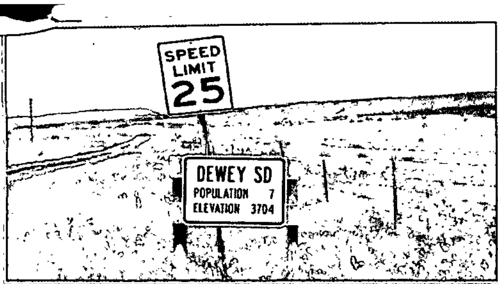

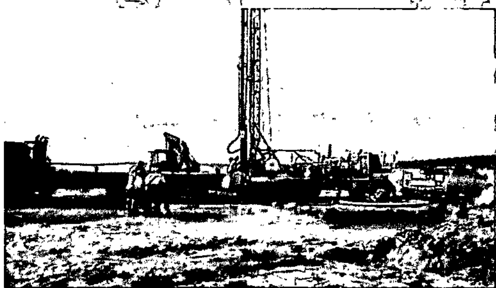

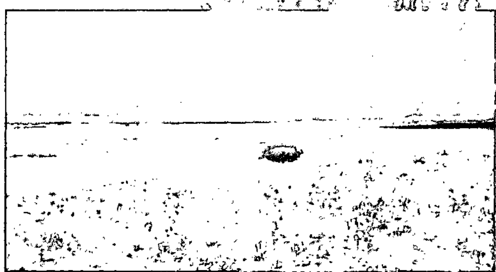

POWERTECH (USA) INC.

Dewey-Burdock Project

Application for NRC Uranium Recovery License Fall River and Custer Counties, South Dakota

TR_RAI Response

Volume I

December 23, 2010

Prepared for

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NRC ID	TR,SR or ER Section	Subject Addressed	Replacement(s) Located
May 19, 2010 RAI	I.	**Process & Restoration Issues**	
TR-RAI-P&R-1	TRS Exhibit 3.2-1,TR Plate 2.6-1	Process & Restoration- vertical position of ore bodies in aquifers	TR Section 2.7.2.2.5
TR-RAI-P&R-2	TR Sect. 2.6	Process & Restoration-inventory of economical sig. mineral & energy-related deposits and activities	TR Section 2.2.2, Exhibit 2.2-1
TR-RAI-P&R-3	TR Sect. 2.6, Fig. 2.6-4	Process & Restoration- seismic evaluation to include event N. of Dewey	TR Section 2.6.6.1.1.1
TR-RAI-P&R-4	TR Sect. 2.7.2.2.16	Process & Restoration- data and structure map for top of Morrison	RAI_ER Exhibit WR-6.1
TR-RAI-P&R-5	TR Sect. 2.7	Process & Restoration- hydraulic connection between Fall River & surface	Response to ER_RAI-WR-2.1(1) (pg.18); 2-1(d) (pg. 22) and Response to ER_RAI-WR-3 (pg.22)
TR-RAI-P&R-6	TR Sect. 2.7	Process & Restoration- confining capacity of Fuson	Response to ER_RAI WR-2; 2-1(a); ER_ RAI Exhibit WR-2.1; ER_ RAI Exhibit WR-2.3; ER_ RAI Exhibit WR-2.4; and ER_ RAI Exhibit WR-2.5
TR-RAI-P&R-7	TR Sect. 2.7	Process & Restoration- Aquifer test	TR_RAI Appendix 2.7-K
TR-RAI-P&R-8	TR Sects. 2.6 & 2.7, TR Plate 2.6-12	Process & Restoration- cross sections with logs	Response: TR_RAI-P&R-8, Response: TR_RAI-P&R-1
TR-RAI-P&R-9	TR Sect. 5.7.1.3	Process & Restoration- plugging and abandonment	Response: TR_RAI-P&R-9, TR Section 5.7.1.3
TR-RAI-P&R-10	TR Sect. 2.7, Append. 2.2-A	Process & Restoration- Number & location of wells	Response: TR_RAI-P&R-10, TR_RAI Table P&R-10, TR_Appendix 2.2-A
TR-RAI-P&R-11	TR Sect. 2.7	Process & Restoration- pumping test details	Response: TR_RAI Section P&R-11, Revised Tables B.2-1, B.3-1, C.2-1 & C.3-1, Table 5.2 of Appendix 2.7-B
TR-RAI-P&R-12a	TR Sect. 2.6, TRS Ex. 2.2-1	Process & Restoration- breccia pipes	Response: TR_RAI-12, TR Section 2.7.2.1.7
TR-RAI-P&R-12b	TR Sect. 2.6, TRS Ex. 3.2.1, TR Fig.2.7-15	Process & Restoration- high, flat potentiometric surface of Lakota in N. Dewey	Response: TR_RAI-12, TR Section 2.7.2.2.8
TR-RAI-P&R-13	TRS Ex. 3.1-3	Process & Restoration- control & containment re infrastructure outside of boundary	Response: TR_RAI-P&R-1, TRS Exhibits 3.1-2 & 3.1-3
TR-RAI-P&R-13*	TRS Ex. 3.1-4, Ex. 3.2-1	Process & Restoration- monitoring ring outside of	TR_RAI-Exhibit P&R-1 and TR Section 4.2.2.1 and

		boundary	Figure 2.1-1
TR-RAI-P&R-14a	TR Sects. 3.1, 6.1.9	Process & Restoration- clarify liquid waste disposal options	Response: TR_RAI Table P&R-14.1, TR Sections 4.2 and 6.1.9
TR-RAI-P&R-14b	TR Sect. 3.1	Process & Restoration- preferred option	Response: TR_RAI-P&R-14(b), ER_RAI Appendix WR-7
TR-RAI-P&R-14c	TR Sect. 3.1	Process & Restoration- water balance	Response: TR_RAI_P&R-14(c), TR Section 3.1.5
TR-RAI-P&R-14d	TR Sect. 3.1	Process & Restoration- waste quality data table	Response: TR_RAI-P&R-14(d)
TR-RAI-P&R-14e	TR Sect. 3.1	Process & Restoration- Deep Disposal Well details	ER_RAI- Appendix WR-7, ER_RAI-PA-5.2
TR-RAI-P&R-14f	TR Sect. 3.1	Process & Restoration- pond contingencies for >10 yrs	Response: TR_RAI-P&R-14(f), TR Section 3.1.
TR-RAI-P&R-14g	TR Sect. 3.1	Process & Restoration- central plant brine pond size and purpose	Response: TR_RAI-P&R-14(g)
TR-RAI-P&R-14h	TR Sect. 3.1	Process & Restoration- pond construction design specs	Response: TR_RAI-P&R-14(h)
TR-RAI-P&R-14i	TR Sect. 3.1	Process & Restoration- impoundment inspections	Response: TR_RAI-P&R-14(i), TR Section 3.1.6.1.1
TR-RAI-P&R-14j	TR Sect. 3.1	Process & Restoration- multiple tank failure	Response: TR_RAI-P&R-14(j), TR Section 5.7.1.3, ER_RAI-PO-3
TR-RAI-P&R-14k	TR Sect. 3.1	Process & Restoration- Shutdown controls for DDW	Refer to Section 2.K of Appendix WR-7
TR-RAI-P&R-15	TR Sects. 4.2 & 6.2	Process & Restoration- 112.(2) waste disposal agreement	TR Section 3.1.9
TR-RAI-P&R-16	TR Sects. 6.2 & 6.3	Process & Restoration- land cleanup program	Response: TR_RAI-P&R-16.1, TR_RAI-P&R-16.2, TR_RAI-5.7.9, TR Sections 4.2.1 and 6.2
TR-RAI-P&R-17	TR Sect. 6.3	Process & Restoration- commitments re removal & disposal	Response: TR_RAI-P&R-17, TR Section 6.3.3.1
May 19, 2010	**II.**	**Radiological Issues**	
TR-RAI-RI-1	TR Sect. 5.3	Radiological- RSO authority commitment	Response: TR_RAI-RI-1, TR Section 5.1.5
TR-RAI-RI-2	TR Sect. 5.3	Radiological- RSO designee criteria for RWPs	Response: TR_RAI-RI-2, TR Sections 5.2.2 & 5.4
TR-RAI-RI-3	TR Sect. 5.3	Radiological- RSO designee criteria re safety inspections	Response: TR_RAI-RI-3, TR Sections 5.2.2 & 5.4
TR-RAI-RI-4a	TR Tables 2.8-23 & 2.8-30 in Append. 2.8-H	Radiological-LLD, error, for fish analyses	TR Sections 2.8.4, 2.9.3.2.1
TR-RAI-RI-4b	TR Tables 2.9-16 & 2.9-17	Radiological- LLD, error for groundwater	See TR-RAI-RI-4a above
TR-RAI-RI-4c	TR Table 2.9-5	Radiological- LLD values for soil samples	See TR-RAI-RI-4a above
TR-RAI-RI-4d	TR Tables 2.9.8 & 2.9.9	Radiological- LLD, error & QA for sediment samples	See TR-RAI-RI-4a above
TR-RAI-RI-4e	TR Table 2.9-12	Radiological- LLD for airborne radionuclides	See TR-RAI-RI-4a above
TR-RAI-RI-5	TR Tables 2.8-23, 2.8-30 & 2.9-19	Radiological-reporting per RG 4.14, use of "ND" & "u"	Response: TR_RAI Attachment RI-5

May 19, 2010	**III.**	**Miscellaneous Issues**	
TR-RAI-MI-1a	TR Sect. 3.2.8	Miscellaneous- chemicals with potential to impact rad safety	TR Section 3.2.8.1
TR-RAI-MI-1b	TR Sect. 3.2.8, Figs. 3.2-4 & 3.2-5	Miscellaneous- storage locations of chemicals	Response: TR_RAI-MI-1b, TR Sections 3.2.8 & 7.5.1
TR-RAI-MI-1c	TR Sect. 3.2.8.3	Miscellaneous- acid storage and ventilation	TR Section 3.2.8.4
TR-RAI-MI-2	TR Sect. 5.7.7	Miscellaneous- dryer operation & monitoring	TR Section 4.1.2.2
TR-RAI-MI-3	TR Sect. 3.2.12	Miscellaneous- backup in event of power failure	TR Section 3.2.12.1
TR-RAI-MI-4a	TR Sect. 6.6	Miscellaneous- commitment to surety mechanism	Response: TR_RAI-MI-4a
TR-RAI-MI-4b	TR Sect. 6.6	Miscellaneous- update surety prior to licensing	Response: TR_RAI-4b
TR-RAI-MI-4c	TR Sect. 6.6, Append. 6.6-A	Miscellaneous- discussion of tables	Response: TR_RAI-4c
TR-RAI-MI-4d	TR Sect. 6.6	Miscellaneous- pore volumes and flare factor	Response: TR_RAI-4d
TR-RAI-MI-4e	TR Sect. 6.6	Miscellaneous- surety-related commitments	Response: TR_RAI-4e
TR-RAI-MI-5	TR Sect. 2.7	Miscellaneous- floodplain analysis	Response: TR_RAI-5
TR-RAI-MI-6	TR Sect. 2.7	Miscellaneous- peak flows, erosion protection	Response: TR_RAI-6
May 29, 2010	**TR Section 2.5**	**Meteorology**	
TR RAI -2.5-1.a	TR Sect. 2.5	Meteorology-NWS Station	TR_ Section 2.5.2
TR RAI -2.5-1.b	TR Sect. 2.5	Meteorology-years used	TR_ Section 2.5.2
TR RAI-2.5-1.c	TR Sect. 2.5	Meteorology-wind direct.	TR Section 2.5.3.2
TR RAI-2.5-2	TR Sect. 2.5	Meteorology-atmospheric stability	TR Section 2.5.3.2.1 and Table 2.5-8
TR RAI-2.5-3	TR Sect. 2.5	Meteorology-stability data	TR Section 2.5.3.2.2 and Table 2.5-10
TR RAI-2.5-4	TR Sect. 2.5	Meteorology-annual wind rose	TR Appendix 2.5-D Section C
TR RAI-2.5-5.a	TR Sect. 2.5.3.2	Meteorology-consistent units for wind speed	TR Appendix 2.5-D
TR RAI-2.5-5.b	TR Sect. 2.5, Table 2.5-7	Meteorology-wind data	TR Appendix 2.5-D
TR RAI-2.5-6	TR Sect. 2.5	Meteorology-seasonal wind roses	TR Appendix 2.5-D;Figures 4-6 and 4-7
TR RAI-2.5-7	TR Sect. 2.5	Meteorology-atmospheric stability method	TR Section 2.5.3.2.1 and Table 2.5-9
TR RAI-2.5-8	TR Sect 2.5	Meteorology-wind stability class; inversion height	TR Section 2.5.3.2.3
TR RAI-2.5-9	TR Sect. 2.5	Meteorology-instruments	TR Appendix 2.5-D
TR RAI-2.5-10	TR Sect. 2.5	Meteorology-maintenance	TR Section 2.5.1
May 29, 2010	**TR Section 2.6**	**Geology and Seismology**	
TR RAI-2.6-1	TR Sect. 2.6	Geology/Seismology-Newcastle Sandstone	TR Section 2.6.1.2 and 2.7.2.2.6
TR RAI-2.6-2	TR Sect. 2.6	Geo/Seismo-Minnewaste Limestone	TR Section 2.6.1.2
TR RAI-2.6-3	TR Sect. 2.6	Geo/Seismo-mineralogy	TR Section 2.6.3

TR RAI-2.6-4	TR Sect. 2.6	Geo/Seismo-well abandonment records	TR Section 2.2.3.2.3
May 29, 2010	**TR Section 2.7**	**Hydrology**	
TR RAI-2.7-1	TR Sect. 2.7	Hydrology- Figure 2.7-1 "Site Drainage Systems" (obsolete figure)	Refer to TR_Plate 2.5-1 or SR_Exhibit 3.1-2 or SR_Exhibit 3.1-3
TR RAI-2.7-2	TR Sect. 2.7	Hydrology-Drainage at Dewey	TR_Section 2.7.4.5
TR-RAI-2.7-3	TR Sect. 2.7	Hydrology-Peak flows/water levels. Figures 2.7-10 and 2.7-11_Replaced	TR_Section 2.7.1.4.4 and Exhibit 2.7-3
TR RAI-2.7-4	TR Sect. 2.7	Hydrology-Erosion risks	Appendix 2.7-F1 "Subbasin Figures" and Appendix 2.7-F2 "HEC-1 Model Outputs for Burdock and Dewey".
TR RAI-2.7-5	TR Sect. 2.7	Hydro -potentiometric Surface of the Fall River and Lakota Aquifers	TR_Section 2.7.2.2.8 Figure 2.7-15 and Figure 2.7-16
TR RAI-2.7-6	TR Sect. 2.7.2.2.8	Hydrology-potentiometric head method/artesian	TR_Section 2.7.2.2.8
TR RAI-2.7-7	TR Sect. 2.7	Hydrology-structure maps,	Response: TR RAI-2.7-7; see also Exhibit 2.7-2
TR RAI-2.7-8	TR Sect. 2.7	Hydrology-potentiometric maps	TR_Section 2.7.2.2.8
TR RAI-2.7-9	TR Sect. 2.7	Hydrology-discharge to alluvial aquifers	TR Section 2.7.2.2.10
TR RAI-2.7-10	TR Sect. 2.7	Hydrology-springs from production zone	TR Section 2.7.2.2.10
TR RAI-2.7-11	TR Sect. 2.7	Hydrology-use of "water"	Response: TR RAI-2.7-11
TR RAI-2.7-12	TR Sect. 2.7	Hydrology-detect and inform of water impact	Response: TR RAI-2.7-12
TR RAI-2.7-13.a	TR Sect. 2.7	Hydrology-procedures to protect public health	Response: TR RAI-2.7-13a
TR RAI-2.7-13.b	TR Sect. 2.7, Append. 2.2-A	Hydrology-wells 618, 628	Response: TR RAI-2.7-13b
TR RAI-2.7-13.c	TR Sect. 2.7, Append. 2.2-A	Hydrology-condition of MWs 605,609,637,& 668	Response: TR RAI-2.7-13c and Supplemental Section 5.1
TR RAI-2.7-13.d	TR Append. 2.2-A, Fig. 8	Hydrology-well 16	Response: TR RAI-2.7-13 (d)
TR RAI-2.7-13.e	TR Append. 2.2-A	Hydrology-domestic wells 13, 42, 2, 7, 8, 18, 20 96, 115, 135 & 4002 In or out	Response: TR RAI-2.7-13 (e) and TR_RAI – Figure 2.7-13(e)
TR RAI-2.7-13.f	TR Append. 2.2-A	Hydrology-Stock wells 17, 49, 38, 61	Response: TR RAI-2.7-13 (f)
TR RAI-2.7-13.g	TR Append. 2.2-A	Hydrology-Stock wells 12, 51, 510, 619, 620 & 650	Response: TR_RAI-2.7-13 (g)
TR RAI-2.7-14	TR Append. 2.2-A	Hydrology-type of use of Lakota wells 51 and 14	Response: TR_RAI-2.7-14
TR RAI-2.7-15	TR Sect. 2.7	Hydrology-data table, well-by-well, etc.	Response: TR_RAI-2.7-15 and TR_RAI Attachment RI-5, Letter and Appendix 2.7-G Attachment A; TR_Section 2.7.3.2.2.1
TR RAI-2.7-16	TR Sect. 2.7	Hydrology-sampling Sundance/Unkpapa	Response: TR_RAI-2.7-16

