-4. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL D (continued).

```
GR7118.6     0.01 7116.60     8.00 7116.60    28.00 7118.60    36.00
X1 2600       4.0    0.01    47.00  100.00   100.00  100.00
X2 289.0
GR7117.8     0.01 7115.75    19.00 7115.75    39.00 7117.75    47.00
X12500       4.0     0.01    58.00  100.00   100.00  100.00
X2 289.0
GR7116.9     0.01 7114.90    30.00 7114.90    50.00 7116.90    58.00
X1411         4.0    0.01    58.00  100.00   100.00  100.00
X2 289.0
GR7116.8     0.01 7114.80    30.00 7114.80    50.00 7116.80    58.00
X1 2300       4.0    0.01    58.00  100.00   100.00  100.00
X2 432.5
GR7116.7     0.01 7114.67    30.00 7114.67    50.00 7116.67    58.00
X1 2200       4.0    0.01    58.00  100.00   100.00  100.00
X2 576.0
GR7116.5     0.01 7114.55    30.00 7114.55    50.00 7116.55    58.00
X1 2100       4.0    0.01    58.00  100.00   100.00  100.00
X2 719.5
GR7116.4     0.01 7114.42    30.00 7114.42    50.00 7116.42    58.00
X12000        4.0    0.01    58.00  100.00   100.00  100.00
X2 863.0
GR7116.3     0.01 7114.30    30.00 7114.30    50.00 7116.30    58.00
X1 1900       4.0    0.01    43.33   50.00    50.00   50.00
X2 819.0
GR7116.1     0.01 7114.10    15.33 7114.10    35.33 7116.10    43.33
X11850       4.0     0.01    36.00   50.00    50.00   50.00
X2 797.0
GR7116.0     0.01 7114.00     8.00 7114.00    28.00 7116.00    36.00
X11800       4.0     0.01    36.00  100.00   100.00  100.00
X2 797.0
GR7115.6     0.01 7113.60     8.00 7113.60    28.00 7115.60    36.00
X11700        4.0    0.01    36.00   20.00    20.00   20.00
X2 797.0
GR7114.7     0.01 7112.70     8.00 7112.70    28.00 7114.70    36.00
X1 1680       4.0    0.01    36.40   20.00    20.00   20.00
X2 797.0
GR7114.5     0.01 7112.50     8.00 7112.50    28.40 7114.50    36.40
X1 1660       4.0    0.01    36.80   20.00    20.00   20.00
X2 797.0
GR7114.3     0.01 7112.30     8.00 7112.30    28.80 7114.30    36.80
X1 1640       4.0    0.01    37.20   20.00    20.00   20.00
X2 797.0
GR7114.1     0.01 7112.10     8.00 7112.10    29.20 7114.10    37.20
X1 1620       4.0    0.01    37.60   20.00    20.00   20.00
X2 797.0
GR7113.9     0.01 7111.90     8.00 7111.90    29.60 7113.90    37.60
X11600        4.0    0.01    38.00   20.00    20.00   20.00
X2 797.0
GR7113.7     0.01 7111.70     8.00 7111.70    30.00 7113.70    38.00
X1 1580       4.0    0.01    39.30   20.00    20.00   20.00
X2 797.0
GR7113.4     0.01 7111.43     8.00 7111.43    31.30 7113.43    39.30
X1 1560       4.0    0.01    40.60   20.00    20.00   20.00
X2 797.0
GR7113.2     0.01 7111.16     8.00 7111.16    32.60 7113.16    40.60
X1 1540       4.0    0.01    41.90   20.00    20.00   20.00
X2 797.0
GR7112.9     0.01 7110.89     8.00 7110.89    33.90 7112.89    41.90
X1 1520       4.0    0.01    43.20   20.00    20.00   20.00
X2 797.0
GR7112.6     0.01 7110.62     8.00 7110.62    35.20 7112.62    43.20
X1 1500       4.0    0.01    44.50   20.00    20.00   20.00
X2 797.0
GR7112.4     0.01 7110.35     8.00 7110.35    36.50 7112.35    44.50
X1 1480       4.0    0.01    45.80   20.00    20.00   20.00
X2 797.0
GR7112.1     0.01 7110.08     8.00 7110.08    37.80 7112.08    45.80
X1 1460       4.0    0.01    47.10   20.00    20.00   20.00
X2 797.0
GR7111.8     0.01 7109.81     8.00 7109.81    39.10 7111.81    47.10
X1 1440       4.0    0.01    48.40   20.00    20.00   20.00
X2 797.0
GR7111.5     0.01 7109.54     8.00 7109.54    40.40 7111.54    48.40
X1 1420       4.0    0.01    49.70   20.00    20.00   20.00
X2 797.0
GR7111.3     0.01 7109.27     8.00 7109.27    41.70 7111.27    49.70
X11400        4.0    0.01    51.00   20.00    20.00   20.00
X2 797.0
GR7111.0     0.01 7109.00     8.00 7109.00    43.00 7111.00    51.00
X1 1380       4.0    0.01    52.00   20.00    20.00   20.00
```

TABLE F-4. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL D (continued).

```
X2 797.0
GR7110.8   0.01 7108.76   8.00 7108.76   44.00 7110.76   52.00
X1 1360    4.0     0.01  53.00   20.00   20.00   20.00
X2 797.0
GR7110.5   0.01 7108.52   8.00 7108.52   45.00 7110.52   53.00
X1 1340    4.0     0.01  54.00   20.00   20.00   20.00
X2 797.0
GR7110.3   0.01 7108.28   8.00 7108.28   46.00 7110.28   54.00
X1 1320    4.0     0.01  55.00   20.00   20.00   20.00
X2 797.0
GR7110.0   0.01 7108.04   8.00 7108.04   47.00 7110.04   55.00
X11300     4.0     0.01  56.00   20.00   20.00   20.00
X2 797.0
GR7109.8   0.01 7107.80   8.00 7107.80   48.00 7109.80   56.00
X1 1280    4.0     0.01  58.00   20.00   20.00   20.00
X2 797.0
GR7109.6   0.01 7107.64   8.00 7107.64   50.00 7109.64   58.00
X1 1260    4.0     0.01  60.00   20.00   20.00   20.00
X2 797.0
GR7109.5   0.01 7107.48   8.00 7107.48   52.00 7109.48   60.00
X1 1240    4.0     0.01  62.00   20.00   20.00   20.00
X2 797.0
GR7109.3   0.01 7107.32   8.00 7107.32   54.00 7109.32   62.00
X1 1220    4.0     0.01  64.00   20.00   20.00   20.00
X2 797.0
GR7109.2   0.01 7107.16   8.00 7107.16   56.00 7109.16   64.00
X11200     4.0   0.01   66.00  100.00  100.00  100.00
X2 797.0
GR7109.0   0.01 7107.00   8.00 7107.00   58.00 7109.00   66.00
X11100     4.0     0.01  66.00  100.00  100.00  100.00
X2 850.0
GR7108.1   0.01 7106.10   8.00 7106.10   58.00 7108.10   66.00
X1 1000    4.0     0.01  66.00  100.00  100.00  100.00
X2 875.0
GR7107.2   0.01 7105.15   8.00 7105.15   58.00 7107.15   66.00
X1900      4.0     0.01  66.00  100.00  100.00  100.00
X2 900.0
GR7106.2   0.01 7104.20   8.00 7104.20   58.00 7106.20   66.00
X1 800     4.0     0.01  66.00  100.00  100.00  100.00
X2 950.0
GR7105.5   0.01 7103.55   8.00 7103.55   58.00 7105.55   66.00
X1700      4.0   0.01   66.00  100.00  100.00  100.00
X21000.0
GR7104.9   0.01 7102.90   8.00 7102.90   58.00 7104.90   66.00
X1600      4.0     0.01  66.00   20.00   20.00   20.00
X21100.0
GR7102.5   0.01 7100.50   8.00 7100.50   58.00 7102.50   66.00
X1 580     4.0     0.01  66.00   20.00   20.00   20.00
X21110.0
GR7101.9   0.01 7099.86   8.00 7099.86   58.00 7101.86   66.00
X1 560     4.0     0.01  66.00   20.00   20.00   20.00
X21120.0
GR7101.2   0.01 7099.22   8.00 7099.22   58.00 7101.22   66.00
X1 540     4.0     0.01  66.00   20.00   20.00   20.00
X21130.0
GR7100.6   0.01 7098.58   8.00 7098.58   58.00 7100.58   66.00
X1 520     4.0     0.01  66.00   20.00   20.00   20.00
X21140.0
GR7099.9   0.01 7097.94   8.00 7097.94   58.00 7099.94   66.00
X1 500     4.0     0.01  66.00   20.00   20.00   20.00
X21150.0
GR7099.3   0.01 7097.30   8.00 7097.30   58.00 7099.30   66.00
X1 480     4.0     0.01  66.00   20.00   20.00   20.00
X21160.0
GR7098.7   0.01 7096.66   8.00 7096.66   58.00 7098.66   66.00
X1 460     4.0     0.01  66.00   20.00   20.00   20.00
X21170.0
GR7098.0   0.01 7096.02   8.00 7096.02   58.00 7098.02   66.00
X1 440     4.0     0.01  66.00   20.00   20.00   20.00
X21180.0
GR7097.4   0.01 7095.38   8.00 7095.38   58.00 7097.38   66.00
X1 420     4.0     0.01  66.00   20.00   20.00   20.00
X21190.0
GR7096.7   0.01 7094.74   8.00 7094.74   58.00 7096.74   66.00
X1400      4.0     0.01  66.00   20.00   20.00   20.00
X21200.0
GR7096.1   0.01 7094.10   8.00 7094.10   58.00 7096.10   66.00
X1 380     4.0     0.01  66.00   20.00   20.00   20.00
X21210.0
GR7095.3   0.01 7093.32   8.00 7093.32   58.00 7095.32   66.00
```

TABLE F-4. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL D (continued).

```
X1 360       4.0     0.01    66.00   20.00    20.00    20.00
X21220.0
GR7094.5    0.01 7092.54     8.00 7092.54    58.00 7094.54    66.00
X1 340       4.0     0.01    66.00   20.00    20.00    20.00
X21230.0
GR7093.8    0.01 7091.76     8.00 7091.76    58.00 7093.76    66.00
X1 320       4.0     0.01    66.00   20.00    20.00    20.00
X21240.0
GR7093.0    0.01 7090.98     8.00 7090.98    58.00 7092.98    66.00
X1300        4.0     0.01    66.00   20.00    20.00    20.00
X21250.0
GR7092.2    0.01 7090.20     8.00 7090.20    58.00 7092.20    66.00
X1 280       4.0     0.01    66.00   20.00    20.00    20.00
X21261.8
GR7091.2    0.01 7089.17     8.00 7089.17    58.00 7091.17    66.00
X1 260       4.0     0.01    66.00   20.00    20.00    20.00
X21273.5
GR7090.1    0.01 7088.13     8.00 7088.13    58.00 7090.13    66.00
X1 240       4.0     0.01    66.00   20.00    20.00    20.00
X21285.3
GR7089.1    0.01 7087.09     8.00 7087.09    58.00 7089.09    66.00
X1 220       4.0     0.01    66.00    5.00     5.00     5.00
X21297.1
GR7088.1    0.01 7086.06     8.00 7086.06    58.00 7088.06    66.00
X1413       4.0     0.01    66.00   15.00    15.00    15.00
X21300.0
GR7087.8    0.01 7085.80     8.00 7085.80    58.00 7087.80    66.00
X1200       4.0     0.01    66.00   50.00    50.00    50.00
X21300.0
GR7087.0    0.01 7085.00     8.00 7085.00    58.00 7087.00    66.00
X1150       4.0     0.01    66.00   50.00    50.00    50.00
X21325.0
GR7085.5    0.01 7083.50     8.00 7083.50    58.00 7085.50    66.00
X1100       4.0     0.01    66.00
X21325.0
GR7109.8    0.01 7107.80     8.00 7107.80    58.00 7109.80    66.00
EJ
ER
```

TABLE F-5. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL H.

```
T1      PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2      CHANNEL H
T3      PMF - SUBCRITICAL
J1                                  -1.0                    620.0  6965.0
J2   -1        0    -1.0
NC 0.035   0.035   0.035     0.1      0.3
X140       4.0     0.01   72.00
X2 620.0
GR6967.6    0.01 6963.60   16.00 6963.60   56.00 6967.60   72.00
X150       4.0     0.01   72.00   10.00   10.00   10.00
X2 620.0
GR6967.7    0.01 6963.70   16.00 6963.70   56.00 6967.70   72.00
X1100      4.0     0.01   72.00   50.00   50.00   50.00
X2 620.0
GR6967.8    0.01 6963.80   16.00 6963.80   56.00 6967.80   72.00
X1157      4.0     0.01   72.00   57.00   57.00   57.00
X2 620.0
GR6968.1    0.01 6964.10   16.00 6964.10   56.00 6968.10   72.00
X1165      4.0     0.01   72.00    8.00    8.00    8.00
X2 620.0
GR6969.1    0.01 6965.10   16.00 6965.10   56.00 6969.10   72.00
X1175      4.0     0.01   72.00   10.00   10.00   10.00
X2 620.0
GR6970.4    0.01 6966.40   16.00 6966.40   56.00 6970.40   72.00
X1183      4.0     0.01   64.00    8.00    8.00    8.00
X2 620.0
GR6970.5    0.01 6967.50   12.00 6967.50   52.00 6970.50   64.00
X1193      4.0     0.01   64.00   10.00   10.00   10.00
X2 620.0
GR6971.8    0.01 6968.80   12.00 6968.80   52.00 6971.80   64.00
X1203      4.0     0.01   64.00   10.00   10.00   10.00
X2 620.0
GR6973.1    0.01 6970.10   12.00 6970.10   52.00 6973.10   64.00
X1213      4.0     0.01   64.00   10.00   10.00   10.00
X2 620.0
GR6974.4    0.01 6971.40   12.00 6971.40   52.00 6974.40   64.00
X1223      4.0     0.01   64.00   10.00   10.00   10.00
X2 620.0
GR6975.7    0.01 6972.70   12.00 6972.70   52.00 6975.70   64.00
X1233      4.0     0.01   56.00   10.00   10.00   10.00
X2 620.0
GR6976.0    0.01 6974.00    8.00 6974.00   48.00 6976.00   56.00
X1240      4.0     0.01   56.00    7.00    7.00    7.00
X2 620.0
GR6977.0    0.01 6975.00    8.00 6975.00   48.00 6977.00   56.00
X1 260     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6979.8    0.01 6977.83    8.00 6977.83   48.00 6979.83   56.00
X1 280     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6982.7    0.01 6980.67    8.00 6980.67   48.00 6982.67   56.00
X1300      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6985.5    0.01 6983.50    8.00 6983.50   48.00 6985.50   56.00
X1 320     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6988.1    0.01 6986.10    8.00 6986.10   48.00 6988.10   56.00
X1 340     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6990.7    0.01 6988.70    8.00 6988.70   48.00 6990.70   56.00
X1 360     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6993.3    0.01 6991.30    8.00 6991.30   48.00 6993.30   56.00
X1 380     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6995.9    0.01 6993.90    8.00 6993.90   48.00 6995.90   56.00
X1 400     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6998.5    0.01 6996.50    8.00 6996.50   48.00 6998.50   56.00
X1 420     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7001.1    0.01 6999.10    8.00 6999.10   48.00 7001.10   56.00
X1 440     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7003.7    0.01 7001.70    8.00 7001.70   48.00 7003.70   56.00
X1 460     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7006.3    0.01 7004.30    8.00 7004.30   48.00 7006.30   56.00
X1 480     4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
```

TABLE F-5. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL H (continued).

```
GR7008.9    0.01 7006.90    8.00 7006.90   48.00 7008.90   56.00
X1500        4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7011.5    0.01 7009.50    8.00 7009.50   48.00 7011.50   56.00
X1 520       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7014.1    0.01 7012.15    8.00 7012.15   48.00 7014.15   56.00
X1 540       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7016.8    0.01 7014.80    8.00 7014.80   48.00 7016.80   56.00
X1 560       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7019.5    0.01 7017.45    8.00 7017.45   48.00 7019.45   56.00
X1 580       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7022.1    0.01 7020.10    8.00 7020.10   48.00 7022.10   56.00
X1 600       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7024.8    0.01 7022.75    8.00 7022.75   48.00 7024.75   56.00
X1 620       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7027.4    0.01 7025.40    8.00 7025.40   48.00 7027.40   56.00
X1 640       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7030.0    0.01 7028.05    8.00 7028.05   48.00 7030.05   56.00
X1 660       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7032.7    0.01 7030.70    8.00 7030.70   48.00 7032.70   56.00
X1 680       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7035.4    0.01 7033.35    8.00 7033.35   48.00 7035.35   56.00
X1700        4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7038.0    0.01 7036.00    8.00 7036.00   48.00 7038.00   56.00
X1 720       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7040.6    0.01 7038.60    8.00 7038.60   48.00 7040.60   56.00
X1 740       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7043.2    0.01 7041.20    8.00 7041.20   48.00 7043.20   56.00
X1 760       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7045.8    0.01 7043.80    8.00 7043.80   48.00 7045.80   56.00
X1 780       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7048.4    0.01 7046.40    8.00 7046.40   48.00 7048.40   56.00
X1 800       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7051.0    0.01 7049.00    8.00 7049.00   48.00 7051.00   56.00
X1 820       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7053.6    0.01 7051.60    8.00 7051.60   48.00 7053.60   56.00
X1 840       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7056.2    0.01 7054.20    8.00 7054.20   48.00 7056.20   56.00
X1 860       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7058.8    0.01 7056.80    8.00 7056.80   48.00 7058.80   56.00
X1 880       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7061.4    0.01 7059.40    8.00 7059.40   48.00 7061.40   56.00
X1900        4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7064.0    0.01 7062.00    8.00 7062.00   48.00 7064.00   56.00
X1 920       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7066.7    0.01 7064.70    8.00 7064.70   48.00 7066.70   56.00
X1 940       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7069.4    0.01 7067.40    8.00 7067.40   48.00 7069.40   56.00
X1 960       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7072.1    0.01 7070.10    8.00 7070.10   48.00 7072.10   56.00
X1 980       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7074.8    0.01 7072.80    8.00 7072.80   48.00 7074.80   56.00
X11000       4.0    0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7077.5    0.01 7075.50    8.00 7075.50   48.00 7077.50   56.00
X11010       4.0    0.01  104.00   10.00   10.00   10.00
```

TABLE F-5. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL H (continued).

```
X2 620.0
GR7085.0    0.01 7077.00   32.00 7077.00   72.00 7085.00  104.00
X11030      4.0     0.01  104.00   20.00   20.00   20.00
X2 620.0
GR7086.5    0.01 7078.50   32.00 7078.50   72.00 7086.50  104.00
X11050      4.0     0.01  104.00   20.00   20.00   20.00
X2 620.0
GR7087.0    0.01 7079.00   32.00 7079.00   72.00 7087.00  104.00
X11100      4.0     0.01  104.00   50.00   50.00   50.00
X2 620.0
GR7087.4    0.01 7079.40   32.00 7079.40   72.00 7087.40  104.00
X11200      4.0     0.01  104.00  100.00  100.00  100.00
X2 620.0
GR7087.6    0.01 7079.60   32.00 7079.60   72.00 7087.60  104.00
X1 1220     4.0     0.01  102.75   20.00   20.00   20.00
X2 620.0
GR7087.7    0.01 7079.70   32.00 7079.70   70.75 7087.70  102.75
X1 1240     4.0     0.01  101.50   20.00   20.00   20.00
X2 620.0
GR7087.8    0.01 7079.80   32.00 7079.80   69.50 7087.80  101.50
X1 1260     4.0     0.01  100.25   20.00   20.00   20.00
X2 620.0
GR7087.9    0.01 7079.90   32.00 7079.90   68.25 7087.90  100.25
X11280      4.0     0.01   99.00   20.00   20.00   20.00
X2 620.0
GR7088.0    0.01 7080.00   32.00 7080.00   67.00 7088.00   99.00
X1 1282     4.0     0.01   97.70    2.00    2.00    2.00
X2 620.0
GR7088.0    0.01 7080.04   31.60 7080.04   66.10 7088.04   97.70
X1 1285     4.0     0.01   95.75    3.00    3.00    3.00
X2 620.0
GR7088.1    0.01 7080.10   31.00 7080.10   64.75 7088.10   95.75
X1 1288     4.0     0.01   93.80    3.00    3.00    3.00
X2 620.0
GR7088.2    0.01 7080.16   30.40 7080.16   63.40 7088.16   93.80
X1 1291     4.0     0.01   91.85    3.00    3.00    3.00
X2 620.0
GR7088.2    0.01 7080.22   29.80 7080.22   62.05 7088.22   91.85
X1 1294     4.0     0.01   89.90    3.00    3.00    3.00
X2 620.0
GR7088.3    0.01 7080.28   29.20 7080.28   60.70 7088.28   89.90
X1 1297     4.0     0.01   87.95    3.00    3.00    3.00
X2 620.0
GR7088.3    0.01 7080.34   28.60 7080.34   59.35 7088.34   87.95
X11300      4.0     0.01   86.00    3.00    3.00    3.00
X2 620.0
GR7088.4    0.01 7080.40   28.00 7080.40   58.00 7088.40   86.00
X1 1303     4.0     0.01   84.65    3.00    3.00    3.00
X2 620.0
GR7088.4    0.01 7080.41   27.70 7080.41   56.95 7088.41   84.65
X1 1306     4.0     0.01   83.30    3.00    3.00    3.00
X2 620.0
GR7088.4    0.01 7080.42   27.40 7080.42   55.90 7088.42   83.30
X1 1309     4.0     0.01   81.95    3.00    3.00    3.00
X2 620.0
GR7088.4    0.01 7080.44   27.10 7080.44   54.85 7088.44   81.95
X1 1312     4.0     0.01   80.60    3.00    3.00    3.00
X2 620.0
GR7088.4    0.01 7080.45   26.80 7080.45   53.80 7088.45   80.60
X1 1315     4.0     0.01   79.25    3.00    3.00    3.00
X2 620.0
GR7088.5    0.01 7080.46   26.50 7080.46   52.75 7088.46   79.25
X1 1318     4.0     0.01   77.90    3.00    3.00    3.00
X2 620.0
GR7088.5    0.01 7080.48   26.20 7080.48   51.70 7088.48   77.90
X1 1321     4.0     0.01   76.55    3.00    3.00    3.00
X2 620.0
GR7088.5    0.01 7080.49   25.90 7080.49   50.65 7088.49   76.55
X1 1324     4.0     0.01   75.20    3.00    3.00    3.00
X2 620.0
GR7088.5    0.01 7080.50   25.60 7080.50   49.60 7088.50   75.20
X1 1327     4.0     0.01   73.85    3.00    3.00    3.00
X2 620.0
GR7088.5    0.01 7080.51   25.30 7080.51   48.55 7088.51   73.85
X1 1330     4.0     0.01   72.50    3.00    3.00    3.00
X2 620.0
GR7088.5    0.01 7080.52   25.00 7080.52   47.50 7088.52   72.50
X1 1333     4.0     0.01   71.15    3.00    3.00    3.00
X2 620.0
GR7088.5    0.01 7080.54   24.70 7080.54   46.45 7088.54   71.15
```