TR RAI-2.7.17	TR Sect. 2.7, Table 2.7-3	Hydrology-MCLs	Response: TR_RAI-2.7-17
TR RAI-2.7-18	TR Sect. 2.7	Hydrology-representative subimpoundments	TR_Section 2.7.3.1
TR RAI-2.7-19	TR Sect. 2.7	Hydrology-suspended, dissolved & total fractions	Response: TR_RAI-2.7-19
TR RAI-2.7-20	TR Sect. 2.7	Hydrology-impoundment Sub05 sampling results	Response: TR_RAI-2.7-20
TR RAI-2.7-21	TR Sect. 2.7, Append.s 2.7-B, 2.7-G, 2.7-I	Hydrology-p.2-195, additional well data	Appendix 2.7-I; Attachment A in Table 2.7-21
TR RAI-2.7-22	TR Sect. 2.7, Append.s 2.7-G, 2.7-I	Hydrology-Well 2, well 7	Appendix 2.7-I and Revised Tables for Appendix 2.7-G
TR RAI-2.7-23	TR Sect. 2.7, Append. 2.7-I	Hydrology-Well 18 mean value	Response: TR_RAI-2.7-23
May 29, 2010	**TR Section 2.9**	**Background Radiological Characteristics**	
TR RAI-2.9-1	TR Sect. 2.9	Radiological-air particulate sampling locations	TR Section 2.9.6.1
TR RAI-2.9-2	TR Sect. 2.9.6.1	Radiological-filter saturation method	TR Section 2.9.6.1
TR RAI 2.9-3	TR Sect. 2.9	Radiological-calibration procedures	TR Section 2.9.6.1
TR RAI-2.9-4	TR Sect. 2.9, Append. 2.9-A	Radiological-one year for air particulates	Response: TR_RAI-2.9-4 and TR Section 2.9.6.1
TR RAI-2.9-5	TR Sect. 2.9, Table 2.9-12	Radiological-LLD values	TR Section 2.9.6.2; Tables 2.9-12 and 2.9-13
TR RAI-2.9-6	TR Sect. 2.9.6.1	Radiological-conversion from mg/filter composite	Response: TR_RAI-2.9-6
TR RAI-2.9-7	TR Sect. 2.9 (p.2-358), Append. 2.9-A (p.16)	Radiological-air particulate collection time periods	Response: TR_RAI-2.9-7 and noted revisions within response
TR RAI-2.9-8	TR Sect. 2.9 (p.2-358), Append. 2.9-A (p.16)	Radiological-air particulate monitoring duration	Response: TR_RAI-2.9-8
TR RAI-2.9-9	TR Sect. 2.9 (p2-359)	Radiological-Th230 value	Response: TR_RAI-2.9-1 for applicable revisions to TR Section 2.9.6.1
TR RAI-2.9-10	TR Sect. 2.9, Append. 2.9-A, Plate 2.5-1, Table 2.9-11	Radiological-"HV" and "AMS"	Response: TR_RAI-2.9-10
TR RAI-2.9-11	TR Sect. 2.9	Radiological-land use for food sampling	TR Section 2.9.10
TR RAI-2.9-12	TR Sects. 2.9, 2.2.2	Radiological-crop sample analyses, agricultural use	TR Section 2.9.10
TR RAI-2.9-13	TR Sects. 2.9, 2.2.2	Radiological-agricultural use of adjacent lands	Response: TR_RAI-2.9-13
TR RAI-2.9-14	TR Sects. 2.9, 2.2.2, 2.8.5.4.2 (p.2-267)	Radiological-game animal sample analyses	Response: 2.9-11; TR Section 2.9.10
TR RAI-2.9-15	TR Sect. 2.9, 2.2.2	Radiological-prohibiting hunting	TR Section 7.1.2

TR RAI-2.9-16	TR Sect. 2.9	Radiological-cow sample results	Response: 2.9-16
TR RAI-2.9-17.a	TR Sect. 2.9, Table 2.9-19 (p.2-378), Append. 2.9-A	Radiological-reporting format	Response: TR_RAI-2.9-17a
TR RAI-2.9-17.b	TR Sect. 2.9	Radiological-LLDs	Response: TR_RAI-2.9-17b
TR RAI-2.9-17.c	TR Sect. 2.9	Radiological-meat LLDs	Response: TR_RAI-2.9-17c
TR RAI-2.9-18	TR Sect. 2.9	Radiological-types of vegetation	Response: TR_RAI-2.9-18
TR RAI-2.9-19	TR Sect. 2.8.5.6.1.2.1	Radiological-grazing areas	Response: TR_RAI-2.9-19
TR RAI-2.9-20	TR Sect. 2.9 (p.2-280), Plate 2.5-1, Fig. 2.9-11	Radiological-fish sampling sites BVC04 & CHR05	TR Section 2.8.5.6.1.1
TR RAI-2.9-21	TR Sect. 2.9	Radiological-fish/impoundments	TR Section 2.8.5.6.1.1
TR RAI-2.9-22	TR Sect. 2.9.2.1.1	Radiological-gamma survey transects	Response: TR_RAI-2.9-22
TR RAI-2.9-23	TR Sect. 2.9	Radiological-daily function tests for instruments	Response: TR_RAI-2.9-23
TR RAI-2.9-24	TR Sect. 2.9	Radiological-locating TLDs	TR_RAI-RC-2.9-1
TR RAI-2.9-25	TR Sect. 2.9	Radiological-TLD lab reports	TR Section 2.9 Attachment A
TR RAI-2.9-26	TR Sect. 2.9.5.2.1, Table 2.9-10, Append. 2.9-A Table 9-1	Radiological-AMS-01 monitoring period	TR Section 2.9.5.2.1
TR RAI-2.9-27.a	TR Sect. 2.9, Table 2.9-10	Radiological-TLD monitoring period	Response: TR_RAI-2.9-27(a) and TR Section 2.9.5.2.1; Table 2.9-10
TR RAI-2.9-27.b	TR Sect. 2.9	Radiological-ambient gamma dose rate	TR Section 2.9.5.2.1 and Sections 9.2 and 11.0 of Appendix 2.9-A
TR RAI-2.9-27.c.i	TR Sect. 2.9.2.1.1	Radiological-gamma survey	Response: TR_RAI-2.9-27(c)(i)
TR RAI-2.9-27.c.ii	TR Sect. 2.9.2.1.1	Radiological-gamma survey statistics	Response: TR_RAI-2.9-27(c)(ii)
TR RAI-2.9-27.c.iii	TR Sect. 2.9.2.1.1	Radiological-gamma dose rate variation	Response: TR_RAI-2.9-27(c)(iii)
TR RAI-2.9-28	TR Sect. 2.9.5.2.1	Radiological-Exclusion of AMS-02	Response: TR_RAI-2.9-28 and 29
TR RAI-2.9-29	TR Sect. 2.9.5.2.1	Radiological-AMS-03 dose rate justification	Response: TR_RAI-2.9-28 and 29
TR RAI-2.9-30.a	TR Sect. 2.9.2.2.1, Sect. 3.2 of Append. 2.9-A	Radiological-statistical documentation	Response: TR_RAI-2.9-30(a)
TR RAI-2.9-30.b	TR Sect. 2.9.2.2.1, Sect. 3.2 of Append. 2.9-A	Radiological-Justify use of IQR re outliers	Response: TR_RAI-2.9-30(b)
TR RAI-2.9-31.a	TR Sect. 2.9.2.2.1, Sect. 3.2 of Append. 2.9-A	Radiological-Outliers	Response: TR_RAI-2.9-31(a)
TR RAI-2.9-31.b	TR Sect. 2.9.2.2.1, Sect. 3.2 of Append. 2.9-A	Radiological-Outliers	Response: TR_RAI-2.9-31(b)

TR RAI-2.9-32.a	TR Sect. 2.9.2.2.2	Radiological-ArcView GIS input and results	Response: TR_RAI-2.9-32(a)
TR RAI-2.9-32.b	TR Sect. 2.9.2.2.2	Radiological-ArcView GIS interpolation scheme	Response: TR_RAI-2.9-32(b)
TR RAI-2.9-32.c	TR Sect. 2.9.2.2.2	Radiological-Fig.2.9-6 error estimates	Response: TR_RAI-2.9-32(c)
TR RAI-2.9-33	TR Sect. 2.9.3.2.1, Append. 2.9-A sect. 4.6.2	Radiological-Different LLDs for Pb-210 in soil	Response: TR_RAI-2.9-33
TR RAI-2.9-34	TR Sect. 2.9.3.1.1	Radiological-soil sampling depth	Response: TR_RAI-2.9-34
TR RAI-2.9-35.a	TR Sect. 2.9	Radiological-statistical documentation re Ra-226 soil sampling	Response: TR_RAI-2.9-35(a)
TR RAI-2.9-35.b	TR Sect. 2.9	Radiological-Use of IQR for outliers	Response: TR_RAI-2.9-35(b)
TR RAI-2.9-35.c	TR Sect. 2.9	Radiological-Cause of outliers	Response: TR_RAI-2.9-35(c)
TR RAI-2.9-36	TR Sect. 2.9.3.1.1	Radiological-input and results from Visual Sampling Plan	Response: TR_RAI-2.9-36
TR RAI-2.9-37.a	TR Sect. 2.9.3.1.1	Radiological-references re soil analyses	Response: TR_RAI-2.9-37(a) and Appendix TR_RAI-RC 2.9-37
TR RAI-2.9-37.b	TR Sect. 2.9.3.1.1	Radiological-analytical method 909.0M	Response: TR_RAI-2.9-37(b) and Appendix TR_RAI-RC 2.9-37
TR RAI-2.9-37.c	TR Sect. 2.9.3.1.1	Radiological-Method 6020A of SW-846 re U	Response: TR_RAI-2.9-37(c) and Appendix TR_RAI-RC 2.9-37
TR RAI-2.9-37.d	TR Sect. 2.9.3.1.1	Radiological-lab documentation re Ra-226	Response: TR_RAI-2.9-37(d) and Appendix TR_RAI-RC 2.9-37
TR RAI-2.9-38.a	TR Sect. 2.9	Radiological-combining gamma-ray surveys	Response: TR_RAI-2.9-38(a)
TR RAI-2.9-38.b	TR Sect. 2.9	Radiological-justify use of “poor fit” regression model for Ra-226	Response: TR_RAI-2.9-38(b)
TR RAI-2.9-39.a	TR Sect. 2.9.2.1.3	Radiological-input and results from ArcView GIS	Response: TR_RAI-2.9-39(a)
TR RAI-2.9-39.b	TR Sect. 2.9.2.1.3	Radiological-ArcView interpolation scheme	Response: TR_RAI-2.9-39(b)
TR RAI-2.9-39.c	TR Sect. 2.9.2.1.3	Radiological-Fig 2.9-7 error estimates	Response: TR_RAI-2.9-3(c)
TR RAI-2.9-40.a	TR Sect. 2.9.3, Figs 2.9-9 &-10, Table2.9-5, Supp. Ex.3.1-2	Radiological-number of soil samples in Dewey area	Response: TR_RAI-2.9-40(a)
TR RAI-2.9-40.b	TR Sect. 2.9.3, Figs 2.9-9 &-10, Table2.9-5, Supp. Ex.3.1-2	Radiological-number of soil samples in Burdock area	Response: TR_RAI-2.9-40(b)
TR RAI-2.9-40.c	TR Sect. 2.9.3, Figs 2.9-9 &-10, Table2.9-5,	Radiological-soil samples between Dewey and Burdock	Response: TR_RAI-2.9-40(c)

	Supp. Ex.3.1-2		
TR RAI-2.9-41	TR Sect. 2.9.4.3(p.2-349), Table 2.7-10(p.2-185)	Radiological-PSCO2	Response: TR_RAI-2.9-41
TR RAI-2.9-42	TR Sect. 2.9	Radiological-sediment sample lab reports	TR Section 2.9-42 Response pages
TR RAI-2.9-43.a	TR Sect. 2.7.3.1, Table 2.7-20	Radiological-surface water sampling	Response: TR_RAI-2.9-43(a)
TR RAI-2.9-43.b	TR Sect. 2.9, Plate2.5-1	Radiological-sampling of drainages	Response: TR_RAI-2.9-43(b)
TR RAI-2.9-44	TR Sect. 2.9, Plate2.5-1, Table 2.7-20	Radiological-sampling of surface water features	Response: TR_RAI-2.9-44
TR RAI-2.9-45	TR Sect. 2.9, Plate 2.5-1	Radiological-PSCO1 v. PS-1	Response: TR_RAI-2.9-45
TR RAI-2.9-46	TR Sect. 2.9	Radiological-BVC01 & UNT01	Response: TR_RAI-2.9-46
TR RAI-2.9-47	TR Sect. 2.9, Append.2.7-F	Radiological-results for BVC01	Response: TR_RAI-2.9-47
TR RAI-2.9-48	TR Sect. 2.9	Radiological-BVC01 data	Response: TR_RAI-2.9-48
TR RAI-2.9-49	TR Sect. 2.9	Radiological-impoundment data	Response: TR_RAI-2.9-49
TR RAI-2.9-50	TR Sect. 2.9	Radiological-surface water LLD	Response: TR_RAI-2.9-50
May 29, 2010	**TR Section 3.1**	**ISR Process and Equipment**	
TR RAI-3.1-1	TR Sect. 3.1	Process & Equip-instrumentation, alarms & controls	TR Section 3.1.3.1, 3.1.4,3.2.12 and 4.1.2
TR RAI-3.1-2	TR Sect. 3.1	Process & Equip-unconfined conditions & limited potentiometric head on eastern PAA	ER_RAI Response WR-3.1 and WR-3.2 on pages 23 through 26 submitted to the NRC August 11, 2010.
TR RAI-3.1-3	TR Sect. 3.1	Process & Equip-restoration timetable	TR Section 6.1.4 and Figure 6.1-1
TR RAI-3.1-4	TR Sect. 3.1	Process & Equip-maintaining hydraulic control	TR Section 3.1.3.1
TR RAI-3.1-5	TR Sect. 3.1 (p.3-14)	Process & Equip-"leachate"	TR Section 3.1.3
TR RAI-3.1-6	TR Sect. 3.1, Supp. Ex. 3.1-1	Process & Equip-Dewey fault and stream lines	Supplemental Exhibit 3.1-1 Revised
TR RAI-3.1-7	TR Sect. 3.1, Supp. Ex. 3.1-2	Process & Equip-land app and pond areas	TR Section 3.1.6.1.1 and 4.2.2.1.4
TR RAI-3.1-8	TR Sect. 3.1, Supp. Ex. 3.1-4	Process & Equip-land app area locations	TR 4.2.2.1
TR RAI-3.1-9	TR Sect. 3.1	Process & Equip-water balance diagram	Figure 3.1-7 in TR Section 3.1.5
May 29, 2010	**TR Section 4.1.1**	**Gaseous and Airborne Particulates**	
TR RAI-4.1-1.a	TR Sect. 4.1.1	Gas & Particulates-exposure outside of plant	TR Section 4.1

TR RAI-4.1-1.b	TR Sect. 4.1.1	Gas & Particulates- affect of openings re exposure	TR Section 4.1.1
TR RAI-4.1-2	TR Sect. 4.1.2.2	Gas & Particulates-discharge for YC dry/pack	TR Section 4.1.2.2
TR RAI-4.1-3	TR Sect. 4.1	Gas & Particulates-vent survey	TR Section 4.1.1
TR RAI-4.1-4	TR Sect. 4.1	Gas & Particulates-radon exhaust vents	TR Section 4.1.1
TR RAI-4.1-5	TR Sect. 4.1	Gas & Particulates-impacts of system failure	TR Section 4.1.3
May 29, 2010	**TR Section 5.2**	**Management Control Program**	
TR RAI-5.2-1	TR Sect. 5.2.6	Management Control- reporting program	TR Section 5.2
TR RAI-5.2-2	TR Sect. 5.2	Management Control- land use survey	TR Section 5.2.6
TR RAI-5.2-3	TR Sect. 5.2	Management Control- cultural resources	TR Section 5.2
TR RAI-5.2-4	TR Sect. 5.2 (p.5-7)	Management Control- Tailings ?	TR Section 5.2.5
May 29, 2010	**TR Section 5.3**	**Management and Audit Program**	
TR RAI-5.3-1.a	TR Sect. 5.3.4	Audit Program-ALARA Program	TR Section 5.3
TR RAI-5.3-1.b	TR Sect. 5.3	Audit Program-ALARA Program	TR Section 5.3
May 29, 2010	**TR Section 5.5**	**Radiation Safety Training**	
TR RAI-5.5-1	TR Sect. 5.5	Radiation Safety Training- policy re declared pregnant women	TR Section 5.5
TR RAI-5.5-2	TR Sect. 5.5	Radiation Safety Training-include nonrad hazards	TR Section 5.5
TR RAI-5.5-3	TR Sect. 5.5	Radiation Safety Training-copy of proposed rad safety instructions	TR Section 5.5
May 29, 2010	**TR Section 5.7.2**	**External Radiation Exposure Monitoring Program**	
TR RAI-5.7.2-1	TR Sect. 5.7.2	External Rad Monitoring-survey instrumentation	TR Sections 5.7.2.3, Response TR_RAI-5.7.2-1
TR RAI-5.7.2-2	TR Sect. 5.7.2	External Rad Monitoring- Gamma dose action level	Response: TR_RAI-5.7.2-2
TR RAI-5.7.2-3	TR Sect. 5.7.2	External Rad Monitoring-high rad area	Response: TR_RAI-5.7.2-3
TR RAI-5.7.2-4	TR Sect. 5.7.2	External Rad Monitoring-No. & category of employee in Ext. Rad Program	Response: TR_RAI-5.7.2-4, TR Section 5.1.1, p.5-3
TR RAI-5.7.2-5	TR Sect. 5.7.2.1	External Rad Monitoring- fixed rad monitoring figure (not Fig. 5.7-1)	TR Section 5.7.2.3, Figs 5.7-2 thru 5.7-5
May 29, 2010	**TR Section 5.7.3**	**In-Plant Airborne Radiation Monitoring Program**	
TR RAI-5.7.3-1.a	TR Sect. 5.7.3.1, Figs 5.7-6 to 5.7-9	Airborne Rad Monitoring-airflow patterns	Response:TR_RAI-5.7.3-1(a)
TR RAI-5.7.3-1.b	TR Sect. 5.7.3.1, Figs 5.7-6 to 5.7-9	Airborne Rad Monitoring-air sampling locations	Response: TR_RAI-5.7.3-1(b)
TR RAI-5.7.3-1.c	TR Sect. 5.7.3.1, Figs 5.7-6 to 5.7-9	Airborne Rad Monitoring- first year air sampling program	Response: TR_RAI-5.7.3-1(c), TR Section 5.7.3.2

TR RAI-5.7.3-2	TR Sect. 5.7.3	Airborne Rad Monitoring-LLD for radon daughters	TR Sections 5.7.3.2 & 4.1.1
TR RAI-5.7.3-3.a	TR Sect. 5.7.3.2	Airborne Rad Monitoring- dwg. for sample stations	TR Section 5.7.3.2
TR RAI-5.7.3-3.b	TR Sect. 5.7.3.2	Airborne Rad Monitoring- airflow patterns	Response: TR_RAI-5.7.3-1(a)
TR RAI-5.7.3-3.c	TR Sect. 5.7.3	Airborne Rad Monitoring-evaluation of sampling locations	TR Section 5.7.3.2
TR RAI-5.7.3-3.d	TR Sect. 5.7.3	Airborne Rad Monitoring- First year air sampling program	TR Section 5.7.3.2
TR RAI-5.7.3-3.e	TR Sect. 5.7.3	Airborne Rad Monitoring- air sampling for non-airborne rad areas	TR Section 5.7.3.2
TR RAI-5.7.3-4	TR Sect. 5.7.3.2	Airborne Rad Monitoring- LLD formula	Response: TR_RAI-5.7.3-4
TR RAI-5.7.3-5	TR Sect. 5.7.3	Airborne Rad Monitoring-action levels for sampling locations	Response: TR_RAI-5.7.3-5
TR RAI-5.7.3-6.a	TR Sects. 5.7.3.2, 4.1.2	Airborne Rad Monitoring- reference in 10CFR20 re H202 YC as "soluble"	Response: TR_RAI-5.7.3-6a
TR RAI-5.7.3-6.b	TR Sects. 5.7.3.2, 4.1.2	Airborne Rad Monitoring-refer to Nov 2009 guidance	TR Section 5.7.4.1
TR RAI-5.7.3-7	TR Sect. 5.7.3.2	Airborne Rad Monitoring- ALARA goal for U uptake	Response: TR_RAI-5.7.3-7
TR RAI-5.7.3-8	TR Sect. 5.7.3	Airborne Rad Monitoring- criteria for use of respirators	Response: TR_RAI-5.7.3-8
May 29, 2010	**TR Section 5.7.4**	**Exposure Calculations**	
TR RAI-5.7.4-1.a	TR Sect. 5.7.4.2	Exposure Calcs- methods to calculate intake of Unat	Response: TR_RAI-5.7.4-1a
TR RAI-5.7.4-1.b	TR Sect. 5.7.4.2	Exposure Calcs- exposure calculations for Unat	Response: TR_RAI-5.7.4-1b
TR RAI-5.7.4-1.c	TR Sect. 5.7.4.2	Exposure Calcs-parameters used in exposure calculations for radon daughters	Response: TR_RAI-5.7.4-1c, TR Section 5.7.4.2
TR RAI-5.7.4-2	TR Sect. 5.7.4.2	Exposure Calcs- calculations for mixture of radionuclides	Response: TR_RAI-5.7.4-2
TR RAI-5.7.4-3	TR Sect. 5.7.4	Exposure Calcs-maintaining soluble uranium intake to 10 mg/wk/person	Response: TR_RAI-5.7.4-3
TR RAI-5.7.4-4	TR Sect. 5.7.4	Exposure Calcs- prenatal radiation exposure program	Response: TR_RAI-5.7.4-4
TR RAI-5.7.4-5	TR Sect. 5.7.4	Exposure Calcs- reporting and record keeping	Response: TR_RAI-5.7.4-5
TR RAI-5.7.4-6	TR Sect. 5.7.4	Exposure Calcs- estimate airborne U concentrations	Response: TR_RAI-5.7.4-6
May 29, 2010	**TR Section 5.7.5**	**Bioassay Program**	
TR RAI-5.7.5-1	TR Sect. 5.7.5	Bioassay- urinalysis as primary technique	Response: TR_RAI-5.7.5-1, Response _TR_RAI 5.7.3-6(a)
TR RAI-5.7.5-2	TR Sect. 5.7.5	Bioassay-conversion of uptake to dose	Response: TR_RAI-5.7.5-2
TR RAI-5.7.5-3	TR Sect. 5.7.5	Bioassay- number and category of personnel in bioassay program	Response: TR_RAI-5.7.5-3

TR RAI-5.7.5-4	TR Sect. 5.7.5	Bioassay-actions taken if positive results	Response: TR_RAI-5.7.5-4
TR RAI-5.7.5-5	TR Sect. 5.7.5	Bioassay-reporting and record keeping	Response: TR_RAI-5.7.5-5, Responses TR_RAI-5.2-1, 5.7.4-5, & 5.7.6-7
May 29, 2010	**TR Section 5.7.6**	**Contamination Control Program**	
TR RAI-5.7.6-1	TR Sects. 5.7.6.3, 5.7.2.3	Contamination Control- limits and action levels for personnel with beta-gamma	Response: TR_RAI-5.7.6-1
TR RAI-5.7.6-2	TR Sect. 5.7.6.2	Contamination Control- skin and clothing monitoring	Response: TR_RAI-5.7.6-2
TR Rai-5.7.6-3	TR Sect. 5.7.6.2	Contamination Control – who performing skin decontamination and verification	TR Section 5.7.6.2
TR RAI-5.7.6-4	TR Sect. 5.7.6	Contamination Control- basis for classification of work areas	TR Section 5.7.6.1
TR RAI-5.7.6-5	TR Sect. 5.7.6	Contamination Control- limits and action levels for areas with beta-gamma	TR Section 5.7.6.1
TR RAI-5.7.6-6	TR Sect. 5.7.6	Contamination Control-surveys of items leaving restricted area	TR Section 5.7.6
TR RAI-5.7.6-7	TR Sect. 5.7.6	Contamination Control-reporting and record keeping	TR Section 5.7.6.6
TR RAI-5.7.6-8	TR Sect. 5.7.6	Contamination Control-applying covering material to contaminated surfaces	TR Section 5.7.6.3
TR RAI-5.7.6-9	TR Sect. 5.7.6	Contamination Control-procedures for interior of pipes, drains, ductwork	TR Section 5.7.6.3
May 29, 2010	**TR Section 5.7.7**	**Airborne Effluent and Environmental Monitoring Program**	
TR RAI-5.7.7-1.a	TR Sect. 4.1.1	Effluent & Env. Monitoring- frequency of sampling radon stacks	TR Section 4.1.1, p.4-2, para 2
TR RAI-5.7.7-1.b	TR Sect. 4.1.1	Effluent & Env. Monitoring- ALARA determination for radon and daughters	TR Sections 4.1, 4.1.1, 5.0, 5.7.1, 5.7.4.2
TR RAI-5.7.7-2	TR Sect. 5.7.6, Fig. 5.7-10	Effluent & Env. Monitoring- placement of air particulate and radon sampling stations	Response: TR_RAI-2.9-1, TR Appendix 2.5-C
TR RAI-5.7.7-3	TR Sect. 5.7.7.1	Effluent & Env. Monitoring- Compositing air particulate filters	Response: TR_RAI-5.7.7-3, Response: TR_RAI-2.9-2
TR RAI-5.7.7-4	TR Sect. 5.7.7	Effluent & Env. Monitoring- Placement of air samplers	Response: TR_RAI-2.9-1, TR Section 5.7.7.1
TR RAI-5.7.7-5	TR Sect. 5.7.7	Effluent & Env. Monitoring- placement of radon samplers with air stations	Response: TR_RAI-2.9-1, TR Section 5.7.7.1
TR RAI-5.7.7-6	TR Sect. 5.7.7	Effluent & Env. Monitoring-radon sampling frequency	Response: TR_RAI-5.7.7-6

TR RAI-5.7.7-7	TR Sect. 5.7.7, Fig. 5.7-10	Effluent & Env. Monitoring- locations of radon monitors	Response: TR_RAI-5.7.7-7, TR Fig. 5.6-10, TR Fig. 2.9-8, Fig. 4-1 in TR Append. 2.9-A
TR RAI-5.7.7-8	TR Sect. 5.7.7.3	Effluent & Env. Monitoring- placement of air monitoring stations	TR Table 2.9-1, item (F), TR Plate 2.5-1
TR RAI-5.7.7-9	TR Sect. 5.7.7	Effluent & Env. Monitoring- sediment sampling program	TR Section 5.7.7.3
TR RAI-5.7.7-10.a	TR Sect. 5.7.7	Effluent & Env. Monitoring- need for collecting and analyzing food sources	Response: TR_RAI-2.9-11 thru 2.9-14, and TR_RAI-2.9-21
TR RAI-5.7.7-10.b	TR Sect. 5.7.7	Effluent & Env. Monitoring- collecting and analyzing game food sources	Response: TR_RAI-2.9-14
TR RAI-5.7.7-10.c	TR Sect. 5.7.7	Effluent & Env. Monitoring- collecting and analyzing garden food sources	Response: TR_RAI-2.9-12
TR RAI-5.7.7-11	TR Sect. 5.7.7.2, Fig. 5.7-10	Effluent & Env. Monitoring- vegetation sampling locations	Response: TR_RAI-5.7.7-11
TR RAI-5.7.7-12	TR Sect. 5.7.7	Effluent & Env. Monitoring- operational direct radiation monitoring	Response: TR_RAI-5.7.7-12
TR RAI-5.7.7-13	TR Sect. 5.7.7	Effluent & Env. Monitoring- airborne effluent and env. monitoring program	TR Sections 4.0, 5.7, Responses: TR_RAI-2.9 & 5.7.7
TR RAI-5.7.7-14	TR Sect. 5.7.7	Effluent & Env. Monitoring- public likely to receive highest exposure	Response: TR_RAI-5.7.7-14, TR Section 7.3
TR RAI-5.7.7-15	TR Sect. 5.7.7	Effluent & Env. Monitoring- public exposure to radon daughters	TR Section 5.7.7.1
TR RAI-5.7.7-16	TR Sect. 5.7.7	Effluent & Env. Monitoring-account for and verify releases	Response: TR_RAI-5.7.7-16, TR Figs. 5.7-6 to 5.7-9
TR RAI-5.7.7-17	TR Sect. 5.7.7	Effluent & Env. Monitoring- LLD for biota and soil	Response: TR_RAI-5.7.7-17
May 29, 2010	**TR Section 5.7.8**	**Groundwater and Surface Water Monitoring Programs**	
TR RAI-5.7.8-1	TR Sect. 5.7.8	Water Monitoring- Surface water monitoring program	Response: TR_RAI-5.7.8-1
TR RAI-5.7.8-2	TR Sect. 5.7.3.1	Water Monitoring- surface water features	Response: TR_RAI-2.7-18, TR_RAI-2.9-43a
TR RAI-5.7.8-3.a	TR Sect. 5.7.8	Water Monitoring- constituents in Table 2.7.3-1 of NUREG 1569	Response: ER_RAI-EMM-1, p.68
TR RAI-5.7.8-3.b	TR Sect. 5.7.8	Water Monitoring- statistical methods	TR Section 5.7.8
TR RAI-5.7.8-4	TR Sect. 5.7.8	Water Monitoring- monitoring mine pit areas	Response: TR_RAI-P&R-5, TR_RAI-2.7-10
TR RAI-5.7.8-5	TR Sect. 5.7.8.3	Water Monitoring- MW sampling densities	Response: TR_RAI-5.7.8-3b
TR RAI-5.7.8-6	TR Sect. 5.7.8.3	Water Monitoring- baseline sampling frequency	Response: TR_RAI-5.7.8-3b
TR RAI-5.7.8-7.a	TRS Sect. 5.2.7	Water Monitoring- excursion indicators	TR Section 3.1.3.13

TR RAI-5.7.8-7.b	TR Sect. 5.7.8	Water Monitoring- sulfate as indicator	Response: TR_RAI-5.7.8-7b
TR RAI-5.7.8-7.c	TR Sect. 5.7.8	Water Monitoring- TDS or conductivity as indicator	Response: TR_RAI-5.7.8-7c
TR RAI-5.7.8-7.d	TR Sect. 5.7.8	Water Monitoring- uranium as indicator	Response: TR_RAI-5.7.8-7d
TR RAI-5.7.8-8	TR Sect. 5.7.8	Water Monitoring- method to be used for establishing UCLs	TR Section 5.7.8.1.1
TR RAI-5.7.8-9	TR Sect. 5.7.8 (p.3-8)	Water Monitoring-process for determining screened horizon	TR Section 5.7.8-9, TR Section 5.7.1.3
TR RAI-5.7.8-10	TR Sect. 5.7.8 (p.3-14)	Water Monitoring- site-specific hydrogeological bases for well spacing	TR Section 3.1.3.1.2
TR RAI-5.7.8-11	TR Sect. 5.7.8, TRS Exs. 3.1-6 & 7	Water Monitoring- variation in well spacing	Response: TR_RAI-P&R-1
TR RAI-5.7.8-12	TR Sect. 5.7.8 (p.3-16)	Water Monitoring- overlying aquifer	TR Section 5.7.8-12, TR Section 3.1.3.1.1
TR RAI-5.7.8-13	TR Sect. 5.7.8 (p.3-16)	Water Monitoring- underlying aquifer	Response: TR_RAI-5.7.8-11
TR RAI-5.7.8-14	TR Sect. 5.7.8, TR Sect. 3.1, TRS Sect. 3.0	Water Monitoring- well field test procedures	Response: TR_RAI-5.7.8-14, TR Section 5.7.1.3
TR RAI-5.7.8-15	TR Sect. 5.7.8	Water Monitoring-excursion monitoring program	TR Section 5.7.8.2
TR RAI-5.7.8-16	TR Sect. 5.7.8	Water Monitoring-excursion corrective action and notification plan	TR Sections 5.7.8.2.2 & 5.7.8.2.3
TR RAI-5.7.8-17	TR Sect. 5.7.8, Figs. 5.7-10 & 5.7-8, Append. 2.2-A	Water Monitoring- water well sampling locations	Response: TR_RAI-5.7.8-17, Figure TR_RAI 5.7.7-9
TR RAI-5.7.8-18. a, b	TR Sect. 5.7.8, Fig. 5.7-10	Water Monitoring- surface water sampling locations	Figure TR_RAI-5.7.7-9, TR Section 5.7.8
TR RAI-5.7.8-19	TR Sect. 5.7.8	Water Monitoring- water sampling methods and parameters	Response: TR_RAI-5.7.8-19
May 29, 2010	**TR Section 5.7.9**	**Quality Assurance**	
TR RAI-5.7.9	TR Sect. 5.7.9	Quality Assurance- Quality assurance program	TR Section 3.1.3.1.1 and TR Section 5.7.9 (Table 5.7-2)
May 29, 2010	**TR Section 6.1**	**Plans and Schedules for Groundwater Quality Restoration**	
TR RAI-6.1-1	TR Sect. 6.1	Groundwater Restoration- restoration goal	TR Section 6.1.1
TR RAI-6.1-2	TR Sect. 6.1	Groundwater Restoration- statistical analysis	TR Section 6.1.1
TR RAI-6.1-3	TR Sect. 6.1, Table 6.1-1	Groundwater Restoration- method establishing TRGs	TR Section 6.1.1(footnote Table 6.1-1)
TR RAI-6.1-4	TR Sect. 6.1	Groundwater Restoration- restoration methods	TR Section 6.1.3 and 6.1.3.2