TABLE F-5. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL H (continued).

```
X1 1336     4.0     0.01    69.80     3.00     3.00     3.00
X2 620.0
GR7088.5    0.01 7080.55    24.40  7080.55    45.40  7088.55    69.80
X1 1339     4.0     0.01    68.45     3.00     3.00     3.00
X2 620.0
GR7088.6    0.01 7080.56    24.10  7080.56    44.35  7088.56    68.45
X1 1342     4.0     0.01    67.10     3.00     3.00     3.00
X2 620.0
GR7088.6    0.01 7080.57    23.80  7080.57    43.30  7088.57    67.10
X1 1345     4.0     0.01    65.75     3.00     3.00     3.00
X2 620.0
GR7088.6    0.01 7080.59    23.50  7080.59    42.25  7088.59    65.75
X1 1348     4.0     0.01    64.40     3.00     3.00     3.00
X2 620.0
GR7088.6    0.01 7080.60    23.20  7080.60    41.20  7088.60    64.40
X1 1351     4.0     0.01    63.05     3.00     3.00     3.00
X2 620.0
GR7088.6    0.01 7080.61    22.90  7080.61    40.15  7088.61    63.05
X1 1354     4.0     0.01    61.70     3.00     3.00     3.00
X2 620.0
GR7088.6    0.01 7080.63    22.60  7080.63    39.10  7088.63    61.70
X1 1357     4.0     0.01    60.35     3.00     3.00     3.00
X2 620.0
GR7088.6    0.01 7080.64    22.30  7080.64    38.05  7088.64    60.35
X1 1360     4.0     0.01    59.00     3.00     3.00     3.00
X2 620.0
GR7088.6    0.01 7080.65    22.00  7080.65    37.00  7088.65    59.00
X1 1363     4.0     0.01    57.65     3.00     3.00     3.00
X2 620.0
GR7088.7    0.01 7080.66    21.70  7080.66    35.95  7088.66    57.65
X1 1366     4.0     0.01    56.30     3.00     3.00     3.00
X2 620.0
GR7088.7    0.01 7080.67    21.40  7080.67    34.90  7088.67    56.30
X1 1369     4.0     0.01    54.95     3.00     3.00     3.00
X2 620.0
GR7088.7    0.01 7080.69    21.10  7080.69    33.85  7088.69    54.95
X1 1372     4.0     0.01    53.60     3.00     3.00     3.00
X2 620.0
GR7088.7    0.01 7080.70    20.80  7080.70    32.80  7088.70    53.60
X1 1375     4.0     0.01    52.25     3.00     3.00     3.00
X2 620.0
GR7088.7    0.01 7080.71    20.50  7080.71    31.75  7088.71    52.25
X1 1378     4.0     0.01    50.90     3.00     3.00     3.00
X2 620.0
GR7088.7    0.01 7080.73    20.20  7080.73    30.70  7088.73    50.90
X1 1381     4.0     0.01    49.55     3.00     3.00     3.00
X2 620.0
GR7088.7    0.01 7080.74    19.90  7080.74    29.65  7088.74    49.55
X1 1384     4.0     0.01    48.20     3.00     3.00     3.00
X2 620.0
GR7088.8    0.01 7080.75    19.60  7080.75    28.60  7088.75    48.20
X1 1387     4.0     0.01    46.85     3.00     3.00     3.00
X2 620.0
GR7088.8    0.01 7080.76    19.30  7080.76    27.55  7088.76    46.85
X1 1390     4.0     0.01    45.50     3.00     3.00     3.00
X2 620.0
GR7088.8    0.01 7080.77    19.00  7080.77    26.50  7088.77    45.50
X1 1393     4.0     0.01    44.15     3.00     3.00     3.00
X2 620.0
GR7088.8    0.01 7080.79    18.70  7080.79    25.45  7088.79    44.15
X1 1396     4.0     0.01    42.80     3.00     3.00     3.00
X2 620.0
GR7088.8    0.01 7080.80    18.40  7080.80    24.40  7088.80    42.80
X1 1399     4.0     0.01    41.45     3.00     3.00     3.00
X2 620.0
GR7088.8    0.01 7080.81    18.10  7080.81    23.35  7088.81    41.45
X1 1402     4.0     0.01    40.10     3.00     3.00     3.00
X2 620.0
GR7088.8    0.01 7080.82    17.80  7080.82    22.30  7088.82    40.10
X1 1405     4.0     0.01    38.75     3.00     3.00     3.00
X2 620.0
GR7088.8    0.01 7080.84    17.50  7080.84    21.25  7088.84    38.75
X1 1408     4.0     0.01    37.40     3.00     3.00     3.00
X2 620.0
GR7088.9    0.01 7080.85    17.20  7080.85    20.20  7088.85    37.40
X1 1411     4.0     0.01    36.05     3.00     3.00     3.00
X2 620.0
GR7088.9    0.01 7080.86    16.90  7080.86    19.15  7088.86    36.05
X1 1414     4.0     0.01    34.70     3.00     3.00     3.00
X2 620.0
```

TABLE F-5. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL H (continued).

```
GR7088.9    0.01 7080.88   16.60 7080.88   18.10 7088.88   34.70
X1 1417     4.0     0.01   33.35    3.00    3.00    3.00
X2 620.0
GR7088.9    0.01 7080.89   16.30 7080.89   17.05 7088.89   33.35
X11420      4.0     0.01   32.00    3.00    3.00    3.00
X2 620.0
GR7088.9    0.01 7080.90   16.00 7080.90   16.00 7088.90   32.00
X11         4.0     0.01   32.00   40.00   40.00   40.00
X2 620.0
GR7089.0    0.01 7081.00   16.00 7081.00   16.00 7089.00   32.00
X11490      4.0     0.01   32.00   30.00   30.00   30.00
X2 620.0
GR7089.0    0.01 7081.00   16.00 7081.00   16.00 7089.00   32.00
X11500      4.0     0.01   37.00   10.00   10.00   10.00
X2 620.0
GR7089.0    0.01 7081.00   16.00 7081.00   21.00 7089.00   37.00
X1 1501     4.0     0.01   37.67    1.00    1.00    1.00
X2 620.0
GR7089.0    0.01 7081.00   16.16 7081.00   21.51 7089.00   37.67
X1 1504     4.0     0.01   39.68    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.00   16.64 7081.00   23.04 7089.00   39.68
X1 1507     4.0     0.01   41.69    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.01   17.12 7081.01   24.57 7089.01   41.69
X1 1510     4.0     0.01   43.70    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.01   17.60 7081.01   26.10 7089.01   43.70
X1 1513     4.0     0.01   45.71    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.01   18.08 7081.01   27.63 7089.01   45.71
X1 1516     4.0     0.01   47.72    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.02   18.56 7081.02   29.16 7089.02   47.72
X1 1519     4.0     0.01   49.73    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.02   19.04 7081.02   30.69 7089.02   49.73
X1 1522     4.0     0.01   51.74    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.02   19.52 7081.02   32.22 7089.02   51.74
X1 1525     4.0     0.01   53.75    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.02   20.00 7081.02   33.75 7089.02   53.75
X1 1528     4.0     0.01   55.76    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.03   20.48 7081.03   35.28 7089.03   55.76
X1 1531     4.0     0.01   57.77    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.03   20.96 7081.03   36.81 7089.03   57.77
X1 1534     4.0     0.01   59.78    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.03   21.44 7081.03   38.34 7089.03   59.78
X1 1537     4.0     0.01   61.79    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.04   21.92 7081.04   39.87 7089.04   61.79
X1 1540     4.0     0.01   63.80    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.04   22.40 7081.04   41.40 7089.04   63.80
X1 1543     4.0     0.01   65.81    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.04   22.88 7081.04   42.93 7089.04   65.81
X1 1546     4.0     0.01   67.82    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.05   23.36 7081.05   44.46 7089.05   67.82
X1 1549     4.0     0.01   69.83    3.00    3.00    3.00
X2 620.0
GR7089.0    0.01 7081.05   23.84 7081.05   45.99 7089.05   69.83
X1 1552     4.0     0.01   71.84    3.00    3.00    3.00
X2 620.0
GR7089.1    0.01 7081.05   24.32 7081.05   47.52 7089.05   71.84
X1 1555     4.0     0.01   73.85    3.00    3.00    3.00
X2 620.0
GR7089.1    0.01 7081.06   24.80 7081.06   49.05 7089.06   73.85
X1 1558     4.0     0.01   75.86    3.00    3.00    3.00
X2 620.0
GR7089.1    0.01 7081.06   25.28 7081.06   50.58 7089.06   75.86
X1 1561     4.0     0.01   77.87    3.00    3.00    3.00
X2 620.0
GR7089.1    0.01 7081.06   25.76 7081.06   52.11 7089.06   77.87
X1 1564     4.0     0.01   79.88    3.00    3.00    3.00
```

TABLE F-5. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL H (continued).

```
X2 620.0
GR7089.1     0.01 7081.06   26.24 7081.06   53.64 7089.06   79.88
X1 1567      4.0     0.01   81.89    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.07   26.72 7081.07   55.17 7089.07   81.89
X1 1570      4.0     0.01   83.90    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.07   27.20 7081.07   56.70 7089.07   83.90
X1 1573      4.0     0.01   85.91    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.07   27.68 7081.07   58.23 7089.07   85.91
X1 1576      4.0     0.01   87.92    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.08   28.16 7081.08   59.76 7089.08   87.92
X1 1579      4.0     0.01   89.93    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.08   28.64 7081.08   61.29 7089.08   89.93
X1 1582      4.0     0.01   91.94    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.08   29.12 7081.08   62.82 7089.08   91.94
X1 1585      4.0     0.01   93.95    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.09   29.60 7081.09   64.35 7089.09   93.95
X1 1588      4.0     0.01   95.96    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.09   30.08 7081.09   65.88 7089.09   95.96
X1 1591      4.0     0.01   97.97    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.09   30.56 7081.09   67.41 7089.09   97.97
X1 1594      4.0     0.01   99.98    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.09   31.04 7081.09   68.94 7089.09   99.98
X1 1597      4.0     0.01  101.99    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.10   31.52 7081.10   70.47 7089.10  101.99
X11600       4.0     0.01  104.00    3.00    3.00    3.00
X2 620.0
GR7089.1     0.01 7081.10   32.00 7081.10   72.00 7089.10  104.00
X11700      4.0    0.01  104.00  100.00  100.00  100.00
X2 620.0
GR7089.2     0.01 7081.20   32.00 7081.20   72.00 7089.20  104.00
EJ
ER
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TABLE F-6. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL H.

```
T1      PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2      CHANNEL H
T3      PMF - SUPERCRITICAL
J1                           1.0     -1.0                          620.0   7088.2
J2   -1          0    -1.0
NC 0.035    0.035    0.035    0.1      0.3
X11700      4.0      0.01  104.00   100.00  100.00  100.00
X2 620.0
GR7089.2    0.01  7081.20   32.00  7081.20   72.00 7089.20  104.00
X11600      4.0      0.01  104.00     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.10   32.00  7081.10   72.00 7089.10  104.00
X1 1597     4.0      0.01  101.99     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.10   31.52  7081.10   70.47 7089.10  101.99
X1 1594     4.0      0.01   99.98     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.09   31.04  7081.09   68.94 7089.09   99.98
X1 1591     4.0      0.01   97.97     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.09   30.56  7081.09   67.41 7089.09   97.97
X1 1588     4.0      0.01   95.96     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.09   30.08  7081.09   65.88 7089.09   95.96
X1 1585     4.0      0.01   93.95     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.09   29.60  7081.09   64.35 7089.09   93.95
X1 1582     4.0      0.01   91.94     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.08   29.12  7081.08   62.82 7089.08   91.94
X1 1579     4.0      0.01   89.93     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.08   28.64  7081.08   61.29 7089.08   89.93
X1 1576     4.0      0.01   87.92     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.08   28.16  7081.08   59.76 7089.08   87.92
X1 1573     4.0      0.01   85.91     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.07   27.68  7081.07   58.23 7089.07   85.91
X1 1570     4.0      0.01   83.90     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.07   27.20  7081.07   56.70 7089.07   83.90
X1 1567     4.0      0.01   81.89     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.07   26.72  7081.07   55.17 7089.07   81.89
X1 1564     4.0      0.01   79.88     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.06   26.24  7081.06   53.64 7089.06   79.88
X1 1561     4.0      0.01   77.87     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.06   25.76  7081.06   52.11 7089.06   77.87
X1 1558     4.0      0.01   75.86     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.06   25.28  7081.06   50.58 7089.06   75.86
X1 1555     4.0      0.01   73.85     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.06   24.80  7081.06   49.05 7089.06   73.85
X1 1552     4.0      0.01   71.84     3.00    3.00    3.00
X2 620.0
GR7089.1    0.01  7081.05   24.32  7081.05   47.52 7089.05   71.84
X1 1549     4.0      0.01   69.83     3.00    3.00    3.00
X2 620.0
GR7089.0    0.01  7081.05   23.84  7081.05   45.99 7089.05   69.83
X1 1546     4.0      0.01   67.82     3.00    3.00    3.00
X2 620.0
GR7089.0    0.01  7081.05   23.36  7081.05   44.46 7089.05   67.82
X1 1543     4.0      0.01   65.81     3.00    3.00    3.00
X2 620.0
GR7089.0    0.01  7081.04   22.88  7081.04   42.93 7089.04   65.81
X1 1540     4.0      0.01   63.80     3.00    3.00    3.00
X2 620.0
GR7089.0    0.01  7081.04   22.40  7081.04   41.40 7089.04   63.80
X1 1537     4.0      0.01   61.79     3.00    3.00    3.00
X2 620.0
GR7089.0    0.01  7081.04   21.92  7081.04   39.87 7089.04   61.79
X1 1534     4.0      0.01   59.78     3.00    3.00    3.00
X2 620.0
GR7089.0    0.01  7081.03   21.44  7081.03   38.34 7089.03   59.78
X1 1531     4.0      0.01   57.77     3.00    3.00    3.00
X2 620.0
```

TABLE F-6. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL H (continued).

```
GR7089.0     0.01 7081.03    20.96 7081.03    36.81 7089.03    57.77
X1 1528      4.0     0.01    55.76     3.00     3.00     3.00
X2 620.0
GR7089.0     0.01 7081.03    20.48 7081.03    35.28 7089.03    55.76
X1 1525      4.0     0.01    53.75     3.00     3.00     3.00
X2 620.0
GR7089.0     0.01 7081.02    20.00 7081.02    33.75 7089.02    53.75
X1 1522      4.0     0.01    51.74     3.00     3.00     3.00
X2 620.0
GR7089.0     0.01 7081.02    19.52 7081.02    32.22 7089.02    51.74
X1 1519      4.0     0.01    49.73     3.00     3.00     3.00
X2 620.0
GR7089.0     0.01 7081.02    19.04 7081.02    30.69 7089.02    49.73
X1 1516      4.0     0.01    47.72     3.00     3.00     3.00
X2 620.0
GR7089.0     0.01 7081.02    18.56 7081.02    29.16 7089.02    47.72
X1 1513      4.0     0.01    45.71     3.00     3.00     3.00
X2 620.0
GR7089.0     0.01 7081.01    18.08 7081.01    27.63 7089.01    45.71
X1 1510      4.0     0.01    43.70     3.00     3.00     3.00
X2 620.0
GR7089.0     0.01 7081.01    17.60 7081.01    26.10 7089.01    43.70
X1 1507      4.0     0.01    41.69     3.00     3.00     3.00
X2 620.0
GR7089.0     0.01 7081.01    17.12 7081.01    24.57 7089.01    41.69
X1 1504      4.0     0.01    39.68     3.00     3.00     3.00
X2 620.0
GR7089.0     0.01 7081.00    16.64 7081.00    23.04 7089.00    39.68
X1 1501      4.0     0.01    37.67     1.00     1.00     1.00
X2 620.0
GR7089.0     0.01 7081.00    16.16 7081.00    21.51 7089.00    37.67
X11500      4.0     0.01   37.00    10.00    10.00    10.00
X2 620.0
GR7089.0     0.01 7081.00    16.00 7081.00    21.00 7089.00    37.00
X11490      4.0     0.01   32.00    30.00    30.00    30.00
X2 620.0
GR7089.0     0.01 7081.00    16.00 7081.00    16.00 7089.00    32.00
X11         4.0     0.01   32.00    40.00    40.00    40.00
X2 620.0
GR7089.0     0.01 7081.00    16.00 7081.00    16.00 7089.00    32.00
X11420       4.0     0.01    32.00     3.00     3.00     3.00
X2 620.0
GR7088.9     0.01 7080.90    16.00 7080.90    16.00 7088.90    32.00
X1 1417      4.0     0.01    33.35     3.00     3.00     3.00
X2 620.0
GR7088.9     0.01 7080.89    16.30 7080.89    17.05 7088.89    33.35
X1 1414      4.0     0.01    34.70     3.00     3.00     3.00
X2 620.0
GR7088.9     0.01 7080.88    16.60 7080.88    18.10 7088.88    34.70
X1 1411      4.0     0.01    36.05     3.00     3.00     3.00
X2 620.0
GR7088.9     0.01 7080.86    16.90 7080.86    19.15 7088.86    36.05
X1 1408      4.0     0.01    37.40     3.00     3.00     3.00
X2 620.0
GR7088.9     0.01 7080.85    17.20 7080.85    20.20 7088.85    37.40
X1 1405      4.0     0.01    38.75     3.00     3.00     3.00
X2 620.0
GR7088.8     0.01 7080.84    17.50 7080.84    21.25 7088.84    38.75
X1 1402      4.0     0.01    40.10     3.00     3.00     3.00
X2 620.0
GR7088.8     0.01 7080.82    17.80 7080.82    22.30 7088.82    40.10
X1 1399      4.0     0.01    41.45     3.00     3.00     3.00
X2 620.0
GR7088.8     0.01 7080.81    18.10 7080.81    23.35 7088.81    41.45
X1 1396      4.0     0.01    42.80     3.00     3.00     3.00
X2 620.0
GR7088.8     0.01 7080.80    18.40 7080.80    24.40 7088.80    42.80
X1 1393      4.0     0.01    44.15     3.00     3.00     3.00
X2 620.0
GR7088.8     0.01 7080.79    18.70 7080.79    25.45 7088.79    44.15
X1 1390      4.0     0.01    45.50     3.00     3.00     3.00
X2 620.0
GR7088.8     0.01 7080.77    19.00 7080.77    26.50 7088.77    45.50
X1 1387      4.0     0.01    46.85     3.00     3.00     3.00
X2 620.0
GR7088.8     0.01 7080.76    19.30 7080.76    27.55 7088.76    46.85
X1 1384      4.0     0.01    48.20     3.00     3.00     3.00
X2 620.0
GR7088.8     0.01 7080.75    19.60 7080.75    28.60 7088.75    48.20
X1 1381      4.0     0.01    49.55     3.00     3.00     3.00
```

TABLE F-6. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL H (continued).

```
X2 620.0
GR7088.7     0.01 7080.74    19.90 7080.74    29.65 7088.74    49.55
X1 1378      4.0     0.01    50.90    3.00     3.00    3.00
X2 620.0
GR7088.7     0.01 7080.73    20.20 7080.73    30.70 7088.73    50.90
X1 1375      4.0     0.01    52.25    3.00     3.00    3.00
X2 620.0
GR7088.7     0.01 7080.71    20.50 7080.71    31.75 7088.71    52.25
X1 1372      4.0     0.01    53.60    3.00     3.00    3.00
X2 620.0
GR7088.7     0.01 7080.70    20.80 7080.70    32.80 7088.70    53.60
X1 1369      4.0     0.01    54.95    3.00     3.00    3.00
X2 620.0
GR7088.7     0.01 7080.69    21.10 7080.69    33.85 7088.69    54.95
X1 1366      4.0     0.01    56.30    3.00     3.00    3.00
X2 620.0
GR7088.7     0.01 7080.67    21.40 7080.67    34.90 7088.67    56.30
X1 1363      4.0     0.01    57.65    3.00     3.00    3.00
X2 620.0
GR7088.7     0.01 7080.66    21.70 7080.66    35.95 7088.66    57.65
X1 1360      4.0     0.01    59.00    3.00     3.00    3.00
X2 620.0
GR7088.6     0.01 7080.65    22.00 7080.65    37.00 7088.65    59.00
X1 1357      4.0     0.01    60.35    3.00     3.00    3.00
X2 620.0
GR7088.6     0.01 7080.64    22.30 7080.64    38.05 7088.64    60.35
X1 1354      4.0     0.01    61.70    3.00     3.00    3.00
X2 620.0
GR7088.6     0.01 7080.63    22.60 7080.63    39.10 7088.63    61.70
X1 1351      4.0     0.01    63.05    3.00     3.00    3.00
X2 620.0
GR7088.6     0.01 7080.61    22.90 7080.61    40.15 7088.61    63.05
X1 1348      4.0     0.01    64.40    3.00     3.00    3.00
X2 620.0
GR7088.6     0.01 7080.60    23.20 7080.60    41.20 7088.60    64.40
X1 1345      4.0     0.01    65.75    3.00     3.00    3.00
X2 620.0
GR7088.6     0.01 7080.59    23.50 7080.59    42.25 7088.59    65.75
X1 1342      4.0     0.01    67.10    3.00     3.00    3.00
X2 620.0
GR7088.6     0.01 7080.57    23.80 7080.57    43.30 7088.57    67.10
X1 1339      4.0     0.01    68.45    3.00     3.00    3.00
X2 620.0
GR7088.6     0.01 7080.56    24.10 7080.56    44.35 7088.56    68.45
X1 1336      4.0     0.01    69.80    3.00     3.00    3.00
X2 620.0
GR7088.5     0.01 7080.55    24.40 7080.55    45.40 7088.55    69.80
X1 1333      4.0     0.01    71.15    3.00     3.00    3.00
X2 620.0
GR7088.5     0.01 7080.54    24.70 7080.54    46.45 7088.54    71.15
X1 1330      4.0     0.01    72.50    3.00     3.00    3.00
X2 620.0
GR7088.5     0.01 7080.52    25.00 7080.52    47.50 7088.52    72.50
X1 1327      4.0     0.01    73.85    3.00     3.00    3.00
X2 620.0
GR7088.5     0.01 7080.51    25.30 7080.51    48.55 7088.51    73.85
X1 1324      4.0     0.01    75.20    3.00     3.00    3.00
X2 620.0
GR7088.5     0.01 7080.50    25.60 7080.50    49.60 7088.50    75.20
X1 1321      4.0     0.01    76.55    3.00     3.00    3.00
X2 620.0
GR7088.5     0.01 7080.49    25.90 7080.49    50.65 7088.49    76.55
X1 1318      4.0     0.01    77.90    3.00     3.00    3.00
X2 620.0
GR7088.5     0.01 7080.48    26.20 7080.48    51.70 7088.48    77.90
X1 1315      4.0     0.01    79.25    3.00     3.00    3.00
X2 620.0
GR7088.5     0.01 7080.46    26.50 7080.46    52.75 7088.46    79.25
X1 1312      4.0     0.01    80.60    3.00     3.00    3.00
X2 620.0
GR7088.4     0.01 7080.45    26.80 7080.45    53.80 7088.45    80.60
X1 1309      4.0     0.01    81.95    3.00     3.00    3.00
X2 620.0
GR7088.4     0.01 7080.44    27.10 7080.44    54.85 7088.44    81.95
X1 1306      4.0     0.01    83.30    3.00     3.00    3.00
X2 620.0
GR7088.4     0.01 7080.42    27.40 7080.42    55.90 7088.42    83.30
X1 1303      4.0     0.01    84.65    3.00     3.00    3.00
X2 620.0
GR7088.4     0.01 7080.41    27.70 7080.41    56.95 7088.41    84.65
```

TABLE F-6. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL H (continued).

```
X11300      4.0     0.01    86.00     3.00     3.00     3.00
X2 620.0
GR7088.4    0.01 7080.40    28.00  7080.40    58.00  7088.40    86.00
X1 1297     4.0     0.01    87.95     3.00     3.00     3.00
X2 620.0
GR7088.3    0.01 7080.34    28.60  7080.34    59.35  7088.34    87.95
X1 1294     4.0     0.01    89.90     3.00     3.00     3.00
X2 620.0
GR7088.3    0.01 7080.28    29.20  7080.28    60.70  7088.28    89.90
X1 1291     4.0     0.01    91.85     3.00     3.00     3.00
X2 620.0
GR7088.2    0.01 7080.22    29.80  7080.22    62.05  7088.22    91.85
X1 1288     4.0     0.01    93.80     3.00     3.00     3.00
X2 620.0
GR7088.2    0.01 7080.16    30.40  7080.16    63.40  7088.16    93.80
X1 1285     4.0     0.01    95.75     3.00     3.00     3.00
X2 620.0
GR7088.1    0.01 7080.10    31.00  7080.10    64.75  7088.10    95.75
X1 1282     4.0     0.01    97.70     2.00     2.00     2.00
X2 620.0
GR7088.0    0.01 7080.04    31.60  7080.04    66.10  7088.04    97.70
X11280      4.0     0.01    99.00    20.00    20.00    20.00
X2 620.0
GR7088.0    0.01 7080.00    32.00  7080.00    67.00  7088.00    99.00
X1 1260     4.0     0.01   100.25    20.00    20.00    20.00
X2 620.0
GR7087.9    0.01 7079.90    32.00  7079.90    68.25  7087.90   100.25
X1 1240     4.0     0.01   101.50    20.00    20.00    20.00
X2 620.0
GR7087.8    0.01 7079.80    32.00  7079.80    69.50  7087.80   101.50
X1 1220     4.0     0.01   102.75    20.00    20.00    20.00
X2 620.0
GR7087.7    0.01 7079.70    32.00  7079.70    70.75  7087.70   102.75
X11200      4.0     0.01   104.00   100.00   100.00   100.00
X2 620.0
GR7087.6    0.01 7079.60    32.00  7079.60    72.00  7087.60   104.00
X11100      4.0     0.01   104.00    50.00    50.00    50.00
X2 620.0
GR7087.4    0.01 7079.40    32.00  7079.40    72.00  7087.40   104.00
X11050      4.0     0.01   104.00    20.00    20.00    20.00
X2 620.0
GR7087.0    0.01 7079.00    32.00  7079.00    72.00  7087.00   104.00
X11030      4.0     0.01   104.00    20.00    20.00    20.00
X2 620.0
GR7086.5    0.01 7078.50    32.00  7078.50    72.00  7086.50   104.00
X11010      4.0     0.01   104.00    10.00    10.00    10.00
X2 620.0
GR7085.0    0.01 7077.00    32.00  7077.00    72.00  7085.00   104.00
X11000      4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
GR7077.5    0.01 7075.50     8.00  7075.50    48.00  7077.50    56.00
X1 980      4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
GR7074.8    0.01 7072.80     8.00  7072.80    48.00  7074.80    56.00
X1 960      4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
GR7072.1    0.01 7070.10     8.00  7070.10    48.00  7072.10    56.00
X1 940      4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
GR7069.4    0.01 7067.40     8.00  7067.40    48.00  7069.40    56.00
X1 920      4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
GR7066.7    0.01 7064.70     8.00  7064.70    48.00  7066.70    56.00
X1900       4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
GR7064.0    0.01 7062.00     8.00  7062.00    48.00  7064.00    56.00
X1 880      4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
GR7061.4    0.01 7059.40     8.00  7059.40    48.00  7061.40    56.00
X1 860      4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
GR7058.8    0.01 7056.80     8.00  7056.80    48.00  7058.80    56.00
X1 840      4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
GR7056.2    0.01 7054.20     8.00  7054.20    48.00  7056.20    56.00
X1 820      4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
GR7053.6    0.01 7051.60     8.00  7051.60    48.00  7053.60    56.00
X1 800      4.0     0.01    56.00    20.00    20.00    20.00
X2 620.0
```

TABLE F-6. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL H (continued).

```
GR7051.0    0.01 7049.00    8.00 7049.00   48.00 7051.00   56.00
X1 780      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7046.4    0.01 7046.40    8.00 7046.40   48.00 7048.40   56.00
X1 760      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7045.8    0.01 7043.80    8.00 7043.80   48.00 7045.80   56.00
X1 740      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7043.2    0.01 7041.20    8.00 7041.20   48.00 7043.20   56.00
X1 720      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7040.6    0.01 7038.60    8.00 7038.60   48.00 7040.60   56.00
X1700       4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7038.0    0.01 7036.00    8.00 7036.00   48.00 7038.00   56.00
X1 680      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7035.4    0.01 7033.35    8.00 7033.35   48.00 7035.35   56.00
X1 660      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7032.7    0.01 7030.70    8.00 7030.70   48.00 7032.70   56.00
X1 640      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7030.0    0.01 7028.05    8.00 7028.05   48.00 7030.05   56.00
X1 620      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7027.4    0.01 7025.40    8.00 7025.40   48.00 7027.40   56.00
X1 600      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7024.8    0.01 7022.75    8.00 7022.75   48.00 7024.75   56.00
X1 580      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7022.1    0.01 7020.10    8.00 7020.10   48.00 7022.10   56.00
X1 560      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7019.5    0.01 7017.45    8.00 7017.45   48.00 7019.45   56.00
X1 540      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7016.8    0.01 7014.80    8.00 7014.80   48.00 7016.80   56.00
X1 520      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7014.1    0.01 7012.15    8.00 7012.15   48.00 7014.15   56.00
X1500       4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7011.5    0.01 7009.50    8.00 7009.50   48.00 7011.50   56.00
X1 480      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7008.9    0.01 7006.90    8.00 7006.90   48.00 7008.90   56.00
X1 460      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7006.3    0.01 7004.30    8.00 7004.30   48.00 7006.30   56.00
X1 440      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7003.7    0.01 7001.70    8.00 7001.70   48.00 7003.70   56.00
X1 420      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR7001.1    0.01 6999.10    8.00 6999.10   48.00 7001.10   56.00
X1 400      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6998.5    0.01 6996.50    8.00 6996.50   48.00 6998.50   56.00
X1 380      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6995.9    0.01 6993.90    8.00 6993.90   48.00 6995.90   56.00
X1 360      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6993.3    0.01 6991.30    8.00 6991.30   48.00 6993.30   56.00
X1 340      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6990.7    0.01 6988.70    8.00 6988.70   48.00 6990.70   56.00
X1 320      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6988.1    0.01 6986.10    8.00 6986.10   48.00 6988.10   56.00
X1300       4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6985.5    0.01 6983.50    8.00 6983.50   48.00 6985.50   56.00
X1 280      4.0     0.01   56.00   20.00   20.00   20.00
X2 620.0
GR6982.7    0.01 6980.67    8.00 6980.67   48.00 6982.67   56.00
X1 260      4.0     0.01   56.00   20.00   20.00   20.00
```

TABLE F-6. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL H (continued).

```
X2 620.0
GR6979.8    0.01 6977.83    8.00 6977.83   48.00 6979.83   56.00
X1240       4.0    0.01   56.00    7.00    7.00    7.00
X2 620.0
GR6977.0    0.01 6975.00    8.00 6975.00   48.00 6977.00   56.00
X1233       4.0    0.01   56.00   10.00   10.00   10.00
X2 620.0
GR6976.0    0.01 6974.00    8.00 6974.00   48.00 6976.00   56.00
X1223       4.0    0.01   64.00   10.00   10.00   10.00
X2 620.0
GR6975.7    0.01 6972.70   12.00 6972.70   52.00 6975.70   64.00
X1213       4.0    0.01   64.00   10.00   10.00   10.00
X2 620.0
GR6974.4    0.01 6971.40   12.00 6971.40   52.00 6974.40   64.00
X1203       4.0    0.01   64.00   10.00   10.00   10.00
X2 620.0
GR6973.1    0.01 6970.10   12.00 6970.10   52.00 6973.10   64.00
X1193       4.0    0.01   64.00   10.00   10.00   10.00
X2 620.0
GR6971.8    0.01 6968.80   12.00 6968.80   52.00 6971.80   64.00
X1183       4.0    0.01   64.00    8.00    8.00    8.00
X2 620.0
GR6970.5    0.01 6967.50   12.00 6967.50   52.00 6970.50   64.00
X1175       4.0    0.01   72.00   10.00   10.00   10.00
X2 620.0
GR6970.4    0.01 6966.40   16.00 6966.40   56.00 6970.40   72.00
X1165       4.0    0.01   72.00    8.00    8.00    8.00
X2 620.0
GR6969.1    0.01 6965.10   16.00 6965.10   56.00 6969.10   72.00
X1157       4.0    0.01   72.00   57.00   57.00   57.00
X2 620.0
GR6968.1    0.01 6964.10   16.00 6964.10   56.00 6968.10   72.00
X1100       4.0    0.01   72.00   50.00   50.00   50.00
X2 620.0
GR6967.8    0.01 6963.80   16.00 6963.80   56.00 6967.80   72.00
X150        4.0    0.01   72.00   10.00   10.00   10.00
X2 620.0
GR6967.7    0.01 6963.70   16.00 6963.70   56.00 6967.70   72.00
X140        4.0    0.01   72.00
X2 620.0
GR6967.6    0.01 6963.60   16.00 6963.60   56.00 6967.60   72.00
EJ
ER
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TABLE F-7. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL I.

```
T1        PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2        CHANNEL I - INCLUDES CROSS SECTIONS HC4-1 THROUGH HC4-3
T3        PMF - SUBCRITICAL
J1                                -1.0                       581.0  7086.0
J2   -1        0     -1.0
NC 0.035   0.035   0.035     0.1      0.3
X11440      4.0     0.01   66.00
X2 581.0
GR7083.0    0.01 7081.00    8.00 7081.00   58.00 7083.00   66.00
X11450      4.0     0.01   66.00   10.00   10.00   10.00
X2 581.0
GR7083.0    0.01 7081.00    8.00 7081.00   58.00 7083.00   66.00
X1 1490     4.0     0.01   66.00   40.00   40.00   40.00
X2 581.0
GR7083.3    0.01 7081.31    8.00 7081.31   58.00 7083.31   66.00
X11590      4.0     0.01   66.00  100.00  100.00  100.00
X2 581.0
GR7084.1    0.01 7082.10    8.00 7082.10   58.00 7084.10   66.00
X1 1630     4.0     0.01   66.00   40.00   40.00   40.00
X2 581.0
GR7084.4    0.01 7082.41    8.00 7082.41   58.00 7084.41   66.00
X11730      4.0     0.01   66.00  100.00  100.00  100.00
X2 581.0
GR7085.2    0.01 7083.20    8.00 7083.20   58.00 7085.20   66.00
X1 1770     4.0     0.01   66.00   40.00   40.00   40.00
X2 581.0
GR7085.8    0.01 7083.80    8.00 7083.80   58.00 7085.80   66.00
X11870      4.0     0.01   66.00  100.00  100.00  100.00
X2 581.0
GR7087.3    0.01 7085.30    8.00 7085.30   58.00 7087.30   66.00
X1 1890     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7088.0    0.01 7085.97    8.00 7085.97   58.00 7087.97   66.00
X1 1910     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7088.6    0.01 7086.63    8.00 7086.63   58.00 7088.63   66.00
X11930      4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7089.3    0.01 7087.30    8.00 7087.30   58.00 7089.30   66.00
X1 1940     4.0     0.01   66.00   10.00   10.00   10.00
X2 581.0
GR7089.6    0.01 7087.64    8.00 7087.64   58.00 7089.64   66.00
X1 1960     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7090.3    0.01 7088.32    8.00 7088.32   58.00 7090.32   66.00
X13         4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7091.0    0.01 7089.00    8.00 7089.00   58.00 7091.00   66.00
X1 1995     4.0     0.01   66.00   15.00   15.00   15.00
X2 581.0
GR7091.5    0.01 7089.49    8.00 7089.49   58.00 7091.49   66.00
X1 2015     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7092.1    0.01 7090.14    8.00 7090.14   58.00 7092.14   66.00
X1 2035     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7092.8    0.01 7090.79    8.00 7090.79   58.00 7092.79   66.00
X1 2055     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7093.4    0.01 7091.45    8.00 7091.45   58.00 7093.45   66.00
X12075      4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7094.1    0.01 7092.10    8.00 7092.10   58.00 7094.10   66.00
X1 2090     4.0     0.01   66.00   15.00   15.00   15.00
X2 581.0
GR7094.6    0.01 7092.61    8.00 7092.61   58.00 7094.61   66.00
X1 2110     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7095.3    0.01 7093.28    8.00 7093.28   58.00 7095.28   66.00
X1 2130     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7096.0    0.01 7093.95    8.00 7093.95   58.00 7095.95   66.00
X1 2150     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7096.6    0.01 7094.63    8.00 7094.63   58.00 7096.63   66.00
X12170      4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7097.3    0.01 7095.30    8.00 7095.30   58.00 7097.30   66.00
X1 2270     4.0     0.01   66.00  100.00  100.00  100.00
X2 540.5
```

TABLE F-7. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL I (continued).

```
GR7100.0     0.01 7098.00     8.00 7098.00     58.00 7100.00     66.00
X12370        4.0    0.01    66.00  100.00    100.00  100.00
X2 500.0
GR7102.7     0.01 7100.70     8.00 7100.70     58.00 7102.70     66.00
X1 2390       4.0    0.01    65.09   20.00     20.00   20.00
X2 495.5
GR7102.9     0.01 7100.94     8.00 7100.94     57.09 7102.94     65.09
X1 2410       4.0    0.01    64.18   20.00     20.00   20.00
X2 490.9
GR7103.2     0.01 7101.17     8.00 7101.17     56.18 7103.17     64.18
X1 2430       4.0    0.01    63.27   20.00     20.00   20.00
X2 486.4
GR7103.4     0.01 7101.41     8.00 7101.41     55.27 7103.41     63.27
X1 2450       4.0    0.01    62.36   20.00     20.00   20.00
X2 481.8
GR7103.6     0.01 7101.65     8.00 7101.65     54.36 7103.65     62.36
X1 2470       4.0    0.01    61.45   20.00     20.00   20.00
X2 477.3
GR7103.9     0.01 7101.88     8.00 7101.88     53.45 7103.88     61.45
X1 2490       4.0    0.01    60.55   20.00     20.00   20.00
X2 472.7
GR7104.1     0.01 7102.12     8.00 7102.12     52.55 7104.12     60.55
X1 2510       4.0    0.01    59.64   20.00     20.00   20.00
X2 468.2
GR7104.4     0.01 7102.35     8.00 7102.35     51.64 7104.35     59.64
X1 2530       4.0    0.01    58.73   20.00     20.00   20.00
X2 463.6
GR7104.6     0.01 7102.59     8.00 7102.59     50.73 7104.59     58.73
X1 2550       4.0    0.01    57.82   20.00     20.00   20.00
X2 459.1
GR7104.8     0.01 7102.83     8.00 7102.83     49.82 7104.83     57.82
X1 2570       4.0    0.01    56.91   20.00     20.00   20.00
X2 454.5
GR7105.1     0.01 7103.06     8.00 7103.06     48.91 7105.06     56.91
X12590        4.0    0.01    56.00   20.00     20.00   20.00
X2 450.0
GR7105.3     0.01 7103.30     8.00 7103.30     48.00 7105.30     56.00
X1 2614       4.0    0.01    56.00   24.00     24.00   24.00
X2 444.5
GR7105.7     0.01 7103.66     8.00 7103.66     48.00 7105.66     56.00
X1 2714       4.0    0.01    56.00  100.00    100.00  100.00
X2 421.8
GR7107.2     0.01 7105.18     8.00 7105.18     48.00 7107.18     56.00
X12           4.0    0.01    56.00  100.00    100.00  100.00
X2 399.0
GR7108.7     0.01 7106.70     8.00 7106.70     48.00 7108.70     56.00
X12815       4.0    0.01   56.00    1.00      1.00    1.00
X2 399.0
GR7108.7     0.01 7106.70     8.00 7106.70     48.00 7108.70     56.00
X1 2830       4.0    0.01    56.00   15.00     15.00   15.00
X2 399.0
GR7108.8     0.01 7106.76     8.00 7106.76     48.00 7108.76     56.00
X1 2930       4.0    0.01    56.00  100.00    100.00  100.00
X2 399.0
GR7109.2     0.01 7107.18     8.00 7107.18     48.00 7109.18     56.00
X13030        4.0    0.01    56.00  100.00    100.00  100.00
X2 399.0
GR7109.6     0.01 7107.60     8.00 7107.60     48.00 7109.60     56.00
X1 3040       4.0    0.01    55.20   10.00     10.00   10.00
X2 399.0
GR7109.6     0.01 7107.64     8.00 7107.64     47.20 7109.64     55.20
X1 3060       4.0    0.01    53.60   20.00     20.00   20.00
X2 399.0
GR7109.7     0.01 7107.72     8.00 7107.72     45.60 7109.72     53.60
X1 3080       4.0    0.01    52.00   20.00     20.00   20.00
X2 399.0
GR7109.8     0.01 7107.80     8.00 7107.80     44.00 7109.80     52.00
X1 3100       4.0    0.01    50.40   20.00     20.00   20.00
X2 399.0
GR7109.9     0.01 7107.88     8.00 7107.88     42.40 7109.88     50.40
X1 3120       4.0    0.01    48.80   20.00     20.00   20.00
X2 399.0
GR7110.0     0.01 7107.96     8.00 7107.96     40.80 7109.96     48.80
X1 3140       4.0    0.01    47.20   20.00     20.00   20.00
X2 399.0
GR7110.0     0.01 7108.04     8.00 7108.04     39.20 7110.04     47.20
X1 3160       4.0    0.01    45.60   20.00     20.00   20.00
X2 399.0
GR7110.1     0.01 7108.12     8.00 7108.12     37.60 7110.12     45.60
X1 3180       4.0    0.01    44.00   20.00     20.00   20.00
```

TABLE F-7. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL I (continued).

```
X2 399.0
GR7110.2     0.01 7108.20     8.00 7108.20    36.00 7110.20    44.00
X1 3200      4.0     0.01    42.40   20.00    20.00   20.00
X2 399.0
GR7110.3     0.01 7108.28     8.00 7108.28    34.40 7110.28    42.40
X1 3220      4.0     0.01    40.80   20.00    20.00   20.00
X2 399.0
GR7110.4     0.01 7108.36     8.00 7108.36    32.80 7110.36    40.80
X1 3240      4.0     0.01    39.20   20.00    20.00   20.00
X2 399.0
GR7110.4     0.01 7108.44     8.00 7108.44    31.20 7110.44    39.20
X1 3260      4.0     0.01    37.60   20.00    20.00   20.00
X2 399.0
GR7110.5     0.01 7108.52     8.00 7108.52    29.60 7110.52    37.60
X11          4.0     0.01    36.00   20.00    20.00   20.00
X2 399.0
GR7110.6     0.01 7108.60     8.00 7108.60    28.00 7110.60    36.00
X1 3290      4.0     0.01    37.43   10.00    10.00   10.00
X2 399.0
GR7110.8     0.01 7108.83     8.00 7108.83    29.43 7110.83    37.43
X1 3310      4.0     0.01    40.29   20.00    20.00   20.00
X2 399.0
GR7111.3     0.01 7109.29     8.00 7109.29    32.29 7111.29    40.29
X1 3330      4.0     0.01    43.14   20.00    20.00   20.00
X2 399.0
GR7111.7     0.01 7109.74     8.00 7109.74    35.14 7111.74    43.14
X13350       4.0     0.01    46.00   20.00    20.00   20.00
X2 399.0
GR7112.2     0.01 7110.20     8.00 7110.20    38.00 7112.20    46.00
X1 3360      4.0     0.01    45.33   10.00    10.00   10.00
X2 399.0
GR7112.3     0.01 7110.26     8.00 7110.26    37.33 7112.26    45.33
X1 3380      4.0     0.01    44.00   20.00    20.00   20.00
X2 399.0
GR7112.4     0.01 7110.38     8.00 7110.38    36.00 7112.38    44.00
X1 3400      4.0     0.01    42.67   20.00    20.00   20.00
X2 399.0
GR7112.5     0.01 7110.50     8.00 7110.50    34.67 7112.50    42.67
X1 3420      4.0     0.01    41.33   20.00    20.00   20.00
X2 399.0
GR7112.6     0.01 7110.62     8.00 7110.62    33.33 7112.62    41.33
X1 3440      4.0     0.01    40.00   20.00    20.00   20.00
X2 399.0
GR7112.7     0.01 7110.74     8.00 7110.74    32.00 7112.74    40.00
X1 3460      4.0     0.01    38.67   20.00    20.00   20.00
X2 399.0
GR7112.9     0.01 7110.86     8.00 7110.86    30.67 7112.86    38.67
X1 3480      4.0     0.01    37.33   20.00    20.00   20.00
X2 399.0
GR7113.0     0.01 7110.98     8.00 7110.98    29.33 7112.98    37.33
X13500       4.0     0.01    36.00   20.00    20.00   20.00
X2 399.0
GR7113.1     0.01 7111.10     8.00 7111.10    28.00 7113.10    36.00
EJ
ER
```