TR RAI-6.1-5	TR Sect. 6.1	Groundwater Restoration- Crow Butte analog re expected concentrations	TR Section 6.1.3
TR RAI-6.1-6	TR Sect. 6.1	Groundwater Restoration- effectiveness of groundwater treatment	TR Section 6.1.6.1
TR RAI-6.1-7	TR Sect. 6.1	Groundwater Restoration- pore volume, porosity & Flare factor	Response: TR_RAI-6.1-7
TR RAI-6.1-8	TR Sect. 6.1	Groundwater Restoration- excursion during restoration	TR Section 3.1.3.1.2
TR RAI-6.1-9	TR Sect. 6.1	Groundwater Restoration- documenting effectiveness of restoration	TR Section 3.1.3 and TR Section 6.1.7.1
TR RAI-6.1-10	TR Sect. 6.1	Groundwater Restoration- stability monitoring	TR Section 6.1.7.2
TR RAI-6.1-11	TR Sect. 6.1	Groundwater Restoration- restoration schedule	TR Section 6.1.4, Fig. 6.1.1 (revised)
May 29, 2010	**TR Section 6.2**	**Plans for Reclaiming Disturbed Lands**	
TR RAI-6.2-1.a	TR Sect. 6.2	Reclaiming Disturbed Lands- Focus areas for cleanup	Response: TR_RAI-6.2-1a, Response: TR_RAI-P&R-16(1), TR Section 6.4.1
TR RAI-6.2-1.b	TR Sect. 6.2	Reclaiming Disturbed Lands- decommissioning non-radiological haz constituents	TR Section 7.3.3.8.2, Responses: TR_RAI-WM-3&4, & TR_RAI-WM-6.2
TR RAI-6.2-1.c	TR Sect. 6.2	Reclaiming Disturbed Lands- QA/QC demonstration	Response: TR_RAI-P&R-16-3, Fig. TR_RAI-P&R-16
TR RAI-6.2-2.a	TR Sect. 6.2.1	Reclaiming Disturbed Lands- instruments and techniques	TR Section 6.2
TR RAI-6.2-2.b	TR Sect. 6.2.1	Reclaiming Disturbed Lands- use of pre-reclamation surveys	TR Section 6.2
May 29, 2010	**TR Section 6.3**	**Removal and Disposal of Structures, Waste Material, and Equipment**	
TR RAI-6.3-1	TR Sect. 6.3 (p.6-23)	Removal and Disposal- clarification	TR Section 6.3.3
TR RAI-6.3-2	TR Sect. 6.3.1	Removal and Disposal- surface contamination release limits	TR Section 6.3.1
TR RAI-6.3-3	TR Sect. 6.3.2	Removal and Disposal- treatment of concrete	Response: TR_RAI-6.3.-3
May 29, 2010	**TR Section 6.4**	**Methodologies for Conducting Post Reclamation and Decommissioning Radiological Surveys**	
TR RAI-6.4-1	TR Sect. 6.4	Post D&D Rad Surveys- Elevated Th-230	TR Section 6.2.1
TR RAI-6.4-2	TR Sect. 6.4	Post D&D Rad Surveys- background rad conditions	Response: TR_RAI-6.4-2
TR RAI-6.4-3	TR Sect. 6.4.1.2	Post D&D Rad Surveys- unity rule formula	TR Section 6.4.1.2
TR RAI-6.4-4	TR Sect. 6.4.3	Post D&D Rad Surveys- affected areas	TR Section 6.4.3
TR RAI-6.4-5	TR Sect. 6.4	Post D&D Rad Surveys- evaluating effectiveness of	TR Section 6.2.2(b)

		cleanup	
TR RAI-6.4-6	TR Sects. 6.4.2 & 6.4.3	Post D&D Rad Surveys- excavation control with gamma & 95% confidence	Response: TR_RAI-2.9-38(a-b)
TR RAI-6.4-7	TR Sect. 6.4	Post D&D Rad Surveys- exposure control	TR Section 6.4.1.1.1
TR RAI-6.4-8	TR Sect. 6.4	Post D&D Rad Surveys- reference for QAPP	TR Section 6.4.4
May 29, 2010	**TR Section 7.0**	**Environmental Effects -Accidents**	
TR RAI-7.0-1	TR Sect. 7.0	Accidents- major pipe of tank rupture	TR Section 7.5.2
TR RAI-7.0-2	TR Sect. 7.0	Accidents- potential chemical accidents	TR Section 7.5.2
TR RAI-7.0-3	TR Sect. 7.0	Accidents- fires and explosions	TR Section 7.5.1
TR RAI-7.0-4	TR Sect. 7.0	Accidents- emergency procedures for severe weather	TR Section 7.5.6

I. Process and Restoration

TR RAI-P&R-1
Further define the vertical location of ore bodies proposed for uranium recovery; clearly indicate the aquifer (e.g., Fall River or Lakota) that contains each ore body proposed for uranium recovery. For each well field, illustrate the scaled vertical position of each ore body proposed for uranium recovery within the aquifer that contains it.

Response: TR RAI-P&R-1

See TR_RAI-Response and Replacement Pages, Section P&R-1, for requested additional information and clarification concerning the vertical location of the ore bodies inserted into TR Section 2.7.2.2.5.

TR RAI-P&R-2
Expand on the description of the inventory of economically significant mineral and energy-related deposits and related activities.

Response: TR RAI-P&R-2

See TR_RAI-Response and Replacement Pages, Section P&R-2 for additional information concerning energy – related activities in the vicinity of the PAA. Inserted into TR Section 2.2.2 Land Use; see also Exhibit 2.2-1.

TR RAI-P&R-3
Expand seismic evaluation to include the seismic event north of Dewey, South Dakota.

Response: TR RAI-P&R-3
See TR_RAI-Response and Replacement Pages, Section P&R-3, for additional information inserted into TR Section 2.6.6.1.1.1 Seismic Event North of Dewey, South Dakota.

TR RAI-P&R-4
Please provide locations and documentation for exploratory test holes that penetrate through the Lakota Formation and provide a structure map of the top of the Morrison Formation

Response: TR RAI-P&R-4

See TR_RAI-Response and Replacement Pages; Section P&R-4; Included by reference is a structure contour map developed for a similar NRC RAI located in RAI_ER Exhibit WR-6.1.

TR RAI-P&R-5
Please evaluate where the unconfined Fall River groundwater surface is hydraulically connected to the ground surface at or near wellfields (including the bottom of open mine pits).

Response: TR RAI-P&R-5
Refer to Response to ER_RAI-WR-2.1(1) (pg.18); 2-1(d) (pg. 22) and Response to ER_RAI-WR-3 (pg.22).

TR RAI-P&R-6

Using exploratory test-hole data and other data, please expand the evaluation of Fuson Shale confining capacity within or near the areas where the Fall River aquifer is unconfined and uranium recovery is proposed within the Chilson Member.

Response: TR RAI-P&R-6

Refer to Response to ER_RAI WR-2; 2-1(a); ER_ RAI Exhibit WR-2.1; ER_ RAI Exhibit WR-2.3; ER_ RAI Exhibit WR-2.4; and ER_ RAI Exhibit WR-2.5.

TR RAI-P&R-7

Provide additional aquifer test information.

Response: TR RAI-P&R-7

The requested report titled "Hydrogeologic Investigations at Proposed Uranium Mine near Dewey, South Dakota, "(Boggs, J.M., 1983) is provided in Appendix 2.7-K submitted within the TR_RAI Response package.

TR RAI-P&R-8

Staff requests that the cross section, Plate 2.6-12, be revised to include geophysical log results. Additionally, staff requests the revision of the cross sections for wellfields Dewey II and III to include logs from all test holes that penetrated through the Lakota Formation.

Response: TR RAI-P&R-8

The cross sections developed as a response to TR RAI P&R-1 contain geophysical logs and provide information required to address this RAI. The Dewey II mine unit no longer exists. The Future Mine Units map (Supplement Exhibit 3.1.4) has been revised to allow for a 1600-foot buffer between resources to be mined and the permit boundary. The purpose of this buffer is to provide area for an aquifer exemption boundary and monitor well rings. In the process of applying this mine unit boundary to the resources in the northern portion of the Dewey area, the minable resources were reduced to the point where they no longer appeared to be economical. For this permit application, future mine unit Dewey II has been removed and no mining is planned in the northern portion of the Dewey area. See Also P&R-1 Response.

TR RAI-P&R-9

Clarify quotes in Section 5.7.1.3 of the Technical Report referring to former exploration holes at or near production zones.

Response: TR RAI-P&R-9

Effluent controls for preventing migration of recovery solutions to overlying and underlying aquifers includes:

- Plugging and abandonment of all (historical or recent) exploration holes that may have potential to interfere with operations and/or restoration activities, as determined by the pump tests to be conducted after all operational wells are drilled.
- Historical records indicate the following concerning the 3,835 test holes drilled under the EX-5 permit, e.g. official actions of the South Dakota Board of Minerals and Environment where surety and/or liability under Permit EX-5 was ordered released by the Chairman, Board of Minerals & Environment and signed by both the state and operator affirming "the operation to be in full compliance with the terms and conditions of the permit and all laws pending thereunder released".

TR RAI-P&R-10
Clarify the exact number and locations of wells.

Response: TR RAI-P&R-10
See TR_RAI Response and Replacement Pages; Section P&R-10.
Although the wells are not grouped according to use within the TR_Appendix 2.2-A, Table 1 "Well Location Data" provides: Well ID, Location, Coordinates, and Aquifer for all wells within the applicant's data base. The use type information requested is provided in the TR_Appendix 2.2-A for each set of wells grouped according to aquifer beginning on page 25 of TR_Appendix 2.2-A; the AOR map of the original submission and also provided in TR_Appendix 2.2-A. See TR_Appendix 2.2-A Table 4 for Alluvial wells and use type associated by Figure 5; See Fall River wells and use type within Table 5 of TR_Appendix 2.2-A and the associated Figure 6; Fuson well in Table 6 and Figure 7 in TR_Appendix 2.2-A. Table 7 provides well information for Lakota wells including use type; it is followed by Figure 8 in TR_Appendix 2.2-A, and etc. The well information has been formatted as requested (by use category) and updated; this information is presented in TR_RAI Table P&R-10 located within TR_RAI Response and Replacement Pages; Section P&R-10. Number of known wells within the combined area of the AOR and PAA total 133. Well ID 61 status is currently being used for a stock well and is located within the Lakota aquifer. The procedure for replacement of wells is discussed in the Hydrology response section of the RAI (dated May 28, 2010) document specifically in response to TR_RAI-2.7-13(a). Note: The term Abandoned to denote a use category for wells listed in the TR_Appendix 2.2-A, has been changed to a recognized use category such as Plugged and Abandoned, Domestic, Stock or Monitoring.

TR RAI-P&R-11
Please provide groundwater elevations for the pumping test data

Response: TR RAI-P&R-11
Please note that groundwater elevations for the pumping tests were provided in Tables 4.2 and 5.2 of the pumping test report (i.e. Appendix 2.7-B of the TR, Knight Piesold, 2008b). The groundwater elevations are provided under the table columns headed: (1) "Approximate Groundwater Elevation (ft amsl)" and (2) "Minimum Pumping Groundwater Elevation (ft amsl)". However, to more clearly present

the information requested, the pumping test data in Appendices B (for the Dewey test) and C (for the Burdock test) have been augmented with an additional column for each well entitled "Elevation (ft amsl)" adjacent to the associated time and drawdown value. The groundwater elevation is calculated by subtracting drawdown values from the initial groundwater elevations provided in Tables 4.2 and 5.2 of the pumping test report. The updated tables: Revised Tables B.2-1, B.3-1, C.2-1, and C.3-1 are provided in TR_RAI Response and Replacement Pages; Section P&R-11.

Powertech (USA) is also updating Table 5.2 (Appendix 2.7-B of the TR, Knight Piesold, 2008b) to correct an error associated with the Burdock test pumping well DB-07-11-11C (Hydro ID 680). The value of 3,529 ft amsl reported in Table 5.2, Knight Piesold, 2008b should be changed to 3,571 ft amsl). The average depth to groundwater at DB-07-11-11C is reported as 3,662 ft amsl (TR Appendix 2.7-A). This depth has been used to calculate the groundwater elevations in Revised Tables C.2-1 and C.3-1.

<u>TR RAI-P&R-12</u>

(a) Please specify the source(s) of information used to illustrate breccia pipe locations in Exhibit 2.2-1 of the Technical Report Supplement. Additionally, please specify the specific area of the map in Exhibit 2.2-1 that illustrates known breccia pipe locations.

(b) Staff requests further clarification of the cause of the relatively high and flat potentiometric surface of the Lakota in the northern portion of the Dewey license area.

<u>Response: TR RAI-P&R-12a</u>

See TR_RAI-Response and Replacement Pages; Section P&R-12 for information in TR Section 2.7.2.1.7.

<u>Response: TR RAI-P&R-12b</u>

See TR_RAI-Response and Replacement Pages; Section P&R-12 for additional information inserted into TR Section 2.7.2.2.8.

<u>TR RAI-P&R-13</u>

NRC staff requests confirmation of the above-referenced wellfield locations relative to the license boundary. Please further clarify the control and containment of process fluids for proposed operations infrastructure outside of the license boundary. Please further clarify the composition of the material that will flow through the plant to plant pipeline.

Clarification: Referring to Exhibit 3.1-4 and using the township range blocks for scale, the mine unit outline of Dewey II and Burdock IV wellfields appear to be located such that one or more of the proposed horizontal excursion monitoring wells will be outside of the license boundary. Additionally, cross referencing the proposed Burdock IV ore body for uranium recovery in Exhibit 3.1-4 to Exhibit 3..2-1, NRC is uncertain of the exact location of the Burdock IV wellfield relative to the license boundary (Exhibit 3.-2-1 suggests both monitoring and production wells will be outside of the license boundary).

Response: TR_RAI-P&R-13

1. Confirmation of location of well fields and infrastructure is described and referenced below.
The well field locations relative to the proposed license boundary is provided in information contained within the TR_RAI-Response and Replacement Pages, Section P&R-1, specifically the Exhibits. Confirmation of the first two well field and infrastructure locations are provided in the Updated SR Exhibits 3.1-2 and 3.1-3; the locations for the deep well facilities have also been included by reference; see TR_RAI Table P&R-13 below. All infrastructure associated with the proposed project will be located within the project boundary.

TR_RAI Table P&R-13: Obsolete and Replacement Exhibits and Figure for the TR and SR.

Obsolete Figure or Exhibit and version date	Purpose of Figure	Title of Updated Replacement Figure or Exhibit
SR Exhibit 3.1-4 (28-Jun-09)	Proposed Well Field Locations	SR Exhibit 3.1-4 (16-Dec-10)
SR Exhibit 3.1-2 (05-Aug-09) SR Exhibit 3.1-3 (06-Aug-09) SR Exhibit 3.2-1 (01-Jul-09)	Proposed Initial Well Fields Plant-to-Plant Pipeline Deep Disposal Well Option Land Application Option	SR Exhibit 3.1-2 (12-17-10) SR Exhibit 3.1-3 (12-17-10)
TR Figure 3.1-8	Facility Location-Deep Disposal Well Option	TR Figure 3.1-9 and Appendix WR-7 of the ER RAI Response Class V Application; Figure B-2b

2. Clarification of the materials that will flow through the plant-to-plant pipeline is described below.
The PA proposes to install up to eight underground conduits between the Central Processing Plant and the Satellite Facility. These conduits include pipelines that may transport any of the various fluids present during ISL operations as well as conduits for electronic communication and control purposes; the fluids that may be transported include but are not limited to barren and pregnant production fluids, restoration fluids, RO reject brines, waste water resulting from well drilling and maintenance operations, and Madison or other aquifer water.