TABLE F-8. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL I.

```
T1       PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2       CHANNEL I - INCLUDES CROSS SECTIONS HC4-1 THROUGH HC4-3
T3       PMF - SUPERCRITICAL
J1                            1.0    -1.0                  399.0  7113.0
J2   -1        0    -1.0
NC 0.035   0.035   0.035     0.1     0.3
X13500       4.0    0.01   36.00   20.00    20.00   20.00
X2 399.0
GR7113.1    0.01 7111.10    8.00 7111.10    28.00 7113.10   36.00
X1 3480      4.0    0.01   37.33   20.00    20.00   20.00
X2 399.0
GR7113.0    0.01 7110.98    8.00 7110.98    29.33 7112.98   37.33
X1 3460      4.0    0.01   38.67   20.00    20.00   20.00
X2 399.0
GR7112.9    0.01 7110.86    8.00 7110.86    30.67 7112.86   38.67
X1 3440      4.0    0.01   40.00   20.00    20.00   20.00
X2 399.0
GR7112.7    0.01 7110.74    8.00 7110.74    32.00 7112.74   40.00
X1 3420      4.0    0.01   41.33   20.00    20.00   20.00
X2 399.0
GR7112.6    0.01 7110.62    8.00 7110.62    33.33 7112.62   41.33
X1 3400      4.0    0.01   42.67   20.00    20.00   20.00
X2 399.0
GR7112.5    0.01 7110.50    8.00 7110.50    34.67 7112.50   42.67
X1 3380      4.0    0.01   44.00   20.00    20.00   20.00
X2 399.0
GR7112.4    0.01 7110.38    8.00 7110.38    36.00 7112.38   44.00
X1 3360      4.0    0.01   45.33   10.00    10.00   10.00
X2 399.0
GR7112.3    0.01 7110.26    8.00 7110.26    37.33 7112.26   45.33
X13350       4.0    0.01   46.00   20.00    20.00   20.00
X2 399.0
GR7112.2    0.01 7110.20    8.00 7110.20    38.00 7112.20   46.00
X1 3330      4.0    0.01   43.14   20.00    20.00   20.00
X2 399.0
GR7111.7    0.01 7109.74    8.00 7109.74    35.14 7111.74   43.14
X1 3310      4.0    0.01   40.29   20.00    20.00   20.00
X2 399.0
GR7111.3    0.01 7109.29    8.00 7109.29    32.29 7111.29   40.29
X1 3290      4.0    0.01   37.43   10.00    10.00   10.00
X2 399.0
GR7110.8    0.01 7108.83    8.00 7108.83    29.43 7110.83   37.43
X11          4.0    0.01   36.00   20.00    20.00   20.00
X2 399.0
GR7110.6    0.01 7108.60    8.00 7108.60    28.00 7110.60   36.00
X1 3260      4.0    0.01   37.60   20.00    20.00   20.00
X2 399.0
GR7110.5    0.01 7108.52    8.00 7108.52    29.60 7110.52   37.60
X1 3240      4.0    0.01   39.20   20.00    20.00   20.00
X2 399.0
GR7110.4    0.01 7108.44    8.00 7108.44    31.20 7110.44   39.20
X1 3220      4.0    0.01   40.80   20.00    20.00   20.00
X2 399.0
GR7110.4    0.01 7108.36    8.00 7108.36    32.80 7110.36   40.80
X1 3200      4.0    0.01   42.40   20.00    20.00   20.00
X2 399.0
GR7110.3    0.01 7108.28    8.00 7108.28    34.40 7110.28   42.40
X1 3180      4.0    0.01   44.00   20.00    20.00   20.00
X2 399.0
GR7110.2    0.01 7108.20    8.00 7108.20    36.00 7110.20   44.00
X1 3160      4.0    0.01   45.60   20.00    20.00   20.00
X2 399.0
GR7110.1    0.01 7108.12    8.00 7108.12    37.60 7110.12   45.60
X1 3140      4.0    0.01   47.20   20.00    20.00   20.00
X2 399.0
GR7110.0    0.01 7108.04    8.00 7108.04    39.20 7110.04   47.20
X1 3120      4.0    0.01   48.80   20.00    20.00   20.00
X2 399.0
GR7110.0    0.01 7107.96    8.00 7107.96    40.80 7109.96   48.80
X1 3100      4.0    0.01   50.40   20.00    20.00   20.00
X2 399.0
GR7109.9    0.01 7107.88    8.00 7107.88    42.40 7109.88   50.40
X1 3080      4.0    0.01   52.00   20.00    20.00   20.00
X2 399.0
GR7109.8    0.01 7107.80    8.00 7107.80    44.00 7109.80   52.00
X1 3060      4.0    0.01   53.60   20.00    20.00   20.00
X2 399.0
GR7109.7    0.01 7107.72    8.00 7107.72    45.60 7109.72   53.60
X1 3040      4.0    0.01   55.20   10.00    10.00   10.00
X2 399.0
```

TABLE F-8. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL I (continued).

```
GR7109.6    0.01 7107.64    8.00 7107.64   47.20 7109.64    55.20
X13030      4.0     0.01   56.00  100.00  100.00  100.00
X2 399.0
GR7109.6    0.01 7107.60    8.00 7107.60   48.00 7109.60    56.00
X1 2930     4.0     0.01   56.00  100.00  100.00  100.00
X2 399.0
GR7109.2    0.01 7107.18    8.00 7107.18   48.00 7109.18    56.00
X1 2830     4.0     0.01   56.00   15.00   15.00   15.00
X2 399.0
GR7108.8    0.01 7106.76    8.00 7106.76   48.00 7108.76    56.00
X12815      4.0     0.01  56.00    1.00    1.00    1.00
X2 399.0
GR7108.7    0.01 7106.70    8.00 7106.70   48.00 7108.70    56.00
X12         4.0     0.01   56.00  100.00  100.00  100.00
X2 399.0
GR7108.7    0.01 7106.70    8.00 7106.70   48.00 7108.70    56.00
X1 2714     4.0     0.01   56.00  100.00  100.00  100.00
X2 421.8
GR7107.2    0.01 7105.18    8.00 7105.18   48.00 7107.18    56.00
X1 2614     4.0     0.01   56.00   24.00   24.00   24.00
X2 444.5
GR7105.7    0.01 7103.66    8.00 7103.66   48.00 7105.66    56.00
X12590      4.0     0.01   56.00   20.00   20.00   20.00
X2 450.0
GR7105.3    0.01 7103.30    8.00 7103.30   48.00 7105.30    56.00
X1 2570     4.0     0.01   56.91   20.00   20.00   20.00
X2 454.5
GR7105.1    0.01 7103.06    8.00 7103.06   48.91 7105.06    56.91
X1 2550     4.0     0.01   57.82   20.00   20.00   20.00
X2 459.1
GR7104.8    0.01 7102.83    8.00 7102.83   49.82 7104.83    57.82
X1 2530     4.0     0.01   58.73   20.00   20.00   20.00
X2 463.6
GR7104.6    0.01 7102.59    8.00 7102.59   50.73 7104.59    58.73
X1 2510     4.0     0.01   59.64   20.00   20.00   20.00
X2 468.2
GR7104.4    0.01 7102.35    8.00 7102.35   51.64 7104.35    59.64
X1 2490     4.0     0.01   60.55   20.00   20.00   20.00
X2 472.7
GR7104.1    0.01 7102.12    8.00 7102.12   52.55 7104.12    60.55
X1 2470     4.0     0.01   61.45   20.00   20.00   20.00
X2 477.3
GR7103.9    0.01 7101.88    8.00 7101.88   53.45 7103.88    61.45
X1 2450     4.0     0.01   62.36   20.00   20.00   20.00
X2 481.8
GR7103.6    0.01 7101.65    8.00 7101.65   54.36 7103.65    62.36
X1 2430     4.0     0.01   63.27   20.00   20.00   20.00
X2 486.4
GR7103.4    0.01 7101.41    8.00 7101.41   55.27 7103.41    63.27
X1 2410     4.0     0.01   64.18   20.00   20.00   20.00
X2 490.9
GR7103.2    0.01 7101.17    8.00 7101.17   56.18 7103.17    64.18
X1 2390     4.0     0.01   65.09   20.00   20.00   20.00
X2 495.5
GR7102.9    0.01 7100.94    8.00 7100.94   57.09 7102.94    65.09
X12370      4.0     0.01   66.00  100.00  100.00  100.00
X2 500.0
GR7102.7    0.01 7100.70    8.00 7100.70   58.00 7102.70    66.00
X1 2270     4.0     0.01   66.00  100.00  100.00  100.00
X2 540.5
GR7100.0    0.01 7098.00    8.00 7098.00   58.00 7100.00    66.00
X12170      4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7097.3    0.01 7095.30    8.00 7095.30   58.00 7097.30    66.00
X1 2150     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7096.6    0.01 7094.63    8.00 7094.63   58.00 7096.63    66.00
X1 2130     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7096.0    0.01 7093.95    8.00 7093.95   58.00 7095.95    66.00
X1 2110     4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7095.3    0.01 7093.28    8.00 7093.28   58.00 7095.28    66.00
X1 2090     4.0     0.01   66.00   15.00   15.00   15.00
X2 581.0
GR7094.6    0.01 7092.61    8.00 7092.61   58.00 7094.61    66.00
X12075      4.0     0.01   66.00   20.00   20.00   20.00
X2 581.0
GR7094.1    0.01 7092.10    8.00 7092.10   58.00 7094.10    66.00
X1 2055     4.0     0.01   66.00   20.00   20.00   20.00
```

TABLE F-8. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL I (continued).

```
X2 581.0
GR7093.4    0.01 7091.45    8.00 7091.45    58.00 7093.45    66.00
X1 2035      4.0    0.01   66.00   20.00    20.00   20.00
X2 581.0
GR7092.8    0.01 7090.79    8.00 7090.79    58.00 7092.79    66.00
X1 2015      4.0    0.01   66.00   20.00    20.00   20.00
X2 581.0
GR7092.1    0.01 7090.14    8.00 7090.14    58.00 7092.14    66.00
X1 1995      4.0    0.01   66.00   15.00    15.00   15.00
X2 581.0
GR7091.5    0.01 7089.49    8.00 7089.49    58.00 7091.49    66.00
X13          4.0    0.01   66.00   20.00    20.00   20.00
X2 581.0
GR7091.0    0.01 7089.00    8.00 7089.00    58.00 7091.00    66.00
X1 1960      4.0    0.01   66.00   20.00    20.00   20.00
X2 581.0
GR7090.3    0.01 7088.32    8.00 7088.32    58.00 7090.32    66.00
X1 1940      4.0    0.01   66.00   10.00    10.00   10.00
X2 581.0
GR7089.6    0.01 7087.64    8.00 7087.64    58.00 7089.64    66.00
X11930       4.0    0.01   66.00   20.00    20.00   20.00
X2 581.0
GR7089.3    0.01 7087.30    8.00 7087.30    58.00 7089.30    66.00
X1 1910      4.0    0.01   66.00   20.00    20.00   20.00
X2 581.0
GR7088.6    0.01 7086.63    8.00 7086.63    58.00 7088.63    66.00
X1 1890      4.0    0.01   66.00   20.00    20.00   20.00
X2 581.0
GR7088.0    0.01 7085.97    8.00 7085.97    58.00 7087.97    66.00
X11870       4.0    0.01   66.00  100.00   100.00  100.00
X2 581.0
GR7087.3    0.01 7085.30    8.00 7085.30    58.00 7087.30    66.00
X1 1770      4.0    0.01   66.00   40.00    40.00   40.00
X2 581.0
GR7085.8    0.01 7083.80    8.00 7083.80    58.00 7085.80    66.00
X11730       4.0    0.01   66.00  100.00   100.00  100.00
X2 581.0
GR7085.2    0.01 7083.20    8.00 7083.20    58.00 7085.20    66.00
X1 1630      4.0    0.01   66.00   40.00    40.00   40.00
X2 581.0
GR7084.4    0.01 7082.41    8.00 7082.41    58.00 7084.41    66.00
X11590       4.0    0.01   66.00  100.00   100.00  100.00
X2 581.0
GR7084.1    0.01 7082.10    8.00 7082.10    58.00 7084.10    66.00
X1 1490      4.0    0.01   66.00   40.00    40.00   40.00
X2 581.0
GR7083.3    0.01 7081.31    8.00 7081.31    58.00 7083.31    66.00
X11450      4.0    0.01   66.00   10.00   10.00   10.00
X2 581.0
GR7083.0    0.01 7081.00    8.00 7081.00    58.00 7083.00    66.00
X11440      4.0    0.01   66.00
X2 581.0
GR7083.0    0.01 7081.00    8.00 7081.00    58.00 7083.00    66.00
EJ
ER
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TABLE F-9. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL M.

```
T1        PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2        CHANNEL M - INCLUDES CROSS SECTIONS HC4-6 THROUGH HC4-5
T3        PMF - SUBCRITICAL
J1                                        -1.0                          170.0  7084.0
J2   -1         0     -1.0
NC 0.035    0.035    0.035      0.1       0.3
X1 100.0      4.0      0.1    114.0
X2 170.0
GR7085.7      0.1   7081.7     32.0    7081.7     82.0   7085.7    114.0
X1 200.0      4.0      0.1    114.0     100.0    100.0    100.0
X2 170.0
GR7086.5      0.1   7082.5     32.0    7082.5     82.0   7086.5    114.0
X1 270.0      4.0      0.1    114.0      70.0     70.0     70.0
X2 170.0
GR7087.0      0.1   7083.0     32.0    7083.0     82.0   7087.0    114.0
X1   6.0      4.0      0.1    114.0      25.0     25.0     25.0
X2 170.0
GR7089.0      0.1   7084.0     32.0    7084.0     82.0   7089.0    114.0
X1 395.0      4.0      0.1    114.0     100.0    100.0    100.0
X2 170.0
GR7092.0      0.1   7088.0     32.0    7088.0     82.0   7092.0    114.0
X1 495.0      4.0      0.1    114.0     100.0    100.0    100.0
X2 150.0
GR7098.1      0.1   7094.1     32.0    7094.1     82.0   7098.1    114.0
X1 595.0      4.0      0.1    114.0     100.0    100.0    100.0
X2  80.0
GR7103.9      0.1   7099.9     32.0    7099.9     82.0   7103.9    114.0
X1 605.0      4.0      0.1    114.0      10.0     10.0     10.0
X2  36.0
GR7103.9      0.1  7099.92     32.0   7099.92     82.0   7103.9    114.0
X1 612.0      4.0      0.1     99.0       7.0      7.0      7.0
X2  36.0
GR7103.9      0.1  7099.93     28.0   7099.93     71.0   7103.9     99.0
X1 618.0      4.0      0.1     99.0       6.0      6.0      6.0
X2  36.0
GR7103.9      0.1  7099.94     20.0   7099.94     56.0   7103.9     76.0
X1 625.0      4.0      0.1     62.0       7.0      7.0      7.0
X2  36.0
GR7104.0      0.1  7099.96     16.0   7099.96     46.0   7104.0     76.0
X1 633.0      4.0      0.1     60.0       8.0      8.0      8.0
X2  36.0
GR7105.0      0.1  7099.97     20.0   7099.97     40.0   7105.0     60.0
X1 641.0      4.0      0.1     66.0       8.0      8.0      8.0
X2  36.0
GR7107.0      0.1  7099.98     28.0   7099.98     38.0   7107.0     66.0
X1 645.0      4.0      0.1     61.0       4.0      4.0      4.0
X2  36.0
GR7107.0      0.1  7099.99     28.0   7099.99     33.0   7107.0     61.0
X1 650.0      3.0      0.1     80.0       5.0      5.0      5.0
X2  36.0
GR7110.0      0.1  7100.00     40.0   7110.00     80.0
X1 660.0      3.0      0.1     60.0      10.0     10.0     10.0
X2  36.0
GR7110.0      0.1  7100.02     30.0   7110.02     60.0
X1 670.0      3.0      0.1     50.0      10.0     10.0     10.0
X2  36.0
GR7110.0      0.1  7100.04     25.0   7110.04     50.0
X1 680.0      3.0      0.1     40.0      10.0     10.0     10.0
X2  36.0
GR7110.1      0.1  7100.06     20.0   7110.06     40.0
X1   5.0      3.0      0.1     52.0      25.0     25.0     25.0
X2  36.0
GR7113.1      0.1  7100.11     26.0    7113.1     52.0
X1 730.0      3.0      0.1     52.0      25.0     25.0     25.0
X2  36.0
GR7113.2      0.1  7100.16     26.0    7113.2     52.0
X1 755.0      4.0      0.1    105.0      25.0     25.0     25.0
X2  36.0
GR7110.2      0.1  7100.21     40.0   7100.21     65.0   7110.2    105.0
EJ
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TABLE F-10. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL M.

```
T1       PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2       CHANNEL M - INCLUDES CROSS SECTIONS HC4-6 THROUGH HC4-5
T3       PMF - SUPERCRITICAL
J1                             1.0     -1.0                        36.0  7105.0
J2    -1        0      -1.0
NC 0.035    0.035    0.035     0.1      0.3
X1 755.0      4.0      0.1   105.0     25.0     25.0     25.0
X2  36.0
GR7110.2      0.1 7100.21     40.0 7100.21     65.0   7110.2    105.0
X1 730.0    3.0        0.1    52.0     25.0     25.0     25.0
X2  36.0
GR7113.2      0.1 7100.16     26.0   7113.2     52.0
X1   5.0    3.0        0.1    52.0     25.0     25.0     25.0
X2  36.0
GR7113.1      0.1 7100.11     26.0   7113.1     52.0
X1 680.0    3.0        0.1    40.0     10.0     10.0     10.0
X2  36.0
GR7110.1      0.1 7100.06     20.0 7110.06     40.0
X1 670.0    3.0        0.1    50.0     10.0     10.0     10.0
X2  36.0
GR7110.0      0.1 7100.04     25.0 7110.04     50.0
X1 660.0    3.0        0.1    60.0     10.0     10.0     10.0
X2  36.0
GR7110.0      0.1 7100.02     30.0 7110.02     60.0
X1 650.0    3.0        0.1    80.0      5.0      5.0      5.0
X2  36.0
GR7110.0      0.1 7100.00     40.0 7110.00     80.0
X1 645.0    4.0        0.1    61.0      4.0      4.0      4.0
X2  36.0
GR7107.0      0.1 7099.99     28.0 7099.99     33.0   7107.0     61.0
X1 641.0    4.0        0.1    66.0      8.0      8.0      8.0
X2  36.0
GR7107.0      0.1 7099.98     28.0 7099.98     36.0   7107.0     66.0
X1 633.0    4.0        0.1    60.0      8.0      8.0      8.0
X2  36.0
GR7105.0      0.1 7099.97     20.0 7099.97     40.0   7105.0     60.0
X1 625.0    4.0        0.1    62.0      7.0      7.0      7.0
X2  36.0
GR7104.0      0.1 7099.96     16.0 7099.96     46.0   7104.0     76.0
X1 618.0    4.0        0.1    99.0      6.0      6.0      6.0
X2  36.0
GR7103.9      0.1 7099.94     20.0 7099.94     56.0   7103.9     76.0
X1 612.0    4.0        0.1    99.0      7.0      7.0      7.0
X2  36.0
GR7103.9      0.1 7099.93     28.0 7099.93     71.0   7103.9     99.0
X1 605.0    4.0        0.1   114.0     10.0     10.0     10.0
X2  36.0
GR7103.9      0.1 7099.92     32.0 7099.92     82.0   7103.9    114.0
X1 595.0    4.0        0.1   114.0    100.0    100.0    100.0
X2  80.0
GR7103.9    0.1    7099.9     32.0   7099.9     82.0   7103.9    114.0
X1 495.0    4.0        0.1   114.0    100.0    100.0    100.0
X2 150.0
GR7098.1    0.1    7094.1     32.0   7094.1     82.0   7098.1    114.0
X1 395.0    4.0        0.1   114.0    100.0    100.0    100.0
X2 170.0
GR7092.0    0.1    7088.0     32.0   7088.0     82.0   7092.0    114.0
X1   6.0    4.0        0.1   114.0     25.0     25.0     25.0
X2 170.0
GR7089.0    0.1    7084.0     32.0   7084.0     82.0   7089.0    114.0
X1 270.0    4.0        0.1   114.0     70.0     70.0     70.0
X2 170.0
GR7087.0    0.1    7083.0     32.0   7083.0     82.0   7087.0    114.0
X1 200.0    4.0        0.1   114.0    100.0    100.0    100.0
X2 170.0
GR7086.5    0.1    7082.5     32.0   7082.5     82.0   7086.5    114.0
X1 100.0    4.0        0.1   114.0    100.0    100.0    100.0
X2 170.0
GR7085.7    0.1    7081.7     32.0   7081.7     82.0   7085.7    114.0
EJ
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TABLE F-11. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL N.