3. Clarification of monitoring well ring location is describe below.
All well fields and their associated perimeter monitor well rings will be located within the proposed license boundary. The proposed locations of well fields are depicted in TR_RAI-Exhibit P&R-1.

TR_RAI-P&R-14
Provide revised and additional information on plans for the disposal of liquid wastes.
(a) The applicant needs to bring greater clarity and organization to the new information on liquid disposal options.

Response: TR_RAI-P&R-14(a)
Clarification and organization to new information on the topic of liquid disposal is described below in TR-RAI Table P&R-14.1. Revised text is also provided for TR Section 6.1.9 in TR_RAI-Response and Replacement Pages; Section 6.1.

TR-RAI Table P&R-14.1: Modifications and Clarification to Prior Submissions

Document	Section No.	Topic/original statement	Revised
Technical Report	3.1.5.2	Disposal of CPP brines by trucking to disposal well at Burns Wyoming	The offsite disposal of CPP brines is no longer being considered
	6.1.3	No section on Groundwater sweep was provided.	A new TR Section 6.1.3.2 on groundwater sweep is provided with a revised TR Section 6.1.3 in the response to TR-RAI-6.1-4.
		Use of Reverse Osmosis technology	RO will be utilized only with the deep well option.
	6.1.3.1	Class I Disposal wells	Class I injection well is no longer an option. Application has been made to US EPA for Class V deep disposal wells.
	6.1.6	Target disposal zone stated to be the Minnelusa formation	Both the Minnelusa Formation and the Deadwood Formations are target disposal zones
	6.1.9	Waste Water disposal methods	A revised TR section 6.1.9 is provided.

Supplemental Report (August, 2009)	4.2	Number of deep disposal wells stated to be two	A maximum of eight disposal wells will be utilized.
	4.2	Target disposal zone stated to be "the Minnelusa formation, or deeper."	Both the Minnelusa Formation and the Deadwood Formation are target disposal zones.
	Exhibit 3.1-3	Location of Disposal wells	Locations of the first four Class V wells are shown in Figure TR-RAI-P&R-13-1

(b) The applicant (upfront in Section 4.2) needs to clearly state the options being considered and their preference of use.

<u>Response: TR RAI-P&R-14(b)</u>
See TR_RAI-Response and Replacement Pages; Section P&R-14(b). Wastewater will be disposed by either injection in Class V wells or by land application. The preferred method of disposal is via Class V wells. The locations of the initial Class V wells are provided in Appendix WR-7 of the ER RAI Response. Prior to disposal, wastewater will have been treated with ion exchange to remove uranium and other metals, and treated with barium chloride to cause precipitation and removal of radium.

(c) The applicant needs to provide water balance diagrams for the Dewey and Burdock facilities during normal operation and during restoration.

<u>Response: TR RAI-P&R-14(c)</u>
The information requested can be found in TR_RAI Response and Replacement Pages; P&R-14(c) for water balance diagram in TR Section 3.1.5.

(d) The applicant needs to provide waste quality data tables and demonstrate the liquid waste will meet EPA Class V regulations as stated.

<u>Response: TR RAI-P&R-14(d)</u>
See TR_RAI-Response and Replacement Pages; Section P&R-14(d) for the provided liquid waste table

(e) The applicant needs to provide: (1) the results of the analyses to determine the targeted disposal zone; (2) the basis for reaching the conclusion of needing only one well at each site, including information on how the applicant will ensure backup storage capacity for liquid waste in the event that the deep wells need to be shut down for a short time (particularly for the option of deep well only); (3) the status of the application for the EPA Class V Permit; and (4) a discussion as to how it meets the requirements of 20.2002.

Response: TR_RAI-P&R-14(e)
1) Applicant directs reviewer's attention to the Appendix WR-7 "Class V Application", Section 2.H Operating Data; pg. 2-28. This document was submitted with the ER_RAI Response package to the Uranium Recovery Licensing Branch on August 11, 2010.

2) During development of the Class V application, it was determined that between four and eight disposal wells will be necessary to handle the volume of waste. During short term shutdowns, the additional capacity will be handled by the other wells in the disposal system.

3) The Class V Application was submitted to EPA on March 30, 2010. Jurisdiction for a Class V permit rests with EPA and the application was deemed complete on April 28, 2010. This subject was also addressed in ER_RAI Response to WR-7 and ER_RAI Response to PA-5.1 "ER Table 1.6.1: Permits and Licenses for the Proposed Project". See also ER_RAI Response to PA-5.2.

4) Powertech (USA) (USA) is not disposing of radioactive wastes via a Class V well.

(f) The applicant needs to provide the pond contingencies for project life extending beyond 10 years.

Response: TR_RAI-P&R-14(f)
See TR_RAI-Response and Replacement Pages; Section P&R-14(f) in TR Section 4.1 for revisions and additional information.

(g) The application does not clearly indicate the purpose of the central processing plant brine ponds, and why the sizes are different under the two disposal options.

Response: TR_RAI-P&R-14(g)
See TR_RAI-Response and Replacement Pages; Section P&R-14(g) for additional information.

(h) The applicant needs to provide impoundment construction specs for all these aspects and a description of the testing and inspection program during construction, including frequency of earthwork testing.

Response: TR_RAI-P&R-14(h)
See TR_RAI-Response and Replacement Pages; Section P&R-14(h) for the Dewey-Burdock Project Pond and Land Application Technical Specifications and QA/QC Plan.

(i) Information on inspection of the impoundment systems is insufficient.

- ***The applicant needs to provide a commitment for and details of the periodic inspection of all impoundment systems in accordance with Regulatory Guide 3.11.***
- ***The applicant should specify and provide the basis for selecting the indicator parameter(s) used to verify leaks.***

Response to TR RAI-P&R-14(i)

See TR_RAI-Response and Replacement Pages; Section P&R-14(i) for TR Section 3.1.6.1.1.

(j) The applicant needs to address the likelihood of, and measures for, preventing or containing a multiple tank failure such as might occur if one failed tank fell into an adjacent tank. Also provide information on the ability of the sump system to handle the volume of the largest spill from a hazardous materials source.

Response to TR RAI-P&R-14(j)

See TR_RAI-Response and Replacement Pages; Section P&R-14(j) for TR Section 5.7.1.3 additional information. Also refer to Response to ER_RAI PO-3 for more information concerning an accident analysis of a catastrophic tank failure involving the yellowcake thickener, included in NUREG/CR-6733 (Mackin, et al, 2001).

(k) The applicant needs to describe the controls for shut down of the deep well injection system

Response to TR RAI-P&R-14(k)

The reviewer is directed to Section 2.K. "Injection Procedures" of Appendix WR-7 "UIC application, Class V Non-Hazardous Injection Wells (March 2010)" located in the ER_RAI Response package submitted to the NRC in August of 2010.

TR RAI-P&R-15

The applicant has not identified where it will dispose of 11e. (2) wastes. The applicant needs to provide this information now, or the license will have a condition requiring verification of the solid waste disposal agreement prior to the start of operations.

Response: TR RAI-P&R-15

See TR Section 3.1.9. The applicant is unable to provide an approved waste disposal agreement for 11e. (2) byproduct material disposal with this response. The applicant acknowledges that without an approved 11e. (2) byproduct disposal agreement, the NRC will include a license condition requiring verification of an approved 11e. (2) byproduct disposal agreement at an NRC or NRC Agreement State licensed disposal facility.

TR RAI-P&R-16

Additional discussion of the land cleanup program needs to be provided.

(1) which areas would be focused on during the surveys (such as well field surfaces, areas around structures in process and storage areas, on-site transportation routes, historical spill areas, retention ponds, and areas near the deep disposal wells)

(2) Plans for decommissioning non-radiological hazardous constituents as required by 10 CFR Part 40, Appendix A, Criterion 6(7)

(3) The actual QAPP for radiological monitoring (including decommissioning), rather than just a commitment to include the aspects discussed in Regulatory Guide 8.15.

Response: TR RAI-P&R-16

(1) See TR_RAI Response Replacement Pages; P&R 16-1 for information concerning TR Section 6.4 "Methodologies for Conducting Post-Reclamation and Decommissioning Radiological Surveys".

(2) See TR_RAI Response Replacement Pages; P&R-16(2); also refer to 6.2 "Plans and Schedules for Reclaiming Disturbed Lands"

(3) The request for the Quality Assurance Program Plan ("actual QAPP") for radiological monitoring (including decommissioning), as written, appears to be in error as the reference, Regulatory Guide 8.15, titled, "Acceptable Programs for Respiratory Protection," is not relevant to the subject being addressed. However, the applicant suspects the intended reference is Regulatory Guide 4.15 (RG 4.15). For the purpose of this response, it is assumed that RG 4.15, titled, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment," is the intended reference. See also, TR_RAI Response Replacement Pages; Section 5.7.9 "Quality Assurance Program". Also see TR sections 4.2 "Liquid Waste" and 6.2 "Plans and Schedules for Reclaiming Disturbed Lands"

TR RAI-P&R-17

Section 6.3: The applicant needs to provide additional commitments in the section on removal and disposal of structures, waste materials, and equipment.

(1) to make plans for radioactivity measurements on the interior surfaces of pipes, drain lines, and ductwork by including plans to measure at all traps and other access points where contamination is likely to be representative of system-wide contamination.

(2) to assume that all premises, equipment, or scrap likely to be contaminated but that cannot be measured, would be assumed by the applicant to be contaminated in excess of limits and will treated accordingly.

Response: TR RAI-P&R-17

See TR_RAI Response Replacement Pages; P&R-17 for TR Section 6.3.3.1.

Response: TR RAI-P&R-2

TR Section 2.2.2 Land Use
And Exhibit 2.2-1

Expanded Description of Inventory of Significant Mineral and Energy Related Deposits and Activities Near the Dewey-Burdock Proposed Area of Activity

2.2 Uses of Adjacent Lands and Waters

2.2.1 General Setting

The PAA straddles the western county border between Custer and Fall River, South Dakota. Land within the project boundary is predominantly privately owned (97.5 percent) and the remaining 2.5 percent is managed by the Bureau of Land Management (BLM).

2.2.2 Land Use

Land use within the proposed project boundary primarily consists of agriculture related to grazing, as well as hunting and historical mining. A 2 km review area is not available for the project site because the four counties in the study area do not utilize zoning or land use plans outside of urban areas. There is no commercial crop production within the permit area, although approximately 388.79 acres of land are irrigated in Sec. 32, T 6S, R. 1E along Beaver Creek. The majority of agricultural production is related to grazing. Most land serves as grazing land for cattle that are sold as food, as well as a small number of horses.

An independent investigation of land use conducted by Powertech (USA) provided information concerning energy – related activities within the vicinity of the PAA depicted in Exhibit 2.2-1 and described below:

<u>Historical</u> - Forest Service and BLM oil and gas leases in the vicinity of the proposed project were located; however, Powertech (USA) was informed that the areas are not available for bid. Records were located for three plugged and abandoned oil/gas wells: API_ 40 047 20065 (P&A 12-26-1975), API_ 40 047 05095 (P&A 08-19-1964) and API_4004720071 (P&A 12-23-1976);

There was no historical, active or planned coal bed methane leases discovered within the vicinity of the PAA.

<u>Active</u> - Oil and gas wells located within the AOR but outside the PAA are depicted on Exhibit 2.2-1. The assumption was made that the wells described as Producer, Salt water disposal (SWD) and Converted to Water Well are active since no P&A records were found during the investigation. The main concentration of O&G wells are located approximately 4 miles west of the PAA.

<u>Proposed Future</u> - One known proposed project is the GCC Dacotah project. Currently there is no mineral production in the area. Six miles north east of the project boundary there is a possible limestone quarry for GCC Dakota, a cement manufacturing company. Commencement of this

project is approximately 10 years out. The GCC Dacotah project should have no effect upon the Dewey – Burdock proposed project as the GCC project boundary just crosses the most north and eastern boundary in section 20 resulting in minor overlap of the Powertech lease; there is no activity anticipated for this area concerning Powertech's ISL proposed project.

There is a landowners group that is exploring the possibility of a wind farm. Most of the landowners involved are also involved with the Powertech Dewey-Burdock Project, and therefore will not jeopardize the uranium project for the wind project Exhibit 2.2-1. Also the uranium deposits tend to be in the lower elevations in the area and the wind project if it were to develop would be using the ridges to get the best wind. The wind farm is still in the conceptual phase as of 04 August, 2010.

According to the United States Department of Agriculture's (USDA) 2002 census, Custer County generated $11,536,000 and Fall River County generated $49,003,000 from the selling of livestock, poultry and their products. The results from the 2007 Census will not be available until February 4, 2009. According to the National Agriculture Statistics Service, in 2008 the two counties had a combined total 78,000 head of cattle (No data was available for poultry, pig, or sheep inventories). Table 2.2-1 shows the 2008 livestock inventory for Custer and Fall River Counties.

Table 2.2-1: 2008 Livestock Inventory for Custer and Fall River Counties

Type of Livestock	Number Custer County	Number Fall River County	Percent of Total (Custer and Fall River combined)
Beef Cows	17,000	45,000	22/58%
All Cattle and Calves – excluding Beef Cows	1,000	15,000	1/19%
Sheep and Lamb	N/A	N/A	N/A
Hogs and Pigs	N/A	N/A	N/A
Total Animals	18,000	60,000	100%

Source: USDA, 2008.

Recreation lands are present in Custer, Fall River and Pennington counties within a 50-mile radius of the PAA (Table 2.2-2). Major attractions include Mount Rushmore National Memorial and Wind Cave National Park which are set in the backdrop of the Black Hill National Forest.

POWERTECH (USA) INC.

Response: TR RAI-P&R-3

TR Section 2.6.6.1.1

Additional Information Concerning the

Seismic Event North of Dewey, South Dakota

The U.S. Geological Survey Earthquake Database reports locations, times, and magnitudes for epicenters recorded since 1973. The database reports a total of 10 earthquakes with Richter magnitudes ranging from 2.3 to 3.7 within 100 km radius of the site (Appendix 2.6-G). This list includes epicenters in Wyoming and Nebraska.

2.6.6.1.1.1 Seismic Event North of Dewey, South Dakota

The list provided in Appendix 2.6-G contains date of the event in question, other information included within the list are the origin time, latitude and longitude and the magnitude of this quake. The quake in question occurred 8.5 miles from the center of the Dewey-Burdock property and occurred on 05 January, 2004 at a reported 2.8 Richter Scale magnitude or modified Mercalli intensity of I (South Dakota Geologic Survey Map "Earthquakes in South Dakota, 1872 – 2007" and South Dakota Department of Environment & Natural Resources, www.sdgs.usd.edu/other/faq.html. Accessed on 03 August, 2010; page updated on 29 October, 2009).

The closest historical earthquake to the project site (unknown magnitude) was recorded on May 16, 1975 approximately 19 km (12 miles) southeast of the site. The most recent earthquake recorded in the entire state of South Dakota took place on February 7, 2007, 35 miles east of Rapid City (approximately 80 miles northeast of the project site) and displayed a magnitude of 3.1.

According to the U.S. Geological Survey Earthquake Database (Appendix 2.6-G), two historical earthquakes, each exhibiting a magnitude of 3.7, represent the largest historical events recorded within 100 km (62 miles) of the project. These events occurred on February 6, 1996, and April 9, 1996, and were located 76 km (47 miles) to the north and 30 km (19 miles) to the southwest of the site, respectively. If the search radius was expanded to 200 km (124 miles), an earthquake with magnitude 5.50 occurring on October 18, 1984 approximately 180 km (112 miles) to the southwest of the site is the largest magnitude event near the site.

A zone of higher earthquake frequency is recorded along the eastern flank of the Black Hills (structural deformation also seems to be concentrated on the eastern flank; Geological Survey of South Dakota, 2004) and in the southwest corner of South Dakota (Figure 2.6-3). In addition, the PGA maps (USGS, 2002) of the area display an increase in ground motion to the west and southwest part of the state (Figures 2.6-4 and 2.6-5). Earthquakes may be concentrating along or near the boundaries of structural provinces (e.g. Black Hills and Missouri Plateau, or Missouri Plateau and High Plains) in the Precambrian, crystalline basement. Two possible faulting mechanisms may be at work: 1) initiation of movement along preexisting fractures due to crustal plate movements; or 2) fault movement and fracturing due to glacial rebound (South Dakota Department of Emergency Management website).

According to the U.S. Geological Survey's 2002 Seismic Hazard Mapping Program, the peak ground acceleration (PGA) derived from the probabilistic maximum bedrock acceleration with a 10 percent exceedance in 50 years (475-year return period) is 0.03g (Figure 2.6-4) for the southwestern part of South Dakota. The probabilistic maximum bedrock acceleration with a 2 percent chance of exceedance in 50 years (2,475-year return period) is 0.09g for the region (Figure 2.6-5).

POWERTECH (USA) INC.

Response: TR RAI-P&R-7

Boggs, J. M., (1983). "Hydrogeologic Investigations at Proposed Uranium Mine Near Dewey, South Dakota," Report No. WR28-2-520-109, Norris, Tennessee, October.

POWERTECH (USA) INC.

Response: TR RAI-P&R-10

Well Information for the 133 Wells within the AOR and PAA of the Dewey-Burdock Proposed Project

TR_RAI-P&R-10 Table: Well Information for the 133 Wells within the AOR and PAA of the Dewey-Burdock Proposed Project

HydroID	SD_St_NAD27_X	SD_St_NAD27_Y	Aquifer	Well Use	Status
40	1013415.346	447182.479	Inyan Kara	Domestic	NIU
703	1041621.331	434333.8466	Sundance	Domestic	NIU
7	1033303.803	422416.5989	Fall River	Domestic	IU
2	1026723.769	423922.3154	Lakota	Domestic	IU
18	1022811.793	428959.767	Fall River	Domestic	IU
13	1028359.948	438469.8485	Lakota	Domestic	IU
4002	1013414.27	446931.4894	Inyan Kara	Domestic	IU
96	1011629.945	451853.2213	Lakota	Domestic	IU
115	1017697.249	457640.2935	Lakota	Domestic	IU
107	1017018.156	458158.0845	Fall River	Domestic	IU
138	1017537.353	459030.1485	Fall River	Domestic	IU
109	1020800.761	459624.8194	Lakota	Domestic	IU
43	1031122.687	439435.6473	Lakota	Domestic	NIU
704	1020965.765	436647.1385	Inyan Kara	Domestic and stock	IU
638	1038269.039	437976.1978	Fall River	Monitor	NIU
658	1031234.092	426398.134	Lakota	Monitor	TBD
646	1031247.543	426408.5951	Fall River	Monitor	TBD
694	1028717.157	426835.7392	Fall River	Monitor	TBD
696	1028687.291	426946.1107	Lakota	Monitor	TBD
672	1030632.075	427480.0017	Fall River	Monitor	TBD
673	1030628.398	427511.2578	Fuson Shale	Monitor	TBD
674	1030554.854	427513.0965	Lakota	Monitor	TBD
671	1031016.371	427870.059	Fall River	Monitor	TBD
669	1031005.354	427909.7202	Lakota	Monitor	TBD
670	1031064.845	427936.1609	Fuson Shale	Monitor	TBD
664	1030634.318	428337.8486	Fall River	Monitor	TBD
663	1030658.63	428345.6136	Lakota	Monitor	TBD
605	1031814.362	428483.6888	Inyan Kara	Monitor	TBD
666	1033128.336	428870.4223	Lakota	Monitor	TBD
665	1033153.033	428901.2936	Fall River	Monitor	TBD
662	1035381.452	428928.0354	Unknown	Monitor	TBD
684	1035187.894	429745.4246	Lakota	Monitor	TBD
686	1034966.394	429751.4249	Lakota	Monitor	TBD
690	1035113.145	429970.666	Sundance	Monitor	TBD
688	1035026.789	429974.0291	Fall River	Monitor	TBD
692	1035067.878	429999.1042	Lakota	Monitor	TBD
637	1038074.885	430320.1736	Unknown	Monitor	TBD
660	1031822.021	431029.7556	Lakota	Monitor	TBD
659	1031875.51	431048.4765	Fall River	Monitor	TBD
682	1035136.439	431259.1665	Lakota	Monitor	TBD
678	1026522.329	431925.2786	Alluvium	Monitor	TBD

P&A=Plugged and Abandoned
IU=in use
NIU= not in use
TBD=to be determined

TR_RAI-P&R-10 Table: Well Information for the 133 Wells within the AOR and PAA of the Dewey-Burdock Proposed Project

661	1040976.531	431970.3561	Lakota	Monitor	TBD
3026	1043638.22	432832.7602	Lakota	Monitor	TBD
677	1023526.745	434076.7574	Alluvium	Monitor	TBD
698	1035908.712	435650.5539	Fall River	Monitor	TBD
695	1022384.64	439311.9302	Fall River	Monitor	TBD
697	1022349.64	439346.7801	Lakota	Monitor	TBD
676	1030846.054	439891.0583	Alluvium	Monitor	TBD
685	1020686.735	443414.7441	Fall River	Monitor	TBD
693	1020328.587	443666.5417	Sundance	Monitor	TBD
691	1020366.063	443706.2157	Fall River	Monitor	TBD
687	1020077.667	443729.9234	Fall River	Monitor	TBD
689	1020316.258	443788.5193	Lakota	Monitor	TBD
683	1020209.145	446107.3078	Fall River	Monitor	TBD
679	1032294.334	446244.7314	Alluvium	Monitor	TBD
609	1021734.534	447807.5724	Lakota	Monitor	TBD
610	1021599.254	447968.8198	Fall River	Monitor	TBD
616	1022135.266	453141.2578	Lakota	Monitor	TBD
617	1021028.704	453585.733	Lakota	Monitor	TBD
615	1022172.181	453707.9837	Lakota	Monitor	TBD
614	1022185.009	453769.2626	Fuson Shale	Monitor	TBD
613	1022124.551	453774.8997	Fall River	Monitor	TBD
622	1022775.699	454032.8728	Fall River	Monitor	TBD
612	1021757.108	454133.3505	Lakota	Monitor	TBD
623	1022669.277	454299.4787	Lakota	Monitor	TBD
436	1021602.832	454435.6334	Fall River	Monitor	TBD
657	1021636.936	454497.111	Lakota	Monitor	TBD
147	1020878.663	456566.2851	Lakota	Monitor	TBD
653	1030679.378	422486.796	Unknown	P & A	NIU
639	1045704.084	430721.5882	Unknown	P & A	NIU
652	1036359.683	434742.1525	Inyan Kara	P & A	NIU
655	1033453.837	443306.7453	Inyan Kara	P & A	NIU
654	1032371.943	443409.5899	Inyan Kara	P & A	NIU
502	1031989.61	446360.3538	Alluvium	P & A	NIU
621	1031930.296	446397.4054	Alluvium	P & A	NIU
634	1032501.551	440167.6868	Unknown	P & A	NIU
636	1034774.226	429981.9127	Unknown	P & A	NIU
10	1043556.444	427238.672	Lakota	P & A	NIU
39	1022915.677	448655.9078	Unknown	P & A	NIU
429	1023157.091	452952.7101	Lakota	P & A	NIU
431	1023157.091	452952.7101	Lakota	P & A	NIU
432	1023157.091	452952.7101	Lakota	P & A	NIU
433	1023157.091	452952.7101	Lakota	P & A	NIU

P&A=Plugged and Abandoned
IU=in use
NIU= not in use
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TR_RAI-P&R-10 Table: Well Information for the 133 Wells within the AOR and PAA of the Dewey-Burdock Proposed Project

668	1031029.213	427449.9686	Inyan Kara	Pump test	TBD
680	1035077.56	429968.6768	Lakota	Pump test	TBD
681	1020329.599	443724.6609	Fall River	Pump test	TBD
611	1021836.764	453957.9874	Lakota	Pump test	TBD
645	1027681.088	427998.0455	Unknown	Stock	NIU
606	1033712.842	428608.9489	Lakota	Stock	NIU
113	1046436.631	434416.8886	Unknown	Stock	NIU
41	1015385.104	442080.7853	Alluvium	Stock	NIU
640	1043010.319	427964.7101	Unknown	Stock	NIU
15	1035303.954	438316.8522	Lakota	Stock	NIU
116	1017991.613	458110.9714	Fall River	Stock	NIU
14	1033699.73	434722.9153	Lakota	Stock	NIU
3	1028593.377	421103.6661	Lakota	Stock	IU
9	1038003.452	421805.5831	Fall River	Stock	IU
7002	1033332.5	421930.5611	Lakota	Stock	IU
4	1032516.055	423080.3468	Unknown	Stock	IU
37	1044182.561	423947.2124	Unknown	Stock	IU
6	1037217.863	425012.1651	Unknown	Stock	IU
425	1034449.302	426207.5928	Lakota	Stock	IU
635	1035685.599	427130.4808	Sundance	Stock	IU
5	1035181.406	427283.8659	Lakota	Stock	IU
642	1042925.942	428041.6327	Unknown	Stock	IU
510	1042932.763	428177.7818	Lakota	Stock	IU
114	1045410.431	428653.5014	Sundance	Stock	IU
1	1027696.216	429227.3992	Lakota	Stock	IU
61	1036831.791	429987.0296	Lakota	Stock	IU
506	1050129	430703.6952	Sundance	Stock	IU
17	1040223.165	431328.716	Fall River	Stock	IU
51	1027411.447	431486.5373	Lakota	Stock	IU
650	1043939.546	433014.3542	Lakota	Stock	IU
12	1026977.915	434378.0457	Lakota	Stock	IU
16	1041428.464	434446.4	Lakota	Stock	IU
618	1038073.632	435906.2372	Unknown	Stock	IU
42	1021144.124	436480.8961	Fall River	Stock	IU
619	1034866.071	436728.841	Lakota	Stock	IU
656	1014229.658	442000.2759	Unknown	Stock	IU
38	1024328.053	442288.97	Lakota	Stock	IU
620	1033951.267	443209.4505	Lakota	Stock	IU
49	1018931.904	444022.1394	Fall River	Stock	IU
631	1034334.926	448992.4622	Fall River	Stock	IU
628	1022654.12	449401.8714	Inyan Kara	Stock	IU
270	1014108.25	451942.4937	Inyan Kara	Stock	IU

P&A=Plugged and Abandoned
IU=in use
NIU= not in use
TBD=to be determined

TR_RAI-P&R-10 Table: Well Information for the 133 Wells within the AOR and PAA of the Dewey-Burdock Proposed Project

220	1017872.434	452334.36	Unknown	Stock	IU
48	1015294.765	453036.5831	Lakota	Stock	IU
112	1027864.205	455880.8369	Fall River	Stock	IU
111	1022074.496	459586.2253	Fall River	Stock	IU
106	1018098.899	459624.8113	Unknown	Stock	IU
110	1023777.247	459643.0909	Lakota	Stock	IU
651	1036008.74	424245.848	Lakota	Stock	NIU
117	1022177.422	460795.629	Unknown	Stock and garden	IU

P&A=Plugged and Abandoned
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WR28-2-520-128

HYDROGEOLOGIC INVESTIGATIONS AT PROPOSED URANIUM MINE NEAR DEWEY, SOUTH DAKOTA

TENNESSEE VALLEY AUTHORITY
OFFICE OF NATURAL RESOURCES
DIVISION OF AIR AND WATER RESOURCES
WATER SYSTEMS DEVELOPMENT BRANCH
NORRIS, TENNESSEE

Tennessee Valley Authority
Office of Natural Resources
Division of Air and Water Resources
Water Systems Development Branch

HYDROGEOLOGIC INVESTIGATIONS AT PROPOSED URANIUM MINE NEAR DEWEY, SOUTH DAKOTA

Report No. WR28-2-520-128

Prepared by
J. Mark Boggs

Norris, Tennessee
October 1983

ABSTRACT

The Lakota and Fall River Formations represent aquifers of major importance in the Southern Black Hills Region as well as host rock for uranium ore. An 11-day constant discharge test involving 13 observation wells and numerous private wells was conducted in the Lakota aquifer at TVA's proposed uranium mine near Dewey, South Dakota. The pumping phase of the test was followed by several months of water-level recovery measurements. Results indicate that the test site is located in an area where the Lakota is exceptionally permeable having a transmissivity of 4,400 gpd/ft and a storativity of about 1×10^{-4}. Outside of this locality the Lakota transmissivity decreases substantially due to aquifer thinning and a change to finer-grained sedimentary facies. The drawdown response in the Fall River aquifer was substantially less than that observed during a similar test conducted at TVA's proposed Burdock mine, indicating that the Fuson shale unit lying between the two aquifers is a more effective aquitard in the Dewey area. It is further concluded that the nearby Dewey fault acts as a barrier to horizontal ground-water movement in the Lakota and Fall River aquifers.

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FIGURES

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INTRODUCTION

The following report describes a hydrogeologic test conducted February 1982 at TVA's proposed uranium mine shaft site near Dewey, South Dakota (Figure 1). The Dewey test is one of a series of tests TVA has conducted in aquifer units of the Inyan Kara Group in the southwestern Black Hills area. The purpose of these tests is to obtain sufficient quantitative information about local hydrogeologic conditions to enable prediction of mine depressurization requirements and impacts to local ground-water users.

HYDROGEOLOGIC ENVIRONMENT

The principal aquifers in the region are the alluvial deposits associated with the Cheyenne River and its major tributaries, the Fall River formation, the Lakota formation, the Sundance formation, and the Pahasapa (or Madison) formation. Except for the alluvium, these aquifers crop out peripherally to the Black Hills where they receive recharge from precipitation. Ground-water movement is in the direction of dip, radially from the central Black Hills. In most instances, ground water in these aquifers is under artesian conditions away from the outcrop area, and water flows at ground surface from numerous wells in the area.

The Fall River and Lakota formations which form the Inyan Kara Group are the most widely used aquifers in the region. The alluvium is used locally as a source of domestic and stock water. The Sundance formation is used near its outcrop area in central and northwestern Fall River County. The Pahasapa (Madison) formation is locally accessible only by very deep wells and is the source for five wells in the city of Edgemont.

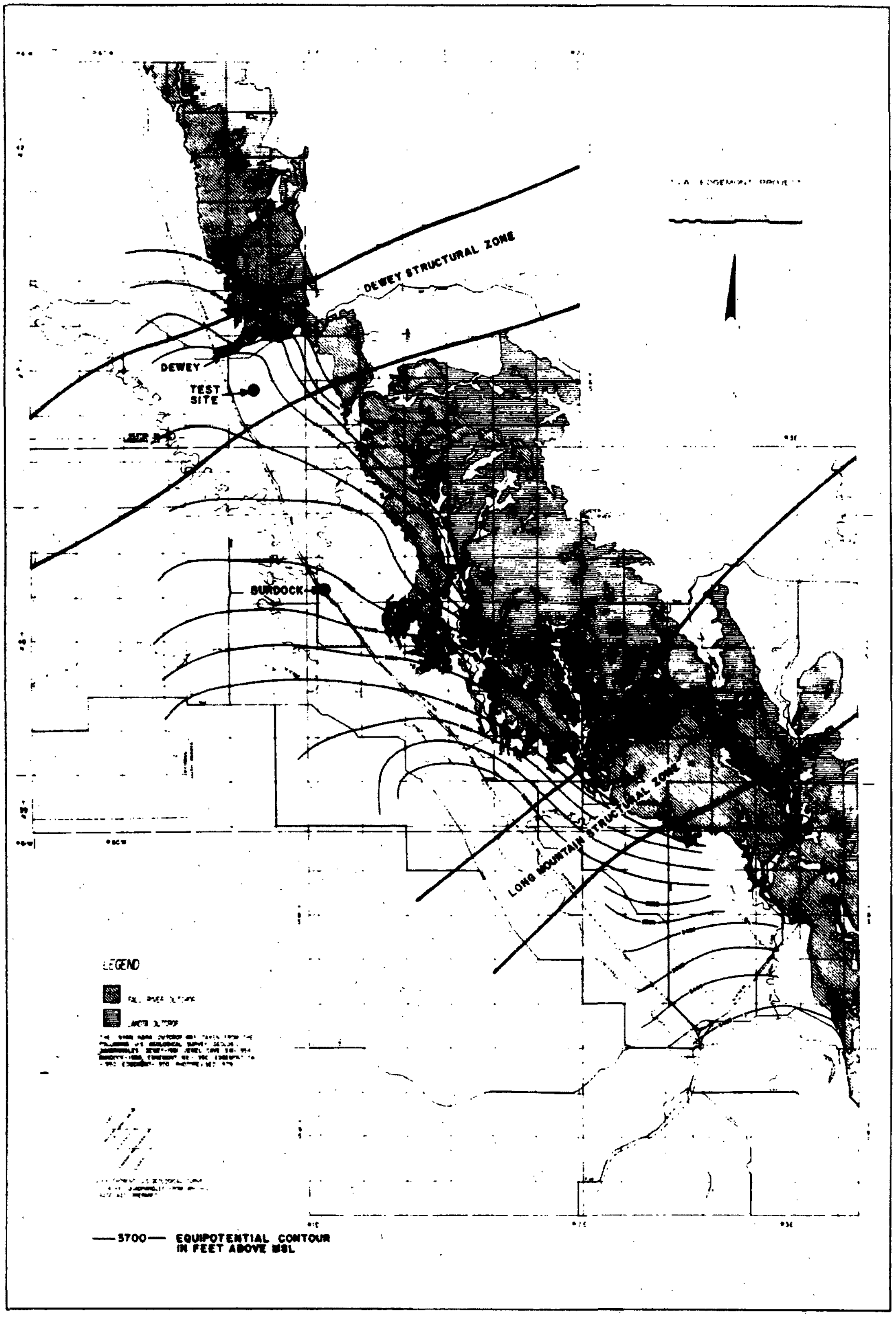

Figure 1: Site Location and Potentiometric Surface Map

The Fall River and Lakota aquifers are of primary concern because of the potential impact of mine dewatering on the numerous wells developed in these aquifers in the vicinity of the mine. At the proposed mine site, the Fall River consists of approximately 180 feet of interbedded fine-grained sandstone, siltstone and carbonaceous shale. The Fall River aquifer is overlain by approximately 400 feet of the Mowry and Skull Creek shales unit, which act as confining beds. Five domestic and stock-watering wells are known to be developed in the Fall River formation within a four-mile radius of the mine site.