```
T1      PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2      CHANNEL N - INCLUDES CROSS SECTIONS HC5-1 THROUGH HC5-5
T3      PMF - SUBCRITICAL
J1                                    -1.0                    229.0  7080.6
J2   -1            -1.0
NC 0.035   0.035   0.035     0.1       0.3
X180.0      4.0    0.01    70.00
X2 229.0
GR7080.0    0.01 7075.00   20.00 7075.00   50.00 7080.00    70.00
X1100.0     4.0    0.01    70.00   20.00   20.00   20.00
X2 229.0
GR7081.2    0.01 7076.20   20.00 7076.20   50.00 7081.20    70.00
X1 110      4.0    0.01    70.00   10.00   10.00   10.00
X2 229.0
GR7081.6    0.01 7076.63   20.00 7076.63   50.00 7081.63    70.00
X15.0       4.0    0.01    70.00   20.00   20.00   20.00
X2 229.0
GR7082.5    0.01 7077.50   20.00 7077.50   50.00 7082.50    70.00
X1140.0     4.0    0.01    70.00   30.00   30.00   30.00
X2 229.0
GR7083.3    0.01 7078.25   20.00 7078.25   50.00 7083.25    70.00
X1190.0     4.0    0.01    70.00   30.00   30.00   30.00
X2 229.0
GR7084.0    0.01 7079.00   20.00 7079.00   50.00 7084.00    70.00
X1 200      4.0    0.01    70.00   10.00   10.00   10.00
X2 212.7
GR7084.3    0.01 7079.33   20.00 7079.33   50.00 7084.33    70.00
X1220.0     4.0    0.01    70.00   20.00   20.00   20.00
X2 180.0
GR7085.0    0.01 7080.00   20.00 7080.00   50.00 7085.00    70.00
X1 230      4.0    0.01    68.33   10.00   10.00   10.00
X2 180.0
GR7085.5    0.01 7080.50   20.00 7080.50   48.33 7085.50    68.33
X1 240      4.0    0.01    66.67   10.00   10.00   10.00
X2 180.0
GR7086.0    0.01 7081.00   20.00 7081.00   46.67 7086.00    66.67
X1250.0     4.0    0.01    65.00   10.00   10.00   10.00
X2 180.0
GR7086.5    0.01 7081.50   20.00 7081.50   45.00 7086.50    65.00
X1 270      4.0    0.01    65.00   20.00   20.00   20.00
X2 180.0
GR7087.4    0.01 7082.40   20.00 7082.40   45.00 7087.40    65.00
X1 290      4.0    0.01    65.00   20.00   20.00   20.00
X2 180.0
GR7088.3    0.01 7083.30   20.00 7083.30   45.00 7088.30    65.00
X1 310      4.0    0.01    65.00   20.00   20.00   20.00
X2 180.0
GR7089.2    0.01 7084.20   20.00 7084.20   45.00 7089.20    65.00
X1 330      4.0    0.01    65.00   20.00   20.00   20.00
X2 180.0
GR7090.1    0.01 7085.10   20.00 7085.10   45.00 7090.10    65.00
X1350.0     4.0    0.01    65.00   20.00   20.00   20.00
X2 180.0
GR7091.0    0.01 7086.00   20.00 7086.00   45.00 7091.00    65.00
X1 365      4.0    0.01    65.00   15.00   15.00   15.00
X2 180.0
GR7092.2    0.01 7087.24   20.00 7087.24   45.00 7092.24    65.00
X14.0       4.0    0.01    65.00   20.00   20.00   20.00
X2 180.0
GR7093.9    0.01 7088.90   20.00 7088.90   45.00 7093.90    65.00
X1395.0     4.0    0.01    65.00   10.00   10.00   10.00
X2 180.0
GR7095.0    0.01 7090.00   20.00 7090.00   45.00 7095.00    65.00
X1400.0     4.0    0.01    60.00    5.00    5.00    5.00
X2 180.0
GR7095.2    0.01 7090.20   20.00 7090.20   40.00 7095.20    60.00
X1 402      4.0    0.01    58.00    2.00    2.00    2.00
X2 180.0
GR7095.4    0.01 7090.36   19.50 7090.36   38.50 7095.36    58.00
X1 404      4.0    0.01    56.00    2.00    2.00    2.00
X2 180.0
GR7095.5    0.01 7090.52   19.00 7090.52   37.00 7095.52    56.00
X1 406      4.0    0.01    54.00    2.00    2.00    2.00
X2 180.0
GR7095.7    0.01 7090.68   18.50 7090.68   35.50 7095.68    54.00
X1 408      4.0    0.01    52.00    2.00    2.00    2.00
X2 180.0
GR7095.8    0.01 7090.84   18.00 7090.84   34.00 7095.84    52.00
X1410.0     4.0    0.01    50.00    2.00    2.00    2.00
X2 180.0
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TABLE F-11. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL N (continued).

```
GR7096.0    0.01 7091.00    17.50 7091.00    32.50 7096.00    50.00
X1 412       4.0    0.01    48.00    2.00     2.00    2.00
X2 180.0
GR7096.1    0.01 7091.10    17.00 7091.10    31.00 7096.10    48.00
X1 414       4.0    0.01    46.00    2.00     2.00    2.00
X2 180.0
GR7096.2    0.01 7091.20    16.50 7091.20    29.50 7096.20    46.00
X1 416       4.0    0.01    44.00    2.00     2.00    2.00
X2 180.0
GR7096.3    0.01 7091.30    16.00 7091.30    28.00 7096.30    44.00
X1 418       4.0    0.01    42.00    2.00     2.00    2.00
X2 180.0
GR7096.4    0.01 7091.40    15.50 7091.40    26.50 7096.40    42.00
X1420.0      4.0    0.01    40.00    2.00     2.00    2.00
X2 180.0
GR7096.5    0.01 7091.50    15.00 7091.50    25.00 7096.50    40.00
X1430.0     4.0    0.01    35.00   10.00    10.00   10.00
X2 180.0
GR7097.0    0.01 7092.00    15.00 7092.00    20.00 7097.00    35.00
X1440.0     4.0    0.01    30.00   10.00    10.00   10.00
X2 180.0
GR7097.5    0.01 7092.50    15.00 7092.50    15.00 7097.50    30.00
X1445.0     4.0    0.01    25.00    5.00     5.00    5.00
X2 180.0
GR7097.8    0.01 7092.80    12.50 7092.80    12.50 7097.80    25.00
X1450.0     4.0    0.01    20.00    5.00     5.00    5.00
X2 180.0
GR7098.0    0.01 7093.00    10.00 7093.00    10.00 7098.00    20.00
X13.0       4.0    0.01    20.00   25.00    25.00   25.00
X2 180.0
GR7098.0    0.01 7093.05    10.00 7093.05    10.00 7098.05    20.00
X1500.0     4.0    0.01    20.00   25.00    25.00   25.00
X2 180.0
GR7098.1    0.01 7093.10    10.00 7093.10    10.00 7098.10    20.00
X1 503       4.0    0.01    25.19    3.00     3.00    3.00
X2 180.0
GR7098.1    0.01 7093.11    11.15 7093.11    14.04 7098.11    25.19
X1 508       4.0    0.01    33.85    5.00     5.00    5.00
X2 180.0
GR7098.1    0.01 7093.12    13.08 7093.12    20.77 7098.12    33.85
X1513.0      4.0    0.01    42.50    5.00     5.00    5.00
X2 180.0
GR7098.1    0.01 7093.13    15.00 7093.13    27.50 7098.13    42.50
X1 515       4.0    0.01    48.75    2.00     2.00    2.00
X2 180.0
GR7098.1    0.01 7093.13    15.83 7093.13    32.92 7098.13    48.75
X1 520       4.0    0.01    64.38    5.00     5.00    5.00
X2 180.0
GR7098.1    0.01 7093.15    17.92 7093.15    46.46 7098.15    64.38
X1525.0      4.0    0.01    80.00    5.00     5.00    5.00
X2 180.0
GR7098.2    0.01 7093.16    20.00 7093.16    60.00 7098.16    80.00
X1600.0     4.0    0.01    80.00   75.00    75.00   75.00
X2 450.0
GR7099.0    0.01 7094.00    20.00 7094.00    60.00 7099.00    80.00
X1 680       4.0    0.01    80.00   80.00    80.00   80.00
X2 649.7
GR7099.1    0.01 7094.14    20.00 7094.14    60.00 7099.14    80.00
X1 780       4.0    0.01    80.00  100.00   100.00  100.00
X2 899.4
GR7099.3    0.01 7094.32    20.00 7094.32    60.00 7099.32    80.00
X12.0        4.0    0.01    80.00  100.00   100.00  100.00
X21149.0
GR7099.5    0.01 7094.50    20.00 7094.50    60.00 7099.50    80.00
X1 885       4.0    0.01    81.25    5.00     5.00    5.00
X21149.0
GR7099.5    0.01 7094.52    20.47 7094.52    60.78 7099.52    81.25
X1 890       4.0    0.01    82.50    5.00     5.00    5.00
X21149.0
GR7099.5    0.01 7094.53    20.94 7094.53    61.56 7099.53    82.50
X1 895       4.0    0.01    83.75    5.00     5.00    5.00
X21149.0
GR7099.5    0.01 7094.55    21.41 7094.55    62.34 7099.55    83.75
X1 900       4.0    0.01    85.00    5.00     5.00    5.00
X21149.0
GR7099.6    0.01 7094.56    21.88 7094.56    63.13 7099.56    85.00
X1 905       4.0    0.01    86.25    5.00     5.00    5.00
X21149.0
GR7099.6    0.01 7094.58    22.34 7094.58    63.91 7099.58    86.25
X1 910       4.0    0.01    87.50    5.00     5.00    5.00
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TABLE F-11. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL N (continued).

```
X21149.0
GR7099.6     0.01 7094.59    22.81 7094.59    64.69 7099.59    87.50
X1 915       4.0     0.01    88.75    5.00     5.00    5.00
X21149.0
GR7099.6     0.01 7094.61    23.28 7094.61    65.47 7099.61    88.75
X1 920       4.0     0.01    90.00    5.00     5.00    5.00
X21149.0
GR7099.6     0.01 7094.63    23.75 7094.63    66.25 7099.63    90.00
X1 925       4.0     0.01    91.25    5.00     5.00    5.00
X21149.0
GR7099.6     0.01 7094.64    24.22 7094.64    67.03 7099.64    91.25
X1 930       4.0     0.01    92.50    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.66    24.69 7094.66    67.81 7099.66    92.50
X1 935       4.0     0.01    93.75    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.67    25.16 7094.67    68.59 7099.67    93.75
X1 940       4.0     0.01    95.00    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.69    25.63 7094.69    69.38 7099.69    95.00
X1 945       4.0     0.01    96.25    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.70    26.09 7094.70    70.16 7099.70    96.25
X1 950       4.0     0.01    97.50    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.72    26.56 7094.72    70.94 7099.72    97.50
X1 955       4.0     0.01    98.75    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.73    27.03 7094.73    71.72 7099.73    98.75
X1 960       4.0     0.01   100.00    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.75    27.50 7094.75    72.50 7099.75   100.00
X1 965       4.0     0.01   101.25    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.77    27.97 7094.77    73.28 7099.77   101.25
X1 970       4.0     0.01   102.50    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.78    28.44 7094.78    74.06 7099.78   102.50
X1 975       4.0     0.01   103.75    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.80    28.91 7094.80    74.84 7099.80   103.75
X1 980       4.0     0.01   105.00    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.81    29.38 7094.81    75.63 7099.81   105.00
X1 985       4.0     0.01   106.25    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.83    29.84 7094.83    76.41 7099.83   106.25
X1 990       4.0     0.01   107.50    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.84    30.31 7094.84    77.19 7099.84   107.50
X1 995       4.0     0.01   108.75    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.86    30.78 7094.86    77.97 7099.86   108.75
X1 1000      4.0     0.01   110.00    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.88    31.25 7094.88    78.75 7099.88   110.00
X1 1005      4.0     0.01   111.25    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.89    31.72 7094.89    79.53 7099.89   111.25
X1 1010      4.0     0.01   112.50    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.91    32.19 7094.91    80.31 7099.91   112.50
X1 1015      4.0     0.01   113.75    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.92    32.66 7094.92    81.09 7099.92   113.75
X1 1020      4.0     0.01   115.00    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.94    33.13 7094.94    81.88 7099.94   115.00
X1 1025      4.0     0.01   116.25    5.00     5.00    5.00
X21149.0
GR7100.0     0.01 7094.95    33.59 7094.95    82.66 7099.95   116.25
X1 1030      4.0     0.01   117.50    5.00     5.00    5.00
X21149.0
GR7100.0     0.01 7094.97    34.06 7094.97    83.44 7099.97   117.50
X1 1035      4.0     0.01   118.75    5.00     5.00    5.00
X21149.0
GR7100.0     0.01 7094.98    34.53 7094.98    84.22 7099.98   118.75
X1 1040      4.0     0.01   120.00    5.00     5.00    5.00
X21149.0
GR7100.0     0.01 7095.00    35.00 7095.00    85.00 7100.00   120.00
```

TABLE F-11. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL N (continued).

```
X1 1045      4.0     0.01  121.25    5.00     5.00    5.00
X21149.0
GR7100.0    0.01 7095.02    35.47 7095.02    85.78 7100.02  121.25
X1 1050      4.0     0.01  122.50    5.00     5.00    5.00
X21149.0
GR7100.0    0.01 7095.03    35.94 7095.03    86.56 7100.03  122.50
X1 1055      4.0     0.01  123.75    5.00     5.00    5.00
X21149.0
GR7100.0    0.01 7095.05    36.41 7095.05    87.34 7100.05  123.75
X1 1060      4.0     0.01  125.00    5.00     5.00    5.00
X21149.0
GR7100.1    0.01 7095.06    36.88 7095.06    88.13 7100.06  125.00
X1 1065      4.0     0.01  126.25    5.00     5.00    5.00
X21149.0
GR7100.1    0.01 7095.08    37.34 7095.08    88.91 7100.08  126.25
X1 1070      4.0     0.01  127.50    5.00     5.00    5.00
X21149.0
GR7100.1    0.01 7095.09    37.81 7095.09    89.69 7100.09  127.50
X1 1075      4.0     0.01  128.75    5.00     5.00    5.00
X21149.0
GR7100.1    0.01 7095.11    38.28 7095.11    90.47 7100.11  128.75
X1 1080      4.0     0.01  130.00    5.00     5.00    5.00
X21149.0
GR7100.1    0.01 7095.13    38.75 7095.13    91.25 7100.13  130.00
X1 1085      4.0     0.01  131.25    5.00     5.00    5.00
X21149.0
GR7100.1    0.01 7095.14    39.22 7095.14    92.03 7100.14  131.25
X1 1090      4.0     0.01  132.50    5.00     5.00    5.00
X21149.0
GR7100.2    0.01 7095.16    39.69 7095.16    92.81 7100.16  132.50
X1 1095      4.0     0.01  133.75    5.00     5.00    5.00
X21149.0
GR7100.2    0.01 7095.17    40.16 7095.17    93.59 7100.17  133.75
X1 1100      4.0     0.01  135.00    5.00     5.00    5.00
X21149.0
GR7100.2    0.01 7095.19    40.63 7095.19    94.38 7100.19  135.00
X1 1105      4.0     0.01  136.25    5.00     5.00    5.00
X21149.0
GR7100.2    0.01 7095.20    41.09 7095.20    95.16 7100.20  136.25
X1 1110      4.0     0.01  137.50    5.00     5.00    5.00
X21149.0
GR7100.2    0.01 7095.22    41.56 7095.22    95.94 7100.22  137.50
X1 1115      4.0     0.01  138.75    5.00     5.00    5.00
X21149.0
GR7100.2    0.01 7095.23    42.03 7095.23    96.72 7100.23  138.75
X1 1120      4.0     0.01  140.00    5.00     5.00    5.00
X21149.0
GR7100.3    0.01 7095.25    42.50 7095.25    97.50 7100.25  140.00
X1 1125      4.0     0.01  141.25    5.00     5.00    5.00
X21149.0
GR7100.3    0.01 7095.27    42.97 7095.27    98.28 7100.27  141.25
X1 1130      4.0     0.01  142.50    5.00     5.00    5.00
X21149.0
GR7100.3    0.01 7095.28    43.44 7095.28    99.06 7100.28  142.50
X1 1135      4.0     0.01  143.75    5.00     5.00    5.00
X21149.0
GR7100.3    0.01 7095.30    43.91 7095.30    99.84 7100.30  143.75
X1 1140      4.0     0.01  145.00    5.00     5.00    5.00
X21149.0
GR7100.3    0.01 7095.31    44.38 7095.31   100.63 7100.31  145.00
X1 1145      4.0     0.01  146.25    5.00     5.00    5.00
X21149.0
GR7100.3    0.01 7095.33    44.84 7095.33   101.41 7100.33  146.25
X1 1150      4.0     0.01  147.50    5.00     5.00    5.00
X21149.0
GR7100.3    0.01 7095.34    45.31 7095.34   102.19 7100.34  147.50
X1 1155      4.0     0.01  148.75    5.00     5.00    5.00
X21149.0
GR7100.4    0.01 7095.36    45.78 7095.36   102.97 7100.36  148.75
X1 1160      4.0     0.01  150.00    5.00     5.00    5.00
X21149.0
GR7100.4    0.01 7095.38    46.25 7095.38   103.75 7100.38  150.00
X1 1165      4.0     0.01  151.25    5.00     5.00    5.00
X21149.0
GR7100.4    0.01 7095.39    46.72 7095.39   104.53 7100.39  151.25
X1 1170      4.0     0.01  152.50    5.00     5.00    5.00
X21149.0
GR7100.4    0.01 7095.41    47.19 7095.41   105.31 7100.41  152.50
X1 1175      4.0     0.01  153.75    5.00     5.00    5.00
X21149.0
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TABLE F-11. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL N (continued).

```
GR7100.4     0.01 7095.42    47.66 7095.42   106.09 7100.42   153.75
X1 1180       4.0    0.01   155.00    5.00     5.00    5.00
X21149.0
GR7100.4     0.01 7095.44    48.13 7095.44   106.88 7100.44   155.00
X1 1185       4.0    0.01   156.25    5.00     5.00    5.00
X21149.0
GR7100.5     0.01 7095.45    48.59 7095.45   107.66 7100.45   156.25
X1 1190       4.0    0.01   157.50    5.00     5.00    5.00
X21149.0
GR7100.5     0.01 7095.47    49.06 7095.47   108.44 7100.47   157.50
X1 1195       4.0    0.01   158.75    5.00     5.00    5.00
X21149.0
GR7100.5     0.01 7095.48    49.53 7095.48   109.22 7100.48   158.75
X11200.0      4.0    0.01   160.00    5.00     5.00    5.00
X21149.0
GR7100.5     0.01 7095.50    50.00 7095.50   110.00 7100.50   160.00
X1 1300       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7100.7     0.01 7095.67    50.00 7095.67   110.00 7100.67   160.00
X1 1400       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7100.8     0.01 7095.83    50.00 7095.83   110.00 7100.83   160.00
X1 1500       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7101.0     0.01 7096.00    50.00 7096.00   110.00 7101.00   160.00
X1 1600       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7101.2     0.01 7096.17    50.00 7096.17   110.00 7101.17   160.00
X1 1700       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7101.3     0.01 7096.33    50.00 7096.33   110.00 7101.33   160.00
X11800.0      4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7101.5     0.01 7096.50    50.00 7096.50   110.00 7101.50   160.00
X1 1850       4.0    0.01   160.00   50.00    50.00   50.00
X21149.0
GR7101.6     0.01 7096.56    50.00 7096.56   110.00 7101.56   160.00
X1 1950       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7101.7     0.01 7096.67    50.00 7096.67   110.00 7101.67   160.00
X1 2050       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7101.8     0.01 7096.78    50.00 7096.78   110.00 7101.78   160.00
X1 2150       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7101.9     0.01 7096.89    50.00 7096.89   110.00 7101.89   160.00
X11.0         4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7102.0     0.01 7097.00    50.00 7097.00   110.00 7102.00   160.00
X1 2300       4.0    0.01   160.00   50.00    50.00   50.00
X21149.0
GR7102.1     0.01 7097.07    50.00 7097.07   110.00 7102.07   160.00
X1 2400       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7102.2     0.01 7097.20    50.00 7097.20   110.00 7102.20   160.00
X1 2500       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7102.3     0.01 7097.33    50.00 7097.33   110.00 7102.33   160.00
X1 2600       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7102.5     0.01 7097.47    50.00 7097.47   110.00 7102.47   160.00
X1 2700       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7102.6     0.01 7097.60    50.00 7097.60   110.00 7102.60   160.00
X1 2800       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7102.7     0.01 7097.73    50.00 7097.73   110.00 7102.73   160.00
X1 2900       4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7102.9     0.01 7097.87    50.00 7097.87   110.00 7102.87   160.00
X13000.0      4.0    0.01   160.00  100.00   100.00  100.00
X21149.0
GR7103.0     0.01 7098.00    50.00 7098.00   110.00 7103.00   160.00
EJ
ER
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TABLE F-12. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL N.

```
T1       PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2       CHANNEL N - INCLUDES CROSS SECTIONS HC5-1 THROUGH HC5-5
T3       PMF - SUPERCRITICAL
J1                            1.0    -1.0                     1149.0  7101.4
J2   -1            -1.0
NC 0.035   0.035   0.035     0.1     0.3
X13000.0     4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7103.0    0.01 7098.00   50.00 7098.00  110.00 7103.00  160.00
X1 2900      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7102.9    0.01 7097.87   50.00 7097.87  110.00 7102.87  160.00
X1 2800      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7102.7    0.01 7097.73   50.00 7097.73  110.00 7102.73  160.00
X1 2700      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7102.6    0.01 7097.60   50.00 7097.60  110.00 7102.60  160.00
X1 2600      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7102.5    0.01 7097.47   50.00 7097.47  110.00 7102.47  160.00
X1 2500      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7102.3    0.01 7097.33   50.00 7097.33  110.00 7102.33  160.00
X1 2400      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7102.2    0.01 7097.20   50.00 7097.20  110.00 7102.20  160.00
X1 2300      4.0    0.01  160.00   50.00   50.00   50.00
X21149.0
GR7102.1    0.01 7097.07   50.00 7097.07  110.00 7102.07  160.00
X11.0        4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7102.0    0.01 7097.00   50.00 7097.00  110.00 7102.00  160.00
X1 2150      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7101.9    0.01 7096.89   50.00 7096.89  110.00 7101.89  160.00
X1 2050      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7101.8    0.01 7096.78   50.00 7096.78  110.00 7101.78  160.00
X1 1950      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7101.7    0.01 7096.67   50.00 7096.67  110.00 7101.67  160.00
X1 1850      4.0    0.01  160.00   50.00   50.00   50.00
X21149.0
GR7101.6    0.01 7096.56   50.00 7096.56  110.00 7101.56  160.00
X11800.0     4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7101.5    0.01 7096.50   50.00 7096.50  110.00 7101.50  160.00
X1 1700      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7101.3    0.01 7096.33   50.00 7096.33  110.00 7101.33  160.00
X1 1600      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7101.2    0.01 7096.17   50.00 7096.17  110.00 7101.17  160.00
X1 1500      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7101.0    0.01 7096.00   50.00 7096.00  110.00 7101.00  160.00
X1 1400      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7100.8    0.01 7095.83   50.00 7095.83  110.00 7100.83  160.00
X1 1300      4.0    0.01  160.00  100.00  100.00  100.00
X21149.0
GR7100.7    0.01 7095.67   50.00 7095.67  110.00 7100.67  160.00
X11200.0     4.0    0.01  160.00    5.00    5.00    5.00
X21149.0
GR7100.5    0.01 7095.50   50.00 7095.50  110.00 7100.50  160.00
X1 1195      4.0    0.01  158.75    5.00    5.00    5.00
X21149.0
GR7100.5    0.01 7095.48   49.53 7095.48  109.22 7100.48  158.75
X1 1190      4.0    0.01  157.50    5.00    5.00    5.00
X21149.0
GR7100.5    0.01 7095.47   49.06 7095.47  108.44 7100.47  157.50
X1 1185      4.0    0.01  156.25    5.00    5.00    5.00
X21149.0
GR7100.5    0.01 7095.45   48.59 7095.45  107.66 7100.45  156.25
X1 1180      4.0    0.01  155.00    5.00    5.00    5.00
X21149.0
GR7100.4    0.01 7095.44   48.13 7095.44  106.88 7100.44  155.00
X1 1175      4.0    0.01  153.75    5.00    5.00    5.00
X21149.0
```

TABLE F-12. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL N (continued).

```
GR7100.4    0.01 7095.42   47.66 7095.42  106.09 7100.42  153.75
X1 1170      4.0    0.01  152.50    5.00    5.00    5.00
X21149.0
GR7100.4    0.01 7095.41   47.19 7095.41  105.31 7100.41  152.50
X1 1165      4.0    0.01  151.25    5.00    5.00    5.00
X21149.0
GR7100.4    0.01 7095.39   46.72 7095.39  104.53 7100.39  151.25
X1 1160      4.0    0.01  150.00    5.00    5.00    5.00
X21149.0
GR7100.4    0.01 7095.38   46.25 7095.38  103.75 7100.38  150.00
X1 1155      4.0    0.01  148.75    5.00    5.00    5.00
X21149.0
GR7100.4    0.01 7095.36   45.78 7095.36  102.97 7100.36  148.75
X1 1150      4.0    0.01  147.50    5.00    5.00    5.00
X21149.0
GR7100.3    0.01 7095.34   45.31 7095.34  102.19 7100.34  147.50
X1 1145      4.0    0.01  146.25    5.00    5.00    5.00
X21149.0
GR7100.3    0.01 7095.33   44.84 7095.33  101.41 7100.33  146.25
X1 1140      4.0    0.01  145.00    5.00    5.00    5.00
X21149.0
GR7100.3    0.01 7095.31   44.38 7095.31  100.63 7100.31  145.00
X1 1135      4.0    0.01  143.75    5.00    5.00    5.00
X21149.0
GR7100.3    0.01 7095.30   43.91 7095.30   99.84 7100.30  143.75
X1 1130      4.0    0.01  142.50    5.00    5.00    5.00
X21149.0
GR7100.3    0.01 7095.28   43.44 7095.28   99.06 7100.28  142.50
X1 1125      4.0    0.01  141.25    5.00    5.00    5.00
X21149.0
GR7100.3    0.01 7095.27   42.97 7095.27   98.28 7100.27  141.25
X1 1120      4.0    0.01  140.00    5.00    5.00    5.00
X21149.0
GR7100.3    0.01 7095.25   42.50 7095.25   97.50 7100.25  140.00
X1 1115      4.0    0.01  138.75    5.00    5.00    5.00
X21149.0
GR7100.2    0.01 7095.23   42.03 7095.23   96.72 7100.23  138.75
X1 1110      4.0    0.01  137.50    5.00    5.00    5.00
X21149.0
GR7100.2    0.01 7095.22   41.56 7095.22   95.94 7100.22  137.50
X1 1105      4.0    0.01  136.25    5.00    5.00    5.00
X21149.0
GR7100.2    0.01 7095.20   41.09 7095.20   95.16 7100.20  136.25
X1 1100      4.0    0.01  135.00    5.00    5.00    5.00
X21149.0
GR7100.2    0.01 7095.19   40.63 7095.19   94.38 7100.19  135.00
X1 1095      4.0    0.01  133.75    5.00    5.00    5.00
X21149.0
GR7100.2    0.01 7095.17   40.16 7095.17   93.59 7100.17  133.75
X1 1090      4.0    0.01  132.50    5.00    5.00    5.00
X21149.0
GR7100.2    0.01 7095.16   39.69 7095.16   92.81 7100.16  132.50
X1 1085      4.0    0.01  131.25    5.00    5.00    5.00
X21149.0
GR7100.1    0.01 7095.14   39.22 7095.14   92.03 7100.14  131.25
X1 1080      4.0    0.01  130.00    5.00    5.00    5.00
X21149.0
GR7100.1    0.01 7095.13   38.75 7095.13   91.25 7100.13  130.00
X1 1075      4.0    0.01  128.75    5.00    5.00    5.00
X21149.0
GR7100.1    0.01 7095.11   38.28 7095.11   90.47 7100.11  128.75
X1 1070      4.0    0.01  127.50    5.00    5.00    5.00
X21149.0
GR7100.1    0.01 7095.09   37.81 7095.09   89.69 7100.09  127.50
X1 1065      4.0    0.01  126.25    5.00    5.00    5.00
X21149.0
GR7100.1    0.01 7095.08   37.34 7095.08   88.91 7100.08  126.25
X1 1060      4.0    0.01  125.00    5.00    5.00    5.00
X21149.0
GR7100.1    0.01 7095.06   36.88 7095.06   88.13 7100.06  125.00
X1 1055      4.0    0.01  123.75    5.00    5.00    5.00
X21149.0
GR7100.0    0.01 7095.05   36.41 7095.05   87.34 7100.05  123.75
X1 1050      4.0    0.01  122.50    5.00    5.00    5.00
X21149.0
GR7100.0    0.01 7095.03   35.94 7095.03   86.56 7100.03  122.50
X1 1045      4.0    0.01  121.25    5.00    5.00    5.00
X21149.0
GR7100.0    0.01 7095.02   35.47 7095.02   85.78 7100.02  121.25
X1 1040      4.0    0.01  120.00    5.00    5.00    5.00
```

TABLE F-12. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL N (continued).

```
X21149.0
GR7100.0     0.01 7095.00    35.00 7095.00    85.00 7100.00   120.00
X1 1035       4.0    0.01   118.75    5.00     5.00    5.00
X21149.0
GR7100.0     0.01 7094.98    34.53 7094.98    84.22 7099.98   118.75
X1 1030       4.0    0.01   117.50    5.00     5.00    5.00
X21149.0
GR7100.0     0.01 7094.97    34.06 7094.97    83.44 7099.97   117.50
X1 1025       4.0    0.01   116.25    5.00     5.00    5.00
X21149.0
GR7100.0     0.01 7094.95    33.59 7094.95    82.66 7099.95   116.25
X1 1020       4.0    0.01   115.00    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.94    33.13 7094.94    81.88 7099.94   115.00
X1 1015       4.0    0.01   113.75    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.92    32.66 7094.92    81.09 7099.92   113.75
X1 1010       4.0    0.01   112.50    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.91    32.19 7094.91    80.31 7099.91   112.50
X1 1005       4.0    0.01   111.25    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.89    31.72 7094.89    79.53 7099.89   111.25
X1 1000       4.0    0.01   110.00    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.88    31.25 7094.88    78.75 7099.88   110.00
X1 995        4.0    0.01   108.75    5.00     5.00    5.00
X21149.0
GR7099.9     0.01 7094.86    30.78 7094.86    77.97 7099.86   108.75
X1 990        4.0    0.01   107.50    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.84    30.31 7094.84    77.19 7099.84   107.50
X1 985        4.0    0.01   106.25    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.83    29.84 7094.83    76.41 7099.83   106.25
X1 980        4.0    0.01   105.00    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.81    29.38 7094.81    75.63 7099.81   105.00
X1 975        4.0    0.01   103.75    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.80    28.91 7094.80    74.84 7099.80   103.75
X1 970        4.0    0.01   102.50    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.78    28.44 7094.78    74.06 7099.78   102.50
X1 965        4.0    0.01   101.25    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.77    27.97 7094.77    73.28 7099.77   101.25
X1 960        4.0    0.01   100.00    5.00     5.00    5.00
X21149.0
GR7099.8     0.01 7094.75    27.50 7094.75    72.50 7099.75   100.00
X1 955        4.0    0.01    98.75    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.73    27.03 7094.73    71.72 7099.73    98.75
X1 950        4.0    0.01    97.50    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.72    26.56 7094.72    70.94 7099.72    97.50
X1 945        4.0    0.01    96.25    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.70    26.09 7094.70    70.16 7099.70    96.25
X1 940        4.0    0.01    95.00    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.69    25.63 7094.69    69.38 7099.69    95.00
X1 935        4.0    0.01    93.75    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.67    25.16 7094.67    68.59 7099.67    93.75
X1 930        4.0    0.01    92.50    5.00     5.00    5.00
X21149.0
GR7099.7     0.01 7094.66    24.69 7094.66    67.81 7099.66    92.50
X1 925        4.0    0.01    91.25    5.00     5.00    5.00
X21149.0
GR7099.6     0.01 7094.64    24.22 7094.64    67.03 7099.64    91.25
X1 920        4.0    0.01    90.00    5.00     5.00    5.00
X21149.0
GR7099.6     0.01 7094.63    23.75 7094.63    66.25 7099.63    90.00
X1 915        4.0    0.01    88.75    5.00     5.00    5.00
X21149.0
GR7099.6     0.01 7094.61    23.28 7094.61    65.47 7099.61    88.75
X1 910        4.0    0.01    87.50    5.00     5.00    5.00
X21149.0
GR7099.6     0.01 7094.59    22.81 7094.59    64.69 7099.59    87.50
```

TABLE F-12. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL N (continued).

```
X1 905      4.0     0.01    86.25    5.00     5.00     5.00
X21149.0
GR7099.6    0.01 7094.58    22.34 7094.58    63.91 7099.58    86.25
X1 900      4.0     0.01    85.00    5.00     5.00     5.00
X21149.0
GR7099.6    0.01 7094.56    21.88 7094.56    63.13 7099.56    85.00
X1 895      4.0     0.01    83.75    5.00     5.00     5.00
X21149.0
GR7099.5    0.01 7094.55    21.41 7094.55    62.34 7099.55    83.75
X1 890      4.0     0.01    82.50    5.00     5.00     5.00
X21149.0
GR7099.5    0.01 7094.53    20.94 7094.53    61.56 7099.53    82.50
X1 885      4.0     0.01    81.25    5.00     5.00     5.00
X21149.0
GR7099.5    0.01 7094.52    20.47 7094.52    60.78 7099.52    81.25
X12.0       4.0     0.01    80.00  100.00   100.00   100.00
X21149.0
GR7099.5    0.01 7094.50    20.00 7094.50    60.00 7099.50    80.00
X1 780      4.0     0.01    80.00  100.00   100.00   100.00
X2 899.4
GR7099.3    0.01 7094.32    20.00 7094.32    60.00 7099.32    80.00
X1 680      4.0     0.01    80.00   80.00    80.00    80.00
X2 649.7
GR7099.1    0.01 7094.14    20.00 7094.14    60.00 7099.14    80.00
X1600.0    4.0    0.01    80.00    75.00   75.00    75.00
X2 450.0
GR7099.0    0.01 7094.00    20.00 7094.00    60.00 7099.00    80.00
X1525.0     4.0     0.01    80.00    5.00     5.00     5.00
X2 180.0
GR7098.2    0.01 7093.16    20.00 7093.16    60.00 7098.16    80.00
X1 520      4.0     0.01    64.38    5.00     5.00     5.00
X2 180.0
GR7098.1    0.01 7093.15    17.92 7093.15    46.46 7098.15    64.38
X1 515      4.0     0.01    48.75    2.00     2.00     2.00
X2 180.0
GR7098.1    0.01 7093.13    15.83 7093.13    32.92 7098.13    48.75
X1513.0     4.0     0.01    42.50    5.00     5.00     5.00
X2 180.0
GR7098.1    0.01 7093.13    15.00 7093.13    27.50 7098.13    42.50
X1 508      4.0     0.01    33.85    5.00     5.00     5.00
X2 180.0
GR7098.1    0.01 7093.12    13.08 7093.12    20.77 7098.12    33.85
X1 503      4.0     0.01    25.19    3.00     3.00     3.00
X2 180.0
GR7098.1    0.01 7093.11    11.15 7093.11    14.04 7098.11    25.19
X1500.0    4.0    0.01    20.00    25.00   25.00    25.00
X2 180.0
GR7098.1    0.01 7093.10    10.00 7093.10    10.00 7098.10    20.00
X13.0      4.0    0.01    20.00    25.00   25.00    25.00
X2 180.0
GR7098.0    0.01 7093.05    10.00 7093.05    10.00 7098.05    20.00
X1450.0    4.0    0.01    20.00     5.00    5.00     5.00
X2 180.0
GR7098.0    0.01 7093.00    10.00 7093.00    10.00 7098.00    20.00
X1445.0    4.0    0.01    25.00     5.00    5.00     5.00
X2 180.0
GR7097.8    0.01 7092.80    12.50 7092.80    12.50 7097.80    25.00
X1440.0    4.0    0.01    30.00    10.00   10.00    10.00
X2 180.0
GR7097.5    0.01 7092.50    15.00 7092.50    15.00 7097.50    30.00
X1430.0    4.0    0.01    35.00    10.00   10.00    10.00
X2 180.0
GR7097.0    0.01 7092.00    15.00 7092.00    20.00 7097.00    35.00
X1420.0     4.0     0.01    40.00    2.00     2.00     2.00
X2 180.0
GR7096.5    0.01 7091.50    15.00 7091.50    25.00 7096.50    40.00
X1 418      4.0     0.01    42.00    2.00     2.00     2.00
X2 180.0
GR7096.4    0.01 7091.40    15.50 7091.40    26.50 7096.40    42.00
X1 416      4.0     0.01    44.00    2.00     2.00     2.00
X2 180.0
GR7096.3    0.01 7091.30    16.00 7091.30    28.00 7096.30    44.00
X1 414      4.0     0.01    46.00    2.00     2.00     2.00
X2 180.0
GR7096.2    0.01 7091.20    16.50 7091.20    29.50 7096.20    46.00
X1 412      4.0     0.01    48.00    2.00     2.00     2.00
X2 180.0
GR7096.1    0.01 7091.10    17.00 7091.10    31.00 7096.10    48.00
X1410.0     4.0     0.01    50.00    2.00     2.00     2.00
X2 180.0
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TABLE F-12. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL N (continued).

```
GR7096.0    0.01 7091.00    17.50 7091.00    32.50 7096.00    50.00
X1 408       4.0    0.01    52.00    2.00     2.00    2.00
X2 180.0
GR7095.8    0.01 7090.84    18.00 7090.84    34.00 7095.84    52.00
X1 406       4.0    0.01    54.00    2.00     2.00    2.00
X2 180.0
GR7095.7    0.01 7090.68    18.50 7090.68    35.50 7095.68    54.00
X1 404       4.0    0.01    56.00    2.00     2.00    2.00
X2 180.0
GR7095.5    0.01 7090.52    19.00 7090.52    37.00 7095.52    56.00
X1 402       4.0    0.01    58.00    2.00     2.00    2.00
X2 180.0
GR7095.4    0.01 7090.36    19.50 7090.36    38.50 7095.36    58.00
X1400.0     4.0    0.01    60.00    5.00     5.00    5.00
X2 180.0
GR7095.2    0.01 7090.20    20.00 7090.20    40.00 7095.20    60.00
X1395.0     4.0    0.01    65.00   10.00    10.00   10.00
X2 180.0
GR7095.0    0.01 7090.00    20.00 7090.00    45.00 7095.00    65.00
X14.0        4.0    0.01    65.00   20.00    20.00   20.00
X2 180.0
GR7093.9    0.01 7088.90    20.00 7088.90    45.00 7093.90    65.00
X1 365       4.0    0.01    65.00   15.00    15.00   15.00
X2 180.0
GR7092.2    0.01 7087.24    20.00 7087.24    45.00 7092.24    65.00
X1350.0      4.0    0.01    65.00   20.00    20.00   20.00
X2 180.0
GR7091.0    0.01 7086.00    20.00 7086.00    45.00 7091.00    65.00
X1 330       4.0    0.01    65.00   20.00    20.00   20.00
X2 180.0
GR7090.1    0.01 7085.10    20.00 7085.10    45.00 7090.10    65.00
X1 310       4.0    0.01    65.00   20.00    20.00   20.00
X2 180.0
GR7089.2    0.01 7084.20    20.00 7084.20    45.00 7089.20    65.00
X1 290       4.0    0.01    65.00   20.00    20.00   20.00
X2 180.0
GR7088.3    0.01 7083.30    20.00 7083.30    45.00 7088.30    65.00
X1 270       4.0    0.01    65.00   20.00    20.00   20.00
X2 180.0
GR7087.4    0.01 7082.40    20.00 7082.40    45.00 7087.40    65.00
X1250.0      4.0    0.01    65.00   10.00    10.00   10.00
X2 180.0
GR7086.5    0.01 7081.50    20.00 7081.50    45.00 7086.50    65.00
X1 240       4.0    0.01    66.67   10.00    10.00   10.00
X2 180.0
GR7086.0    0.01 7081.00    20.00 7081.00    46.67 7086.00    66.67
X1 230       4.0    0.01    68.33   10.00    10.00   10.00
X2 180.0
GR7085.5    0.01 7080.50    20.00 7080.50    48.33 7085.50    68.33
X1220.0      4.0    0.01    70.00   20.00    20.00   20.00
X2 180.0
GR7085.0    0.01 7080.00    20.00 7080.00    50.00 7085.00    70.00
X1 200       4.0    0.01    70.00   10.00    10.00   10.00
X2 212.7
GR7084.3    0.01 7079.33    20.00 7079.33    50.00 7084.33    70.00
X1190.0     4.0    0.01    70.00   30.00    30.00   30.00
X2 229.0
GR7084.0    0.01 7079.00    20.00 7079.00    50.00 7084.00    70.00
X1140.0     4.0    0.01    70.00   30.00    30.00   30.00
X2 229.0
GR7083.3    0.01 7078.25    20.00 7078.25    50.00 7083.25    70.00
X15.0        4.0    0.01    70.00   20.00    20.00   20.00
X2 229.0
GR7082.5    0.01 7077.50    20.00 7077.50    50.00 7082.50    70.00
X1 110       4.0    0.01    70.00   10.00    10.00   10.00
X2 229.0
GR7081.6    0.01 7076.63    20.00 7076.63    50.00 7081.63    70.00
X1100.0     4.0    0.01    70.00   20.00    20.00   20.00
X2 229.0
GR7081.2    0.01 7076.20    20.00 7076.20    50.00 7081.20    70.00
X180.0      4.0    0.01    70.00
X2 229.0
GR7080.0    0.01 7075.00    20.00 7075.00    50.00 7080.00    70.00
EJ
ER
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TABLE F-13. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL O.

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T1       PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2       CHANNEL O
T3       PMF - SUBCRITICAL
J1                               -1.0                    583.0  7100.0
J2   -1        0     -1.0
NC 0.035   0.035   0.035     0.1       0.3
X140         4.0    0.01   52.00
X2 583.0
GR7100.8     0.01 7096.80   16.00 7096.80   36.00 7100.80   52.00
X19          4.0    0.01   52.00   15.00   15.00   15.00
X2 583.0
GR7101.0     0.01 7097.00   16.00 7097.00   36.00 7101.00   52.00
X1100        4.0    0.01   52.00   45.00   45.00   45.00
X2 583.0
GR7102.0     0.01 7098.00   16.00 7098.00   36.00 7102.00   52.00
X1 150       4.0    0.01   52.00   50.00   50.00   50.00
X2 583.0
GR7102.7     0.01 7098.67   16.00 7098.67   36.00 7102.67   52.00
X1250        4.0    0.01   52.00  100.00  100.00  100.00
X2 583.0
GR7104.0     0.01 7100.00   16.00 7100.00   36.00 7104.00   52.00
X1 310       4.0    0.01   52.00   60.00   60.00   60.00
X2 583.0
GR7104.4     0.01 7100.38   16.00 7100.38   36.00 7104.38   52.00
X1410        4.0    0.01   52.00  100.00  100.00  100.00
X2 583.0
GR7105.0     0.01 7101.00   16.00 7101.00   36.00 7105.00   52.00
X1 411       4.0    0.01   52.46    1.00    1.00    1.00
X2 574.8
GR7104.0     0.01 7101.00   16.00 7101.00   36.50 7104.00   52.46
X1 414       4.0    0.01   53.84    3.00    3.00    3.00
X2 550.2
GR7104.0     0.01 7101.02   16.00 7101.02   38.00 7104.02   53.84
X1 417       4.0    0.01   55.22    3.00    3.00    3.00
X2 525.6
GR7104.0     0.01 7101.03   16.00 7101.03   39.50 7104.03   55.22
X1420        4.0    0.01   48.70    3.00    3.00    3.00
X2 501.0
GR7104.0     0.01 7101.05   12.00 7101.05   37.00 7104.05   48.70
X1460        4.0    0.01   48.70   40.00   40.00   40.00
X2 501.0
GR7104.3     0.01 7101.25   12.00 7101.25   37.00 7104.25   48.70
X1 465       4.0    0.01   48.73    5.00    5.00    5.00
X2 501.0
GR7104.3     0.01 7101.27   12.00 7101.27   37.00 7104.27   48.73
X1 470       4.0    0.01   48.76    5.00    5.00    5.00
X2 501.0
GR7104.3     0.01 7101.30   12.00 7101.30   37.00 7104.30   48.76
X1 475       4.0    0.01   48.79    5.00    5.00    5.00
X2 501.0
GR7104.3     0.01 7101.33   12.00 7101.33   37.00 7104.33   48.79
X1 480       4.0    0.01   48.82    5.00    5.00    5.00
X2 501.0
GR7104.4     0.01 7101.35   12.00 7101.35   37.00 7104.35   48.82
X1 485       4.0    0.01   48.85    5.00    5.00    5.00
X2 501.0
GR7104.4     0.01 7101.38   12.00 7101.38   37.00 7104.38   48.85
X1 490       4.0    0.01   48.88    5.00    5.00    5.00
X2 501.0
GR7104.4     0.01 7101.40   12.00 7101.40   37.00 7104.40   48.88
X1 495       4.0    0.01   48.91    5.00    5.00    5.00
X2 501.0
GR7104.4     0.01 7101.42   12.00 7101.42   37.00 7104.42   48.91
X1 500       4.0    0.01   48.94    5.00    5.00    5.00
X2 501.0
GR7104.5     0.01 7101.45   12.00 7101.45   37.00 7104.45   48.94
X1 505       4.0    0.01   48.97    5.00    5.00    5.00
X2 501.0
GR7104.5     0.01 7101.48   12.00 7101.48   37.00 7104.48   48.97
X16          4.0    0.01   49.00    5.00    5.00    5.00
X2 501.0
GR7104.5     0.01 7101.50   12.00 7101.50   37.00 7104.50   49.00
X1610        4.0    0.01   49.00  100.00  100.00  100.00
X2 501.0
GR7105.0     0.01 7102.00   12.00 7102.00   37.00 7105.00   49.00
X1 620       4.0    0.01   49.00   10.00   10.00   10.00
X2 501.0
GR7105.0     0.01 7102.05   12.00 7102.05   37.00 7105.05   49.00
X1 720       4.0    0.01   49.00  100.00  100.00  100.00
X2 501.0
```

TABLE F-13. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL O (continued).

```
GR7105.5     0.01 7102.52   12.00 7102.52   37.00 7105.52    49.00
X1820         4.0    0.01   49.00  100.00  100.00  100.00
X2 501.0
GR7106.0     0.01 7103.00   12.00 7103.00   37.00 7106.00    49.00
X1 830        4.0    0.01   49.00   10.00   10.00   10.00
X2 501.0
GR7106.0     0.01 7103.05   12.00 7103.05   37.00 7106.05    49.00
X1 930        4.0    0.01   49.00  100.00  100.00  100.00
X2 501.0
GR7106.5     0.01 7103.54   12.00 7103.54   37.00 7106.54    49.00
X1 1030       4.0    0.01   49.00  100.00  100.00  100.00
X2 501.0
GR7107.0     0.01 7104.02   12.00 7104.02   37.00 7107.02    49.00
X1 1130       4.0    0.01   49.00  100.00  100.00  100.00
X2 501.0
GR7107.5     0.01 7104.51   12.00 7104.51   37.00 7107.51    49.00
X11230        4.0    0.01   49.00  100.00  100.00  100.00
X2 501.0
GR7108.0     0.01 7105.00   12.00 7105.00   37.00 7108.00    49.00
EJ
ER
```