The Fall River formation is underlain by Fuson member of the Lakota formation consisting primarily of siltstone and shale with occasional fine-grained sandstone lenses. Thickness of the Fuson is on the order of 100 feet in the site vicinity. The Fuson acts as a leaky aquitard between the Fall River and Lakota aquifers.

The Chilson member of the Lakota formation is the source for some 30 wells within a four-mile radius of the mine site. It also represents the primary uranium-bearing unit targeted for mining. The Chilson (also referred to as the "Lakota aquifer" in this report) consists of about 120 feet of consolidated to semi-consolidated, fine-to-coarse grained sandstone with interbedded siltstone and shale. It is underlain by the Morrison formation consisting of interbedded shale and fine-grained sandstone. Regionally, the Morrison is not considered an aquifer. Under conditions of ground-water withdrawal from the Chilson, the Morrison is expected to act as an aquitard.

Recharge to the Fall River and Lakota aquifers is believed to occur at their outcrop areas. Gott, et al. (1974), suggest on the basis of geochemical data that recharge to these aquifers may also be derived from the upward movement of ground water along solution collapses and breccia pipes from the deeper Minnelusa and Pahasapa aquifers. The solution collapse and breccia pipe features lie within the Dewey and Long Mountain structural zones (Figure 1).

Inasmuch as the proposed mine site lies only about one mile south of the Dewey fault trace, one of the primary objectives of the test was to determine the hydrologic significance of the fault and its affect on the propagation of drawdown in the vicinity of the mine during depressurization. Vertical displacement on the major fault generally increases toward the southwest, and is on the order of 200 feet at the point where the fault trace crosses the South Dakota-Wyoming border. Thus, it appears that the Fall River and Lakota aquifers are completely offset by the fault in the site vicinity.

LAKOTA AQUIFER TEST

Design

The shaft site for the Dewey mining area had not been selected at the time the aquifer testing designs were made. The test site was, therefore, located in the general vicinity of the proposed mine site within close proximity to the Dewey fault. The test well was completed to a depth of 804 feet and was screened within the Chilson member of the Lakota Formation. A network of eleven observation wells were constructed along two perpendicular lines intersecting at the pumped well for the purpose investigating hydrologic boundary conditions. One line of wells was oriented normal to the Dewey fault trace, and the other was approximately normal to the aquifer outcrop belt to the east (see Figure 2). Seven of these wells were developed in the Chilson member, three in the Fall River formation,

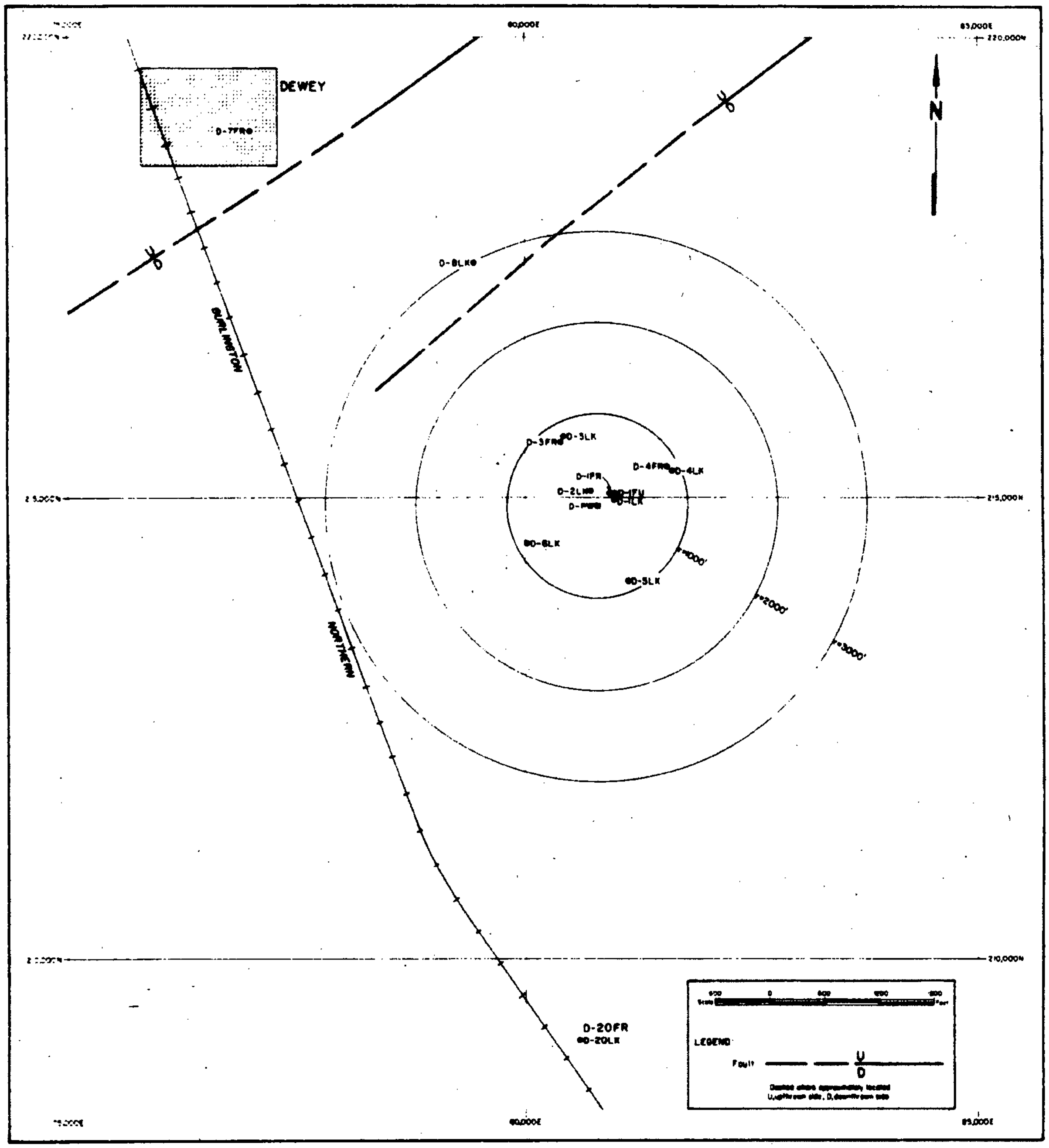

Figure 2: Well Location Map

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and one in the Fuson. Preexisting observation wells BPZ-20LAK and BPZ-20FR (hereafter referred to as D-20LK and D-20FR, respectively) located about one mile south of the test well were also monitored during the test. Construction details for these wells are given in Table 1. In addition, periodic measurements of water level (or well flowrate) were made during the test at all private wells within the test site vicinity.

Based upon preliminary drilling results in the Dewey test site area and experience from the Burdock aquifer tests, it was expected that the Fall River and Lakota aquifers in the Dewey area would respond essentially as a single aquifer system. As a result less emphasis was placed on measurement of the Fuson aquitard properties.

Procedures

A constant-discharge aquifer test was initiated at 1000 hours on February 16, 1982. Discharge from the well was pumped into an arroyo which ultimately drained into a stock pond located about one mile west of the test site. There was no possibility of recirculation of well discharge water during the test due to the 400+ feet thickness of shale between ground surface and the top of the Fall River aquifer. The well pumping rate was monitored with an in-line flow meter and with an orifice plate and manometer device at the end of the discharge line. The pumping rate varied little during the test ranging from 493 to 503 gpm and averaging 495 gpm. The pumping phase of the test lasted 11 days and was followed by approximately 10 months of recovery measurements. Water level measurements in all wells were made with electric probes. Flow rates associated with offsite private wells were checked with a bucket and stop watch.

TABLE 1. Well Construction Data

Well No.	Depth (feet)	Casing Diameter (inches)	Depth Interval of Open Borehole or Well Screen (feet)	Distance From Pumped Well (feet)
D-PW	804	10	695-725, 755-800	--
D-1LK	800	4	712-800	189
D-1FU	620	4	609-620	229
D-1FR	580	4	504-580	186
D-2LK	800	4	692-800	191
D-3LK	800	4	715-800	851
D-3FR	590	4	505-590	810
D-4LK	780	4	714-780	905
D-4FR	580	4	503-580	879
D-5LK	835	4	735-835	872
D-6LK	810	4	715-810	890
D-7FR	120	4	119-120	5610
D-8LK	750	4	650-750	2785
D-20LK	860	4	798-860	5700
D-20FR	672	1	671-672	5700

Analysis

Semilogarithmic graphs of drawdown (s) versus time (t) for the pumped well and observation wells are given in Appendix A. The drawdown trends in wells D-PW, D-1LK and D-2LK are essentially the same, i.e., there is a period of roughly linear drawdown during the first 1000 minutes of the test, followed by a gradual increase in the rate of drawdown during the remainder of the test. The remaining Lakota wells exhibit s-t curves which have a continuous increase in slope throughout the test without stabilizing to a linear drawdown trend. A slight increase in hydrostatic water level was observed during the early period of the test in the Fall River and Fuson wells. This seemingly paradoxical behavior, known as the Noordbergum effect, is due to a transfer of stress from the pumped aquifer to the adjacent aquitards and aquifers (Gambolati, 1974). Drawdowns observed in the Fall River and Fuson wells were much less than those recorded during a similar test conducted near Burdock (Boggs and Jenkins, 1980). The Jacob straight-line method (Walton, 1970) was applied to the semilog graphs for the Lakota wells to obtain the values of transmissivity (T) and storativity (S) presented in Table 2. In the case of the closer observation wells, two straight-line data fits were possible: one using the early data and another using the late data. Only the late data for the more distant observation wells were analyzed by this method.

Logarithmic s-t graphs for all test wells are given in Appendix B. Theis curve-matching techniques (Walton, 1970) were applied to the Lakota aquifer curves to obtain the T and S estimates presented in Table 2. Due to the somewhat unusual shape of the s-t response curves, the only curve-match solutions possible were those using the early data.

TABLE 2. Computed Lakota Aquifer Properties

Well	r (ft)	Jacob Method: Drawdown T_e	Jacob Method: Drawdown S_e	Jacob Method: Drawdown T_1	Jacob Method: Recovery T_e	Jacob Method: Recovery T_1	Theis Method T_e	Theis Method S_e
D-PW	0.67	4400	--	890	4890	680	--	--
D-1LK	189	5280	3.E-05	890	4890	650	5210	3.E-05
D-2LK	191	4400	3.E-04	910	4710	650	4090	2.E-04
D-3LK	851	--	--	920	--	670	6900	7.E-05
D-4LK	905	--	--	900	--	680	4090	8.E-05
D-5LK	872	--	--	900	--	670	4410	7.E-05
D-6LK	890	--	--	900	--	650	6030	8.E-05
D-8LK	2785	--	--	940	--	680	3180	5.E-05
D-20LK	5700	--	--	--	--	680	1400	3.E-05

Note: Transmissivity (T_e, T_1) in units of gpd/ft.

A semilog plot of the final drawdown in each Lakota well versus its radial distance from the pumped well is shown in Figure 3. The Jacob straight-line method was applied to this plot to obtain T and S values of 4400 gpd/ft and 10^{-6}, respectively, for the Lakota aquifer. The storativity value computed by this method is considered highly unreliable since it is two orders of magnitude lower than expected.

Water level recovery data for all wells are presented in Appendix C. Data are plotted as semilog graphs of residual drawdown versus t/t' (ratio of time since pumping started to time since pumping stopped). The Lakota graphs were analyzed using the Jacob method. Again, two straight-line fits are possible for the closer Lakota wells. Both are given in Table 2.

Fuson aquitard properties were estimated from the D-1 well group data using the ratio method (Neuman and Witherspoon, 1973). The vertical hydraulic conductivity of the aquitard (K'_v) is computed to be approximately $2x10^{-4}$ ft/d based on the average of several computed K'_v during the interval between 1800 and 5000 minutes. For purposes of the analysis, the specific storativity (S'_s) of the aquitard was assumed to be approximately equal to that computed for the Lakota aquifer (about $7x10^{-7}$ ft^{-1}).

Interpretation

The T estimates obtained from all methods using the early drawdown and recovery data are in reasonably good agreement. Values range from 3180 to 6900 gpd/ft and average approximately 4800 gpd/ft. The T of 4400 gpd/ft derived from the distance drawdown analysis is also consistent with the early T estimates. These values are believed to represent the transmissivity of the Lakota aquifer within the immediate vicinity of the test

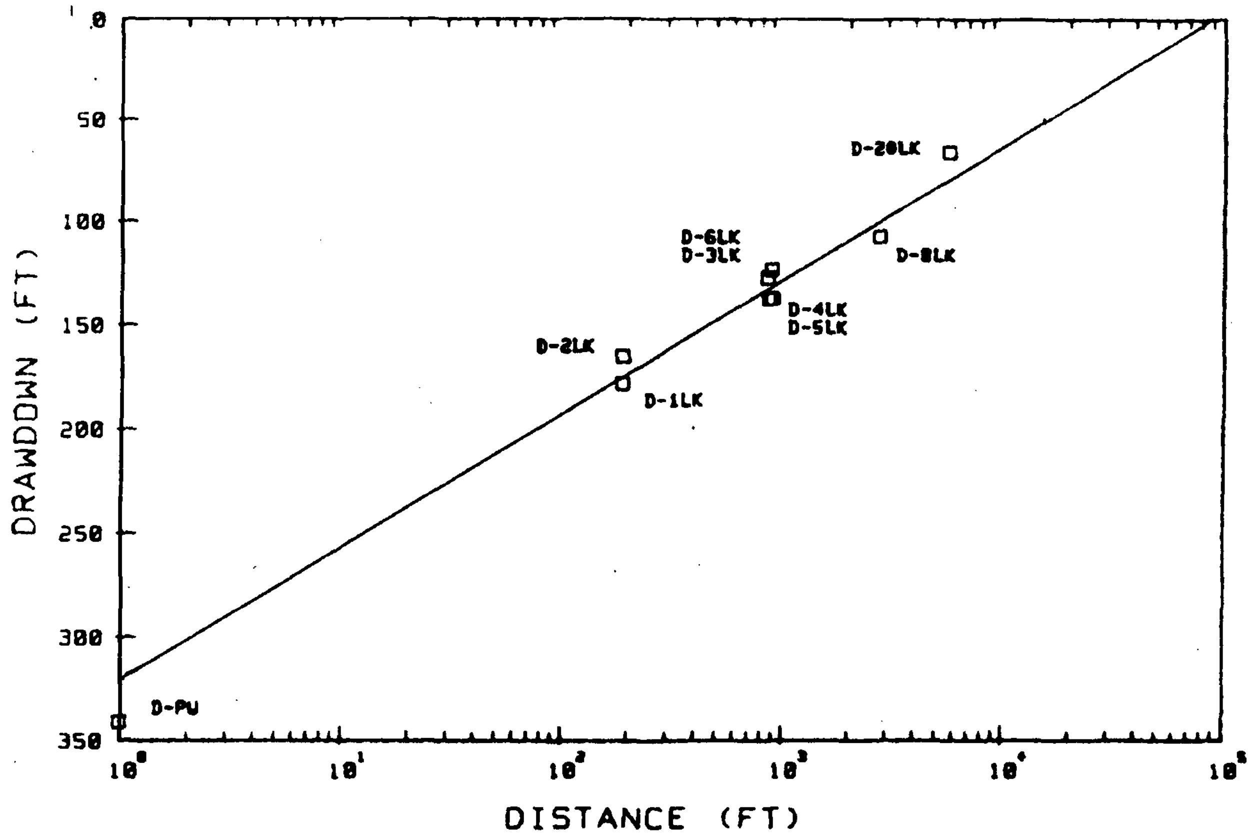


FIGURE 3. DISTANCE-DRAWDOWN GRAPH

site, and are consistent with the physical characteristics of the aquifer materials within this area. The T values computed from the late drawdown data, although consistent from well to well, are not reliable since the rate of drawdown during the later stage of the test never stabilized to the linear or ideal Theis-curve trend. The late recovery data provide the best estimates of the regional or long-term transmissivity of the Lakota aquifer in the Dewey region because of the long duration of this phase of the test.