TABLE F-14. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL O.

```
T1       PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2       CHANNEL O - INCLUDES CROSS SECTIONS HC5-6 AND HC5-9
T3       PMF - SUPERCRITICAL
J1                             1.0    -1.0                       501.0  7108.4
J2    -1         0     -1.0
NC 0.035    0.035    0.035     0.1     0.3
X11230       4.0     0.01    49.00  100.00   100.00  100.00
X2 501.0
GR7108.0     0.01 7105.00    12.00 7105.00    37.00 7108.00    49.00
X1 1130      4.0     0.01    49.00  100.00   100.00  100.00
X2 501.0
GR7107.5     0.01 7104.51    12.00 7104.51    37.00 7107.51    49.00
X1 1030      4.0     0.01    49.00  100.00   100.00  100.00
X2 501.0
GR7107.0     0.01 7104.02    12.00 7104.02    37.00 7107.02    49.00
X1 930       4.0     0.01    49.00  100.00   100.00  100.00
X2 501.0
GR7106.5     0.01 7103.54    12.00 7103.54    37.00 7106.54    49.00
X1 830       4.0     0.01    49.00   10.00    10.00   10.00
X2 501.0
GR7106.0     0.01 7103.05    12.00 7103.05    37.00 7106.05    49.00
X1820        4.0     0.01    49.00  100.00   100.00  100.00
X2 501.0
GR7106.0     0.01 7103.00    12.00 7103.00    37.00 7106.00    49.00
X1 720       4.0     0.01    49.00  100.00   100.00  100.00
X2 501.0
GR7105.5     0.01 7102.52    12.00 7102.52    37.00 7105.52    49.00
X1 620       4.0     0.01    49.00   10.00    10.00   10.00
X2 501.0
GR7105.0     0.01 7102.05    12.00 7102.05    37.00 7105.05    49.00
X1610        4.0     0.01   49.00  100.00   100.00  100.00
X2 501.0
GR7105.0     0.01 7102.00    12.00 7102.00    37.00 7105.00    49.00
X16          4.0     0.01    49.00    5.00     5.00    5.00
X2 501.0
GR7104.5     0.01 7101.50    12.00 7101.50    37.00 7104.50    49.00
X1 505       4.0     0.01    48.97    5.00     5.00    5.00
X2 501.0
GR7104.5     0.01 7101.48    12.00 7101.48    37.00 7104.48    48.97
X1 500       4.0     0.01    48.94    5.00     5.00    5.00
X2 501.0
GR7104.5     0.01 7101.45    12.00 7101.45    37.00 7104.45    48.94
X1 495       4.0     0.01    48.91    5.00     5.00    5.00
X2 501.0
GR7104.4     0.01 7101.42    12.00 7101.42    37.00 7104.42    48.91
X1 490       4.0     0.01    48.88    5.00     5.00    5.00
X2 501.0
GR7104.4     0.01 7101.40    12.00 7101.40    37.00 7104.40    48.88
X1 485       4.0     0.01    48.85    5.00     5.00    5.00
X2 501.0
GR7104.4     0.01 7101.38    12.00 7101.38    37.00 7104.38    48.85
X1 480       4.0     0.01    48.82    5.00     5.00    5.00
X2 501.0
GR7104.4     0.01 7101.35    12.00 7101.35    37.00 7104.35    48.82
X1 475       4.0     0.01    48.79    5.00     5.00    5.00
X2 501.0
GR7104.3     0.01 7101.33    12.00 7101.33    37.00 7104.33    48.79
X1 470       4.0     0.01    48.76    5.00     5.00    5.00
X2 501.0
GR7104.3     0.01 7101.30    12.00 7101.30    37.00 7104.30    48.76
X1 465       4.0     0.01    48.73    5.00     5.00    5.00
X2 501.0
GR7104.3     0.01 7101.27    12.00 7101.27    37.00 7104.27    48.73
X1460        4.0     0.01   48.70   40.00    40.00   40.00
X2 501.0
GR7104.3     0.01 7101.25    12.00 7101.25    37.00 7104.25    48.70
X1420        4.0     0.01    48.70    3.00     3.00    3.00
X2 501.0
GR7104.0     0.01 7101.05    12.00 7101.05    37.00 7104.05    48.70
X1 417       4.0     0.01    55.22    3.00     3.00    3.00
X2 525.6
GR7104.0     0.01 7101.03    16.00 7101.03    39.50 7104.03    55.22
X1 414       4.0     0.01    53.84    3.00     3.00    3.00
X2 550.2
GR7104.0     0.01 7101.02    16.00 7101.02    38.00 7104.02    53.84
X1 411       4.0     0.01    52.46    1.00     1.00    1.00
X2 574.8
GR7104.0     0.01 7101.00    16.00 7101.00    36.50 7104.00    52.46
X1410        4.0     0.01    52.00  100.00   100.00  100.00
X2 583.0
```

TABLE F-14. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL O (continued).

```
GR7105.0     0.01 7101.00    16.00 7101.00    36.00 7105.00    52.00
X1 310        4.0    0.01    52.00   60.00    60.00   60.00
X2 583.0
GR7104.4     0.01 7100.38    16.00 7100.38    36.00 7104.38    52.00
X1250         4.0    0.01    52.00  100.00   100.00  100.00
X2 583.0
GR7104.0     0.01 7100.00    16.00 7100.00    36.00 7104.00    52.00
X1 150        4.0    0.01    52.00   50.00    50.00   50.00
X2 583.0
GR7102.7     0.01 7098.67    16.00 7098.67    36.00 7102.67    52.00
X1100        4.0    0.01    52.00   45.00    45.00   45.00
X2 583.0
GR7102.0     0.01 7098.00    16.00 7098.00    36.00 7102.00    52.00
X19          4.0    0.01    52.00   15.00    15.00   15.00
X2 583.0
GR7101.0     0.01 7097.00    16.00 7097.00    36.00 7101.00    52.00
X140         4.0    0.01    52.00
X2 583.0
GR7100.8     0.01 7096.80    16.00 7096.80    36.00 7100.80    52.00
EJ
ER
```

TABLE F-15. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL P.

```
T1      PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2      CHANNEL P
T3      PMF - SUBCRITICAL
J1                                       -1.0                         583.0  7104.0
J2   -1          0     -1.0
NC 0.035    0.035    0.035      0.1      0.3
X1410         4.0     0.01    44.00
X2 583.0
GR7104.0     0.01 7101.00    12.00 7101.00    32.00 7104.00    44.00
X1 10         4.0     0.01    44.00   10.00    10.00   10.00
X2 446.3
GR7104.3     0.01 7101.33    12.00 7101.33    32.00 7104.33    44.00
X130          4.0     0.01    44.00   20.00    20.00   20.00
X2 173.0
GR7105.0     0.01 7102.00    12.00 7102.00    32.00 7105.00    44.00
X18          4.0     0.01    44.00   20.00    20.00   20.00
X2 173.0
GR7105.5     0.01 7102.50    12.00 7102.50    32.00 7105.50    44.00
X170         4.0     0.01    44.00   20.00    20.00   20.00
X2 173.0
GR7106.0     0.01 7103.00    12.00 7103.00    32.00 7106.00    44.00
X1110        4.0     0.01    44.00   40.00    40.00   40.00
X2 173.0
GR7107.0     0.01 7104.00    12.00 7104.00    32.00 7107.00    44.00
X1160        4.0     0.01    44.00   50.00    50.00   50.00
X2 173.0
GR7108.0     0.01 7105.00    12.00 7105.00    32.00 7108.00    44.00
X1200        4.0     0.01    44.00   40.00    40.00   40.00
X2 173.0
GR7108.5     0.01 7105.50    12.00 7105.50    32.00 7108.50    44.00
X1240        4.0     0.01    44.00   40.00    40.00   40.00
X2 173.0
GR7109.0     0.01 7106.00    12.00 7106.00    32.00 7109.00    44.00
X1300        4.0     0.01    44.00   60.00    60.00   60.00
X2 173.0
GR7109.5     0.01 7106.50    12.00 7106.50    32.00 7109.50    44.00
X17          4.0     0.01    44.00   70.00    70.00   70.00
X2 173.0
GR7110.0     0.01 7107.00    12.00 7107.00    32.00 7110.00    44.00
X1450        4.0     0.01    44.00   80.00    80.00   80.00
X2 173.0
GR7110.5     0.01 7107.50    12.00 7107.50    32.00 7110.50    44.00
X1540        4.0     0.01    44.00   90.00    90.00   90.00
X2 173.0
GR7111.0     0.01 7108.00    12.00 7108.00    32.00 7111.00    44.00
X1600        4.0     0.01    44.00   60.00    60.00   60.00
X2 173.0
GR7111.5     0.01 7108.50    12.00 7108.50    32.00 7111.50    44.00
X1670        4.0     0.01    44.00   70.00    70.00   70.00
X2 173.0
GR7112.0     0.01 7109.00    12.00 7109.00    32.00 7112.00    44.00
X1760        4.0     0.01    44.00   90.00    90.00   90.00
X2 173.0
GR7112.5     0.01 7109.50    12.00 7109.50    32.00 7112.50    44.00
X1840        4.0     0.01    44.00   80.00    80.00   80.00
X2 173.0
GR7113.0     0.01 7110.00    12.00 7110.00    32.00 7113.00    44.00
EJ
ER
```

TABLE F-16. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL P.

```
T1       PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2       CHANNEL P
T3       PMF - SUPERCRITICAL
J1                                1.0    -1.0                        173.0  7112.4
J2   -1        0     -1.0
NC 0.035  0.035    0.035      0.1      0.3
X1840      4.0     0.01    44.00    80.00    80.00    80.00
X2 173.0
GR7113.0    0.01 7110.00   12.00 7110.00   32.00 7113.00    44.00
X1760      4.0     0.01    44.00    90.00    90.00    90.00
X2 173.0
GR7112.5    0.01 7109.50   12.00 7109.50   32.00 7112.50    44.00
X1670      4.0     0.01    44.00    70.00    70.00    70.00
X2 173.0
GR7112.0    0.01 7109.00   12.00 7109.00   32.00 7112.00    44.00
X1600      4.0     0.01    44.00    60.00    60.00    60.00
X2 173.0
GR7111.5    0.01 7108.50   12.00 7108.50   32.00 7111.50    44.00
X1540      4.0     0.01    44.00    90.00    90.00    90.00
X2 173.0
GR7111.0    0.01 7108.00   12.00 7108.00   32.00 7111.00    44.00
X1450      4.0     0.01    44.00    80.00    80.00    80.00
X2 173.0
GR7110.5    0.01 7107.50   12.00 7107.50   32.00 7110.50    44.00
X17        4.0     0.01    44.00    70.00    70.00    70.00
X2 173.0
GR7110.0    0.01 7107.00   12.00 7107.00   32.00 7110.00    44.00
X1300      4.0     0.01    44.00    60.00    60.00    60.00
X2 173.0
GR7109.5    0.01 7106.50   12.00 7106.50   32.00 7109.50    44.00
X1240      4.0     0.01    44.00    40.00    40.00    40.00
X2 173.0
GR7109.0    0.01 7106.00   12.00 7106.00   32.00 7109.00    44.00
X1200      4.0     0.01    44.00    40.00    40.00    40.00
X2 173.0
GR7108.5    0.01 7105.50   12.00 7105.50   32.00 7108.50    44.00
X1160      4.0     0.01    44.00    50.00    50.00    50.00
X2 173.0
GR7108.0    0.01 7105.00   12.00 7105.00   32.00 7108.00    44.00
X1110      4.0     0.01    44.00    40.00    40.00    40.00
X2 173.0
GR7107.0    0.01 7104.00   12.00 7104.00   32.00 7107.00    44.00
X170       4.0     0.01    44.00    20.00    20.00    20.00
X2 173.0
GR7106.0    0.01 7103.00   12.00 7103.00   32.00 7106.00    44.00
X18        4.0     0.01    44.00    20.00    20.00    20.00
X2 173.0
GR7105.5    0.01 7102.50   12.00 7102.50   32.00 7105.50    44.00
X130       4.0     0.01    44.00    20.00    20.00    20.00
X2 173.0
GR7105.0    0.01 7102.00   12.00 7102.00   32.00 7105.00    44.00
X1 10      4.0     0.01    44.00    10.00    10.00    10.00
X2 446.3
GR7104.3    0.01 7101.33   12.00 7101.33   32.00 7104.33    44.00
X1410      4.0     0.01    44.00
X2 583.0
GR7104.0    0.01 7101.00   12.00 7101.00   32.00 7104.00    44.00
EJ
ER
```

TABLE F-17. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL Q.

```
T1      PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2      CHANNEL Q - INCLUDES CROSS SECTIONS HC5-14 THROUGH HC5-10
T3      PMF - SUBCRITICAL
J1                                  -1.0                    843.0  7063.0
J2   -1           0     -1.0
NC 0.035   0.035   0.035    0.1     0.3
X190        4.0    0.01  190.00
X2 843.0
GR7080.8     0.01 7060.82   80.00 7060.82  110.00 7080.82  190.00
X1100        4.0    0.01  190.00   10.00   10.00   10.00
X2 843.0
GR7080.9     0.01 7060.94   80.00 7060.94  110.00 7080.94  190.00
X1130        4.0    0.01  190.00   30.00   30.00   30.00
X2 843.0
GR7081.3     0.01 7061.30   80.00 7061.30  110.00 7081.30  190.00
X1220        4.0    0.01  190.00   90.00   90.00   90.00
X2 843.0
GR7082.4     0.01 7062.38   80.00 7062.38  110.00 7082.38  190.00
X14.0        4.0    0.01  190.00   10.00   10.00   10.00
X2 843.0
GR7082.5     0.01 7062.50   80.00 7062.50  110.00 7082.50  190.00
X1250        4.0    0.01  190.00   20.00   20.00   20.00
X2 843.0
GR7083.0     0.01 7063.00   80.00 7063.00  110.00 7083.00  190.00
X1260        4.0    0.01  190.00   10.00   10.00   10.00
X2 833.0
GR7083.2     0.01 7063.24   80.00 7063.24  110.00 7083.24  190.00
X1270        4.0    0.01  190.00   10.00   10.00   10.00
X2 823.0
GR7083.5     0.01 7063.49   80.00 7063.49  110.00 7083.49  190.00
X1280        4.0    0.01  190.00   10.00   10.00   10.00
X2 813.0
GR7083.7     0.01 7063.73   80.00 7063.73  110.00 7083.73  190.00
X1290        4.0    0.01  190.00   10.00   10.00   10.00
X2 803.0
GR7084.0     0.01 7063.98   80.00 7063.98  110.00 7083.98  190.00
X1300        4.0    0.01  190.00   10.00   10.00   10.00
X2 792.0
GR7084.2     0.01 7064.22   80.00 7064.22  110.00 7084.22  190.00
X1310        4.0    0.01  190.00   10.00   10.00   10.00
X2 782.0
GR7084.5     0.01 7064.47   80.00 7064.47  110.00 7084.47  190.00
X1320        4.0    0.01  190.00   10.00   10.00   10.00
X2 772.0
GR7084.7     0.01 7064.71   80.00 7064.71  110.00 7084.71  190.00
X1330        4.0    0.01  190.00   10.00   10.00   10.00
X2 761.0
GR7085.0     0.01 7064.96   80.00 7064.96  110.00 7084.96  190.00
X1340        4.0    0.01  190.00   10.00   10.00   10.00
X2 751.0
GR7085.2     0.01 7065.20   80.00 7065.20  110.00 7085.20  190.00
X1 360        4.0    0.01  190.00   20.00   20.00   20.00
X2 751.0
GR7086.1     0.01 7066.12   80.00 7066.12  110.00 7086.12  190.00
X1 380        4.0    0.01  190.00   20.00   20.00   20.00
X2 751.0
GR7087.0     0.01 7067.04   80.00 7067.04  110.00 7087.04  190.00
X1 400        4.0    0.01  190.00   20.00   20.00   20.00
X2 751.0
GR7088.0     0.01 7067.96   80.00 7067.96  110.00 7087.96  190.00
X1 420        4.0    0.01  190.00   20.00   20.00   20.00
X2 751.0
GR7088.9     0.01 7068.88   80.00 7068.88  110.00 7088.88  190.00
X1440         4.0    0.01  190.00   20.00   20.00   20.00
X2 751.0
GR7089.8     0.01 7069.80   80.00 7069.80  110.00 7089.80  190.00
X112.0       4.0    0.01  190.00   60.00   60.00   60.00
X2 751.0
GR7091.3     0.01 7071.30   80.00 7071.30  110.00 7091.30  190.00
X1540        4.0    0.01  190.00   40.00   40.00   40.00
X2 751.0
GR7092.3     0.01 7072.30   80.00 7072.30  110.00 7092.30  190.00
X1 590        4.0    0.01  190.00   50.00   50.00   50.00
X2 751.0
GR7093.6     0.01 7073.56   80.00 7073.56  110.00 7093.56  190.00
X1 690        4.0    0.01  190.00  100.00  100.00  100.00
X2 751.0
GR7096.1     0.01 7076.08   80.00 7076.08  110.00 7096.08  190.00
X1790         4.0    0.01  190.00  100.00  100.00  100.00
X2 751.0
```

TABLE F-17. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL Q (continued).

```
GR7098.6     0.01 7078.60    80.00 7078.60   110.00 7098.60   190.00
X1 870        4.0    0.01   190.00   80.00    80.00   80.00
X2 751.0
GR7100.6     0.01 7080.60    80.00 7080.60   110.00 7100.60   190.00
X1970         4.0    0.01   190.00  100.00   100.00  100.00
X2 751.0
GR7103.1     0.01 7083.10    80.00 7083.10   110.00 7103.10   190.00
X1 980        4.0    0.01   190.00   10.00    10.00   10.00
X2 746.9
GR7103.4     0.01 7083.35    80.00 7083.35   110.00 7103.35   190.00
X11080        4.0    0.01   190.00  100.00   100.00  100.00
X2 706.0
GR7105.9     0.01 7085.90    80.00 7085.90   110.00 7105.90   190.00
X1 1095       4.0    0.01   190.00   15.00    15.00   15.00
X2 706.0
GR7107.3     0.01 7087.31    80.00 7087.31   110.00 7107.31   190.00
X1 1115       4.0    0.01   190.00   20.00    20.00   20.00
X2 706.0
GR7109.2     0.01 7089.18    80.00 7089.18   110.00 7109.18   190.00
X1 1135       4.0    0.01   190.00   20.00    20.00   20.00
X2 706.0
GR7111.1     0.01 7091.05    80.00 7091.05   110.00 7111.05   190.00
X1 1155       4.0    0.01   190.00   20.00    20.00   20.00
X2 706.0
GR7112.9     0.01 7092.93    80.00 7092.93   110.00 7112.93   190.00
X11175        4.0    0.01   190.00   20.00    20.00   20.00
X2 706.0
GR7114.8     0.01 7094.80    80.00 7094.80   110.00 7114.80   190.00
X11180       4.0    0.01  190.00    5.00     5.00    5.00
X2 706.0
GR7114.8     0.01 7094.81    80.00 7094.81   110.00 7114.81   190.00
X11195       4.0    0.01  170.00   15.00    15.00   15.00
X2 706.0
GR7114.9     0.01 7094.85    80.00 7094.85    90.00 7114.85   170.00
X11215        3.0    0.01   160.00   20.00    20.00   20.00
X2 706.0
GR7114.9     0.01 7094.90    80.00 7114.90   160.00
X1 1220       3.0    0.01   146.67    5.00     5.00    5.00
X2 706.0
GR7114.9     0.01 7094.93    73.33 7114.93   146.67
X11230        3.0    0.01   120.00   10.00    10.00   10.00
X2 706.0
GR7115.0     0.01 7095.00    60.00 7115.00   120.00
X1 1240       3.0    0.01   110.00   10.00    10.00   10.00
X2 706.0
GR7115.0     0.01 7095.00    55.00 7115.00   110.00
X11250        3.0    0.01   100.00   10.00    10.00   10.00
X2 706.0
GR7115.0     0.01 7095.00    50.00 7115.00   100.00
X11270        3.0    0.01   100.00   20.00    20.00   20.00
X2 706.0
GR7115.0     0.01 7095.00    50.00 7115.00   100.00
X1 1275       3.0    0.01    96.00    5.00     5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00    48.00 7115.00    96.00
X1 1285       3.0    0.01    88.00   10.00    10.00   10.00
X2 706.0
GR7115.0     0.01 7095.00    44.00 7115.00    88.00
X111.0        4.0    0.01    80.00   10.00    10.00   10.00
X2 706.0
GR7115.0     0.01 7095.00    40.00 7095.00    40.00 7115.00    80.00
X11320       4.0    0.01    80.00   25.00    25.00   25.00
X2 706.0
GR7115.0     0.01 7095.00    40.00 7095.00    40.00 7115.00    80.00
X1 1325       4.0    0.01   102.00    5.00     5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00    48.00 7095.00    54.00 7115.00   102.00
X1 1330       4.0    0.01   124.00    5.00     5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00    56.00 7095.00    68.00 7115.00   124.00
X1 1335       4.0    0.01   146.00    5.00     5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00    64.00 7095.00    82.00 7115.00   146.00
X1 1340       4.0    0.01   168.00    5.00     5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00    72.00 7095.00    96.00 7115.00   168.00
X11345        4.0    0.01   190.00    5.00     5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00    80.00 7095.00   110.00 7115.00   190.00
X11348       4.0    0.01  190.00    3.00     3.00    3.00
```

TABLE F-17. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL Q (continued).

```
X2 700.0
GR7115.3     0.01 7095.34    80.00 7095.34   110.00 7115.34  190.00
X11352       4.0    0.01  190.00    4.00     4.00    4.00
X2 650.0
GR7115.8     0.01 7095.80    80.00 7095.80   110.00 7115.80  190.00
X11356       4.0    0.01  190.00    4.00     4.00    4.00
X2 600.0
GR7116.3     0.01 7096.26    80.00 7096.26   110.00 7116.26  190.00
X11360       4.0    0.01  190.00    4.00     4.00    4.00
X2 550.0
GR7116.7     0.01 7096.72    80.00 7096.72   110.00 7116.72  190.00
X11364       4.0    0.01  190.00    4.00     4.00    4.00
X2 500.0
GR7117.2     0.01 7097.18    80.00 7097.18   110.00 7117.18  190.00
X11368       4.0    0.01  190.00    4.00     4.00    4.00
X2 450.0
GR7117.6     0.01 7097.64    80.00 7097.64   110.00 7117.64  190.00
X11372       4.0    0.01  190.00    4.00     4.00    4.00
X2 400.0
GR7118.1     0.01 7098.10    80.00 7098.10   110.00 7118.10  190.00
X11376       4.0    0.01  190.00    4.00     4.00    4.00
X2 480.0
GR7118.5     0.01 7098.55    80.00 7098.55   110.00 7118.55  190.00
X11380       4.0    0.01  190.00    4.00     4.00    4.00
X2 460.0
GR7119.0     0.01 7099.01    80.00 7099.01   110.00 7119.01  190.00
X11384       4.0    0.01  190.00    4.00     4.00    4.00
X2 440.0
GR7119.5     0.01 7099.47    80.00 7099.47   110.00 7119.47  190.00
X11388       4.0    0.01  190.00    4.00     4.00    4.00
X2 420.0
GR7119.9     0.01 7099.93    80.00 7099.93   110.00 7119.93  190.00
X11392       4.0    0.01  190.00    4.00     4.00    4.00
X2 400.0
GR7120.4     0.01 7100.39    80.00 7100.39   110.00 7120.39  190.00
X11396       4.0    0.01  190.00    4.00     4.00    4.00
X2 300.0
GR7120.9     0.01 7100.85    80.00 7100.85   110.00 7120.85  190.00
X11400       4.0    0.01  190.00    4.00     4.00    4.00
X2 290.0
GR7121.3     0.01 7101.31    80.00 7101.31   110.00 7121.31  190.00
X11404       4.0    0.01  190.00    4.00     4.00    4.00
X2 280.0
GR7121.8     0.01 7101.77    80.00 7101.77   110.00 7121.77  190.00
X11408       4.0    0.01  190.00    4.00     4.00    4.00
X2 270.0
GR7122.2     0.01 7102.22    80.00 7102.22   110.00 7122.22  190.00
X11412       4.0    0.01  190.00    4.00     4.00    4.00
X2 260.0
GR7122.7     0.01 7102.68    80.00 7102.68   110.00 7122.68  190.00
X11416       4.0    0.01  190.00    4.00     4.00    4.00
X2 250.0
GR7123.1     0.01 7103.14    80.00 7103.14   110.00 7123.14  190.00
X11420       4.0    0.01  190.00    4.00     4.00    4.00
X2 243.0
GR7123.6     0.01 7103.60    80.00 7103.60   110.00 7123.60  190.00
X11427       4.0    0.01  190.00    7.00     7.00    7.00
X2 243.0
GR7125.0     0.01 7105.05    80.00 7105.05   110.00 7125.05  190.00
X11434       4.0    0.01  190.00    7.00     7.00    7.00
X2 243.0
GR7126.5     0.01 7106.50    80.00 7106.50   110.00 7126.50  190.00
X11444       4.0    0.01  190.00   10.00    10.00   10.00
X2 243.0
GR7128.1     0.01 7108.15    80.00 7108.15   110.00 7128.15  190.00
X11454       4.0    0.01  190.00   10.00    10.00   10.00
X2 243.0
GR7129.8     0.01 7109.80    80.00 7109.80   110.00 7129.80  190.00
X1 1455       4.0    0.01  189.05    1.00     1.00    1.00
X2 243.0
GR7129.8     0.01 7109.80    80.00 7109.80   109.05 7129.80  189.05
X11475        4.0    0.01  170.00   20.00    20.00   20.00
X2 243.0
GR7129.9     0.01 7109.90    80.00 7109.90    90.00 7129.90  170.00
X11485        3.0    0.01  160.00   10.00    10.00   10.00
X2 243.0
GR7130.0     0.01 7110.00    80.00 7130.00   160.00
X11490        3.0    0.01  144.00    5.00     5.00    5.00
X2 243.0
GR7130.0     0.01 7110.01    72.00 7130.01   144.00
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TABLE F-17. HEC-2 SUBCRITICAL INPUT FILE FOR CHANNEL Q (continued).

```
X11499      3.0    0.01  120.00    9.00    9.00    9.00
X2 243.0
GR7130.0   0.01 7110.03   60.00 7130.03  120.00
X1 1500     3.0    0.01  119.02    1.00    1.00    1.00
X2 243.0
GR7130.0   0.01 7110.03   59.51 7130.03  119.02
X1 1510     3.0    0.01  109.27   10.00   10.00   10.00
X2 243.0
GR7130.0   0.01 7110.05   54.63 7130.05  109.27
X1 1520     3.0    0.01   99.51   10.00   10.00   10.00
X2 243.0
GR7130.1   0.01 7110.07   49.76 7130.07   99.51
X1 1530     3.0    0.01   89.76   10.00   10.00   10.00
X2 243.0
GR7130.1   0.01 7110.08   44.88 7130.08   89.76
X110.0      4.0    0.01   80.00   10.00   10.00   10.00
X2 243.0
GR7130.1   0.01 7110.10   40.00 7110.10   40.00 7130.10   80.00
X1 1543     4.0    0.01   87.50    3.00    3.00    3.00
X2 243.0
GR7130.1   0.01 7110.10   43.16 7110.10   44.34 7130.10   87.50
X1 1548     4.0    0.01  100.00    5.00    5.00    5.00
X2 243.0
GR7130.1   0.01 7110.11   48.42 7110.11   51.58 7130.11  100.00
X1 1553     4.0    0.01  112.50    5.00    5.00    5.00
X2 243.0
GR7130.1   0.01 7110.12   53.68 7110.12   58.82 7130.12  112.50
X1 1558     4.0    0.01  125.00    5.00    5.00    5.00
X2 243.0
GR7130.1   0.01 7110.12   58.95 7110.12   66.05 7130.12  125.00
X1 1563     4.0    0.01  137.50    5.00    5.00    5.00
X2 243.0
GR7130.1   0.01 7110.13   64.21 7110.13   73.29 7130.13  137.50
X1 1568     4.0    0.01  150.00    5.00    5.00    5.00
X2 243.0
GR7130.1   0.01 7110.14   69.47 7110.14   80.53 7130.14  150.00
X1 1573     4.0    0.01  162.50    5.00    5.00    5.00
X2 243.0
GR7130.1   0.01 7110.14   74.74 7110.14   87.76 7130.14  162.50
X11578      4.0    0.01  175.00    5.00    5.00    5.00
X2 243.0
GR7130.1   0.01 7110.15   80.00 7110.15   95.00 7130.15  175.00
X11590      4.0    0.01  190.00   12.00   12.00   12.00
X2 243.0
GR7130.2   0.01 7110.20   80.00 7110.20  110.00 7130.20  190.00
EJ
ER
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TABLE F-18. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL Q.

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T1        PATHFINDER SHIRLEY BASIN TAILINGS RECLAMATION
T2        CHANNEL Q - INCLUDES CROSS SECTIONS HC5-14 THROUGH HC5-10
T3        PMF - SUPERCRITICAL
J1                             1.0     -1.0                      243.0  7118.0
J2   -1          0     -1.0
NC 0.035   0.035   0.035    0.1      0.3
X11590       4.0    0.01  190.00   12.00   12.00   12.00
X2 243.0
GR7130.2     0.01 7110.20   80.00 7110.20  110.00 7130.20  190.00
X11578       4.0    0.01  175.00    5.00    5.00    5.00
X2 243.0
GR7130.1     0.01 7110.15   80.00 7110.15   95.00 7130.15  175.00
X1 1573      4.0    0.01  162.50    5.00    5.00    5.00
X2 243.0
GR7130.1     0.01 7110.14   74.74 7110.14   87.76 7130.14  162.50
X1 1568      4.0    0.01  150.00    5.00    5.00    5.00
X2 243.0
GR7130.1     0.01 7110.14   69.47 7110.14   80.53 7130.14  150.00
X1 1563      4.0    0.01  137.50    5.00    5.00    5.00
X2 243.0
GR7130.1     0.01 7110.13   64.21 7110.13   73.29 7130.13  137.50
X1 1558      4.0    0.01  125.00    5.00    5.00    5.00
X2 243.0
GR7130.1     0.01 7110.12   58.95 7110.12   66.05 7130.12  125.00
X1 1553      4.0    0.01  112.50    5.00    5.00    5.00
X2 243.0
GR7130.1     0.01 7110.12   53.68 7110.12   58.82 7130.12  112.50
X1 1548      4.0    0.01  100.00    5.00    5.00    5.00
X2 243.0
GR7130.1     0.01 7110.11   48.42 7110.11   51.58 7130.11  100.00
X1 1543      4.0    0.01   87.50    3.00    3.00    3.00
X2 243.0
GR7130.1     0.01 7110.10   43.16 7110.10   44.34 7130.10   87.50
X110.0       4.0    0.01   80.00   10.00   10.00   10.00
X2 243.0
GR7130.1     0.01 7110.10   40.00 7110.10   40.00 7130.10   80.00
X1 1530      3.0    0.01   89.76   10.00   10.00   10.00
X2 243.0
GR7130.1     0.01 7110.08   44.88 7130.08   89.76
X1 1520      3.0    0.01   99.51   10.00   10.00   10.00
X2 243.0
GR7130.1     0.01 7110.07   49.76 7130.07   99.51
X1 1510      3.0    0.01  109.27   10.00   10.00   10.00
X2 243.0
GR7130.0     0.01 7110.05   54.63 7130.05  109.27
X1 1500      3.0    0.01  119.02    1.00    1.00    1.00
X2 243.0
GR7130.0     0.01 7110.03   59.51 7130.03  119.02
X11499       3.0    0.01  120.00    9.00    9.00    9.00
X2 243.0
GR7130.0     0.01 7110.03   60.00 7130.03  120.00
X11490       3.0    0.01  144.00    5.00    5.00    5.00
X2 243.0
GR7130.0     0.01 7110.01   72.00 7130.01  144.00
X11485       3.0    0.01  160.00   10.00   10.00   10.00
X2 243.0
GR7130.0     0.01 7110.00   80.00 7130.00  160.00
X11475       4.0    0.01  170.00   20.00   20.00   20.00
X2 243.0
GR7129.9     0.01 7109.90   80.00 7109.90   90.00 7129.90  170.00
X1 1455      4.0    0.01  189.05    1.00    1.00    1.00
X2 243.0
GR7129.8     0.01 7109.80   80.00 7109.80  109.05 7129.80  189.05
X11454       4.0    0.01  190.00   10.00   10.00   10.00
X2 243.0
GR7129.8     0.01 7109.80   80.00 7109.80  110.00 7129.80  190.00
X11444       4.0    0.01  190.00   10.00   10.00   10.00
X2 243.0
GR7128.1     0.01 7108.15   80.00 7108.15  110.00 7128.15  190.00
X11434       4.0    0.01  190.00    7.00    7.00    7.00
X2 243.0
GR7126.5     0.01 7106.50   80.00 7106.50  110.00 7126.50  190.00
X11427       4.0    0.01  190.00    7.00    7.00    7.00
X2 243.0
GR7125.0     0.01 7105.05   80.00 7105.05  110.00 7125.05  190.00
X11420       4.0    0.01  190.00    4.00    4.00    4.00
X2 243.0
GR7123.6     0.01 7103.60   80.00 7103.60  110.00 7123.60  190.00
X11416       4.0    0.01  190.00    4.00    4.00    4.00
X2 250.0
```

TABLE F-18. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL Q (continued).

```
GR7123.1     0.01 7103.14   80.00 7103.14  110.00 7123.14  190.00
X11412       4.0     0.01  190.00    4.00    4.00    4.00
X2 260.0
GR7122.7     0.01 7102.68   80.00 7102.68  110.00 7122.68  190.00
X11408       4.0     0.01  190.00    4.00    4.00    4.00
X2 270.0
GR7122.2     0.01 7102.22   80.00 7102.22  110.00 7122.22  190.00
X11404       4.0     0.01  190.00    4.00    4.00    4.00
X2 280.0
GR7121.8     0.01 7101.77   80.00 7101.77  110.00 7121.77  190.00
X11400       4.0     0.01  190.00    4.00    4.00    4.00
X2 290.0
GR7121.3     0.01 7101.31   80.00 7101.31  110.00 7121.31  190.00
X11396       4.0     0.01  190.00    4.00    4.00    4.00
X2 300.0
GR7120.9     0.01 7100.85   80.00 7100.85  110.00 7120.85  190.00
X11392       4.0     0.01  190.00    4.00    4.00    4.00
X2 400.0
GR7120.4     0.01 7100.39   80.00 7100.39  110.00 7120.39  190.00
X11388       4.0     0.01  190.00    4.00    4.00    4.00
X2 420.0
GR7119.9     0.01 7099.93   80.00 7099.93  110.00 7119.93  190.00
X11384       4.0     0.01  190.00    4.00    4.00    4.00
X2 440.0
GR7119.5     0.01 7099.47   80.00 7099.47  110.00 7119.47  190.00
X11380       4.0     0.01  190.00    4.00    4.00    4.00
X2 460.0
GR7119.0     0.01 7099.01   80.00 7099.01  110.00 7119.01  190.00
X11376       4.0     0.01  190.00    4.00    4.00    4.00
X2 480.0
GR7118.5     0.01 7098.55   80.00 7098.55  110.00 7118.55  190.00
X11372       4.0     0.01  190.00    4.00    4.00    4.00
X2 400.0
GR7118.1     0.01 7098.10   80.00 7098.10  110.00 7118.10  190.00
X11368       4.0     0.01  190.00    4.00    4.00    4.00
X2 450.0
GR7117.6     0.01 7097.64   80.00 7097.64  110.00 7117.64  190.00
X11364       4.0     0.01  190.00    4.00    4.00    4.00
X2 500.0
GR7117.2     0.01 7097.18   80.00 7097.18  110.00 7117.18  190.00
X11360       4.0     0.01  190.00    4.00    4.00    4.00
X2 550.0
GR7116.7     0.01 7096.72   80.00 7096.72  110.00 7116.72  190.00
X11356       4.0     0.01  190.00    4.00    4.00    4.00
X2 600.0
GR7116.3     0.01 7096.26   80.00 7096.26  110.00 7116.26  190.00
X11352       4.0     0.01  190.00    4.00    4.00    4.00
X2 650.0
GR7115.8     0.01 7095.80   80.00 7095.80  110.00 7115.80  190.00
X11348       4.0     0.01  190.00    3.00    3.00    3.00
X2 700.0
GR7115.3     0.01 7095.34   80.00 7095.34  110.00 7115.34  190.00
X11345       4.0     0.01  190.00    5.00    5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00   80.00 7095.00  110.00 7115.00  190.00
X1 1340      4.0     0.01  168.00    5.00    5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00   72.00 7095.00   96.00 7115.00  168.00
X1 1335      4.0     0.01  146.00    5.00    5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00   64.00 7095.00   82.00 7115.00  146.00
X1 1330      4.0     0.01  124.00    5.00    5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00   56.00 7095.00   68.00 7115.00  124.00
X1 1325      4.0     0.01  102.00    5.00    5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00   48.00 7095.00   54.00 7115.00  102.00
X11320       4.0     0.01   80.00   25.00   25.00   25.00
X2 706.0
GR7115.0     0.01 7095.00   40.00 7095.00   40.00 7115.00   80.00
X111.0       4.0     0.01   80.00   10.00   10.00   10.00
X2 706.0
GR7115.0     0.01 7095.00   40.00 7095.00   40.00 7115.00   80.00
X1 1285      3.0     0.01   88.00   10.00   10.00   10.00
X2 706.0
GR7115.0     0.01 7095.00   44.00 7115.00   88.00
X1 1275      3.0     0.01   96.00    5.00    5.00    5.00
X2 706.0
GR7115.0     0.01 7095.00   48.00 7115.00   96.00
X11270       3.0     0.01  100.00   20.00   20.00   20.00
```

TABLE F-18. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL Q (continued).

```
X2 706.0
GR7115.0    0.01 7095.00   50.00 7115.00  100.00
X11250      3.0     0.01  100.00   10.00   10.00   10.00
X2 706.0
GR7115.0    0.01 7095.00   50.00 7115.00  100.00
X1 1240     3.0     0.01  110.00   10.00   10.00   10.00
X2 706.0
GR7115.0    0.01 7095.00   55.00 7115.00  110.00
X11230      3.0     0.01  120.00   10.00   10.00   10.00
X2 706.0
GR7115.0    0.01 7095.00   60.00 7115.00  120.00
X1 1220     3.0     0.01  146.67    5.00    5.00    5.00
X2 706.0
GR7114.9    0.01 7094.93   73.33 7114.93  146.67
X11215      3.0     0.01  160.00   20.00   20.00   20.00
X2 706.0
GR7114.9    0.01 7094.90   80.00 7114.90  160.00
X11195      4.0    0.01  170.00   15.00   15.00   15.00
X2 706.0
GR7114.9    0.01 7094.85   80.00 7094.85   90.00 7114.85  170.00
X11180      4.0    0.01  190.00    5.00    5.00    5.00
X2 706.0
GR7114.8    0.01 7094.81   80.00 7094.81  110.00 7114.81  190.00
X11175      4.0     0.01  190.00   20.00   20.00   20.00
X2 706.0
GR7114.8    0.01 7094.80   80.00 7094.80  110.00 7114.80  190.00
X1 1155     4.0     0.01  190.00   20.00   20.00   20.00
X2 706.0
GR7112.9    0.01 7092.93   80.00 7092.93  110.00 7112.93  190.00
X1 1135     4.0     0.01  190.00   20.00   20.00   20.00
X2 706.0
GR7111.1    0.01 7091.05   80.00 7091.05  110.00 7111.05  190.00
X1 1115     4.0     0.01  190.00   20.00   20.00   20.00
X2 706.0
GR7109.2    0.01 7089.18   80.00 7089.18  110.00 7109.18  190.00
X1 1095     4.0     0.01  190.00   15.00   15.00   15.00
X2 706.0
GR7107.3    0.01 7087.31   80.00 7087.31  110.00 7107.31  190.00
X11080      4.0     0.01  190.00  100.00  100.00  100.00
X2 706.0
GR7105.9    0.01 7085.90   80.00 7085.90  110.00 7105.90  190.00
X1 980      4.0     0.01  190.00   10.00   10.00   10.00
X2 746.9
GR7103.4    0.01 7083.35   80.00 7083.35  110.00 7103.35  190.00
X1970       4.0     0.01  190.00  100.00  100.00  100.00
X2 751.0
GR7103.1    0.01 7083.10   80.00 7083.10  110.00 7103.10  190.00
X1 870      4.0     0.01  190.00   80.00   80.00   80.00
X2 751.0
GR7100.6    0.01 7080.60   80.00 7080.60  110.00 7100.60  190.00
X1790       4.0     0.01  190.00  100.00  100.00  100.00
X2 751.0
GR7098.6    0.01 7078.60   80.00 7078.60  110.00 7098.60  190.00
X1 690      4.0     0.01  190.00  100.00  100.00  100.00
X2 751.0
GR7096.1    0.01 7076.08   80.00 7076.08  110.00 7096.08  190.00
X1 590      4.0     0.01  190.00   50.00   50.00   50.00
X2 751.0
GR7093.6    0.01 7073.56   80.00 7073.56  110.00 7093.56  190.00
X1540       4.0    0.01  190.00   40.00   40.00   40.00
X2 751.0
GR7092.3    0.01 7072.30   80.00 7072.30  110.00 7092.30  190.00
X112.0      4.0    0.01  190.00   60.00   60.00   60.00
X2 751.0
GR7091.3    0.01 7071.30   80.00 7071.30  110.00 7091.30  190.00
X1440       4.0     0.01  190.00   20.00   20.00   20.00
X2 751.0
GR7089.8    0.01 7069.80   80.00 7069.80  110.00 7089.80  190.00
X1 420      4.0     0.01  190.00   20.00   20.00   20.00
X2 751.0
GR7088.9    0.01 7068.88   80.00 7068.88  110.00 7088.88  190.00
X1 400      4.0     0.01  190.00   20.00   20.00   20.00
X2 751.0
GR7088.0    0.01 7067.96   80.00 7067.96  110.00 7087.96  190.00
X1 380      4.0     0.01  190.00   20.00   20.00   20.00
X2 751.0
GR7087.0    0.01 7067.04   80.00 7067.04  110.00 7087.04  190.00
X1 360      4.0     0.01  190.00   20.00   20.00   20.00
X2 751.0
GR7086.1    0.01 7066.12   80.00 7066.12  110.00 7086.12  190.00
```

TABLE F-18. HEC-2 SUPERCRITICAL INPUT FILE FOR CHANNEL Q (continued).

```
X1340      4.0    0.01  190.00   10.00    10.00   10.00
X2 751.0
GR7085.2   0.01 7065.20   80.00 7065.20  110.00 7085.20  190.00
X1330      4.0    0.01  190.00   10.00    10.00   10.00
X2 761.0
GR7085.0   0.01 7064.96   80.00 7064.96  110.00 7084.96  190.00
X1320      4.0    0.01  190.00   10.00    10.00   10.00
X2 772.0
GR7084.7   0.01 7064.71   80.00 7064.71  110.00 7084.71  190.00
X1310      4.0    0.01  190.00   10.00    10.00   10.00
X2 782.0
GR7084.5   0.01 7064.47   80.00 7064.47  110.00 7084.47  190.00
X1300      4.0    0.01  190.00   10.00    10.00   10.00
X2 792.0
GR7084.2   0.01 7064.22   80.00 7064.22  110.00 7084.22  190.00
X1290      4.0    0.01  190.00   10.00    10.00   10.00
X2 803.0
GR7084.0   0.01 7063.98   80.00 7063.98  110.00 7083.98  190.00
X1280      4.0    0.01  190.00   10.00    10.00   10.00
X2 813.0
GR7083.7   0.01 7063.73   80.00 7063.73  110.00 7083.73  190.00
X1270      4.0    0.01  190.00   10.00    10.00   10.00
X2 823.0
GR7083.5   0.01 7063.49   80.00 7063.49  110.00 7083.49  190.00
X1260      4.0    0.01  190.00   10.00    10.00   10.00
X2 833.0
GR7083.2   0.01 7063.24   80.00 7063.24  110.00 7083.24  190.00
X1250      4.0    0.01  190.00   20.00    20.00   20.00
X2 843.0
GR7083.0   0.01 7063.00   80.00 7063.00  110.00 7083.00  190.00
X14.0      4.0    0.01  190.00   10.00    10.00   10.00
X2 843.0
GR7082.5   0.01 7062.50   80.00 7062.50  110.00 7082.50  190.00
X1220      4.0    0.01  190.00   90.00    90.00   90.00
X2 843.0
GR7082.4   0.01 7062.38   80.00 7062.38  110.00 7082.38  190.00
X1130      4.0    0.01  190.00   30.00    30.00   30.00
X2 843.0
GR7081.3   0.01 7061.30   80.00 7061.30  110.00 7081.30  190.00
X1100      4.0    0.01  190.00   10.00    10.00   10.00
X2 843.0
GR7080.9   0.01 7060.94   80.00 7060.94  110.00 7080.94  190.00
X190       4.0    0.01  190.00
X2 843.0
GR7080.8   0.01 7060.82   80.00 7060.82  110.00 7080.82  190.00
EJ
ER
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