In general, drawdown response in the pumped well and closer observation wells is characterized by a period of approximately linear drawdown during the first 1000 minutes of the test, followed by a steadily increasing rate of drawdown until the end of the test. The recovery data reflects the same sort of trend. The late response may be interpreted as either the effect of barrier boundary conditions or a decrease in transmissivity with distance from the test site or both.

Most of the available hydrogeologic information indicates that the Dewey fault acts as a barrier to horizontal ground-water movement in the Inyan Kara aquifers. Vertical displacement along the Dewey fault is on the order of 200 feet in the test site vicinity causing the complete separation of the Lakota aquifer on either side of the fault. Despite the geochemical evidence of Gott, et al. (1974), that the fault may act as conduit for upward circulation of ground water from deeper aquifers to the Inyan Kara Group, a recharge condition is not reflected in the potentiometric surface configuration in the fault zone (Figure 1) or in the test results. A reduction in the rate of drawdown would be expected in the s-t graphs for observation wells closest to the fault if significant recharge occurred in the fault zone. Instead the opposite response is observed in the test data. The s-t curve for well D-8LK (the closest observation well to the fault) exhibits the steepest slope during the late stage of the test, supporting the idea that the fault is a hydrogeologic barrier. Upward recharge may occur in the fault zone but at relatively low rates. Consequently, the fault does not behave as a recharge boundary.

<u>Computer Simulations</u>

A computer ground-water model of the Dewey region was developed to aid in interpreting the test results and refining aquifer parameters. A three-dimensional ground-water flow code developed by Trescott (1975) was used for the simulations. The Inyan Kara is conceptualized as a three-layer aquifer system consisting of the Lakota (Chilson) aquifer, the Fuson aquitard and the Fall River aquifer, with model layers having uniform thicknesses of 120, 100, and 180 feet, respectively. Impervious boundaries are set above the Fall River layer and below the Lakota layer to represent the relatively impermeable shales which bound the Inyan Kara Group. The model area and finite-difference grid are shown in Figure 4. The outcrop area of the Inyan Kara represents the eastern limit of the modeled region. The remaining three sides of the model are set at sufficient distances from the test pumping well to eliminate the possibility of artificial boundary effects in model simulations. The Dewey fault zone was treated as a barrier boundary.

Simulations were made using two basic conceptual models of the Inyan Kara aquifer system to determine which model best represented observed responses during the Dewey test. For case I, uniform T and S values of 4,400 gpd/ft and 1×10^{-4}, respectively were assigned to the Lakota aquifer. A uniform T was used for this case despite evidence of a much lower transmissivity outside of the immediate test site in order to determine

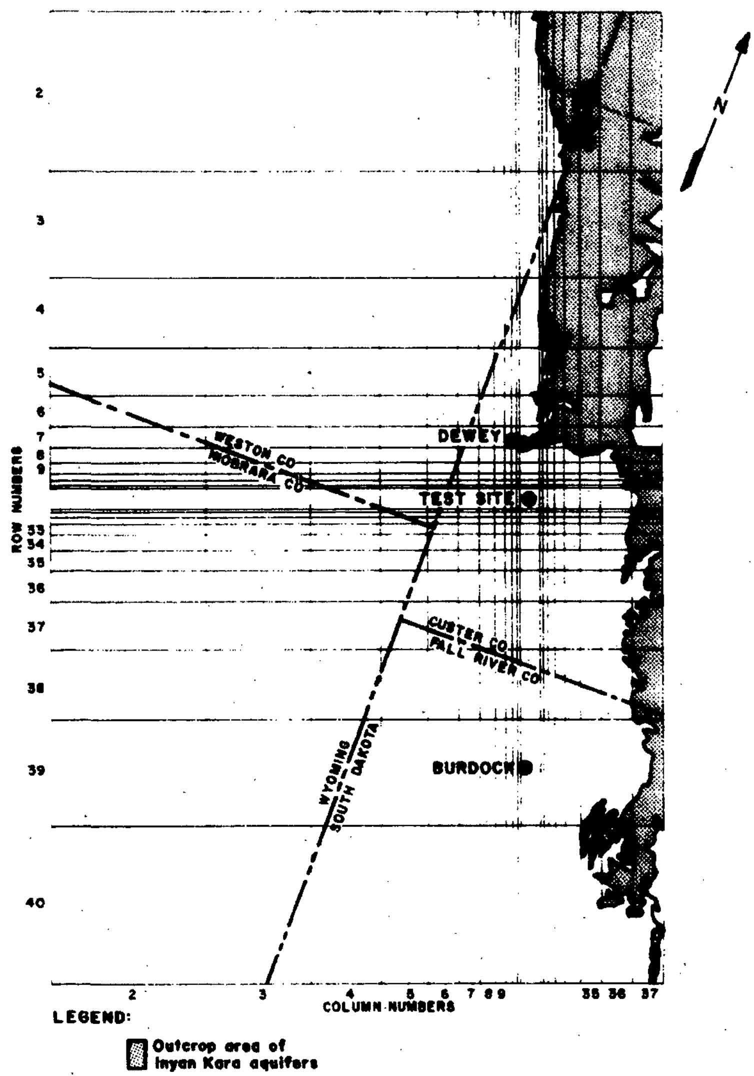


Figure 4: Ground-Water Model Grid

whether the fault alone could account for late drawdown trends. The Fuson aquitard was assigned a uniform K'_v of 10^{-4} ft/d. The Fall River aquifer was represented by uniform T and S values of 400 gpd/ft and 10^{-4} respectively, based on the results of the Burdock tests (Boggs and Jenkins, 1980). A simulation was then made of the 11-day Dewey aquifer test using the average pumping rate of 495 gpm in an attempt to reproduce the test results. A comparison of computed and observed s-t graphs for the Lakota observation wells is shown in Figure 5. Clearly, the barrier boundary condition created by the fault does not fully account for the observed increase in drawdown rate during the latter part of the test.

In Case II, the model was modified to account for the suspected spatial variability of transmissivity in the Lakota aquifer. Geologic evidence indicates that the test site is located in an area where the Lakota is composed of an exceptionally thick course-grained sandstone. Outside of this locality the aquifer becomes thinner and its composition changes to finer-grained sedimentary facies. These changes are particularly evident in the area east of the site. The test results indicate a local T in the immediate site area of about 4,400 gpd/ft and a regional average of about 670 gpd/ft. These T estimates were used along with areal variations in the sandstone-shale composition of the Lakota aquifer in the site vicinity to arrive at the T distribution shown in Figure 6. Exploration borehole geophysical logs were used to estimate the relative amounts of sandstone and shale in the Lakota across the site area. The horizontal hydraulic conductivity of the sandstone is estimated at approximately 5.7×10^{-5} ft/sec based upon the near-field T estimate of 4,400 gpd/ft, an aquifer thickness of 120 feet, and the assumption that the aquifer in the immediate vicinity of the test well and closest observation wells is essentially all sandstone. The

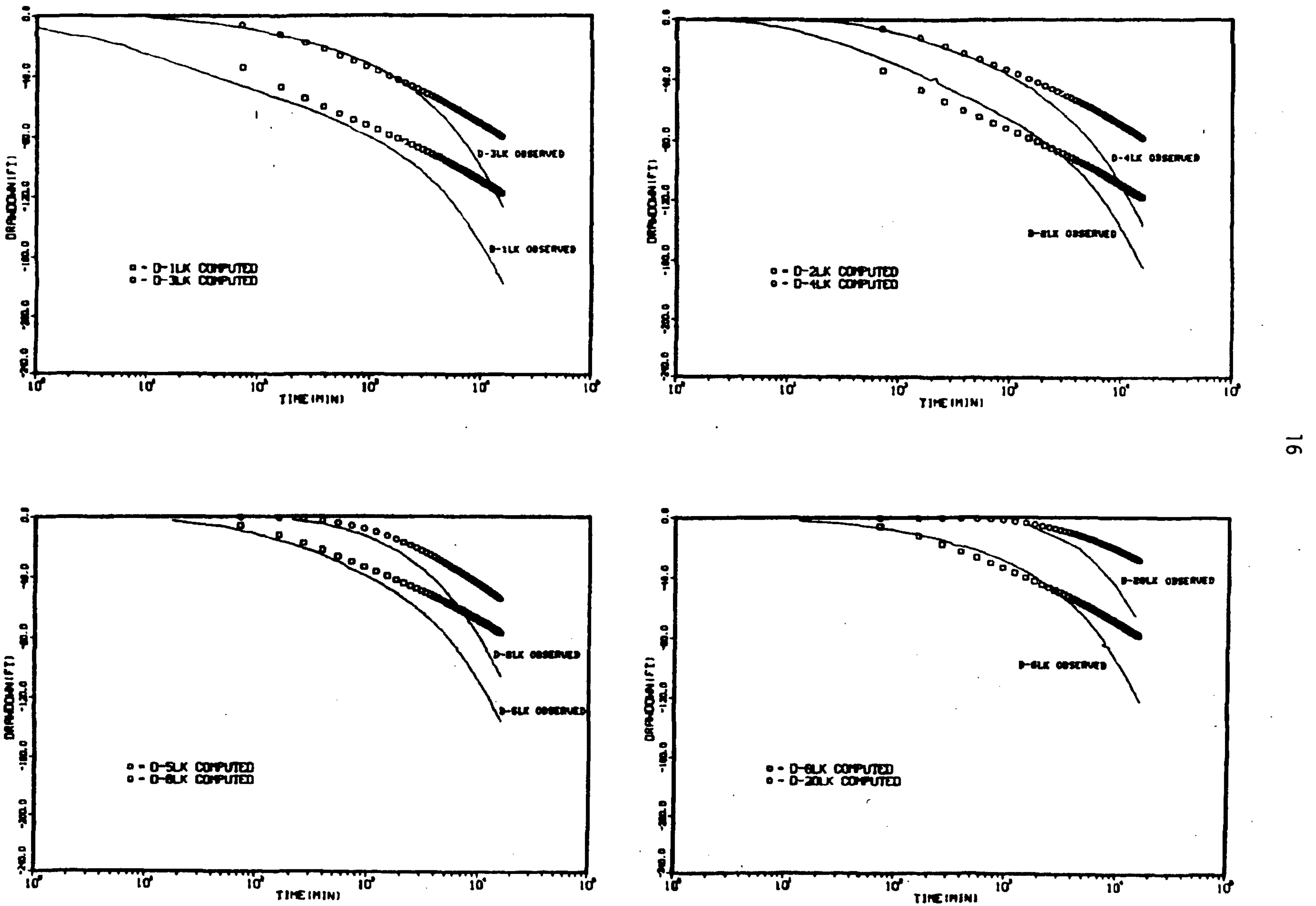


Figure 5. Comparison of Observed and Computed Drawdown, Case I

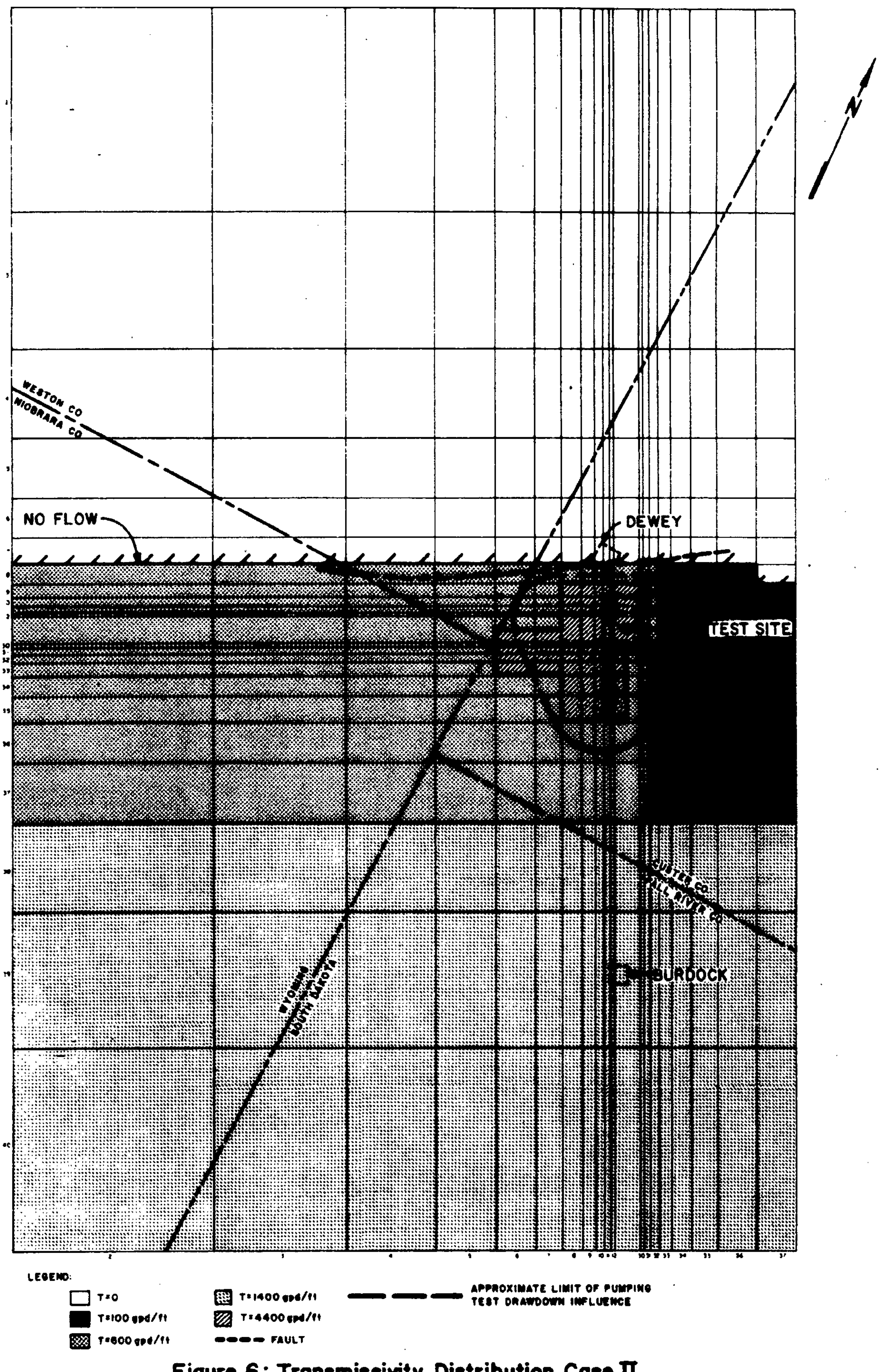


Figure 6: Transmissivity Distribution, Case II

horizontal conductivity of the shale is estimated to be about 10^{-8} ft/sec assuming (1) the measured vertical conductivity of the Fuson shale is also representative of shale in the Lakota aquifer and (2) the ratio of horizontal to vertical conductivity is about 10:1. Given the estimated horizontal conductivities for the sandstone and shale, a representative average conductivity was computed for areas having similar aquifer sandstone-shale ratios. The representative average conductivity was computed from the geometric mean of the conductivity samples as suggested by Bouwer (1969). The transmissivity of 1,400 gpd/ft assigned to the southern portion of the model is based on results of the Burdock aquifer test. Note that although an attempt was made to assign realistic transmissivity values to the entire model region, model simulation results are mainly affected by the transmissivity distribution within the observed limits of influence of the 11-day aquifer test as indicated in Figure 6. Outside of this region the model is relatively insensitive to the assigned T values.

The Case II simulation results are shown in Figure 7. The agreement between the computed and observed drawdown trends in the Lakota wells is quite good overall. At least part of the discrepancy between observed and computed responses in these units is due to the fact that computed hydraulic heads are average values over the thickness of the aquifer or aquitard layer.

The observed drawdown trends could, perhaps, be reproduced using some alternative T distribution without the barrier boundary condition assumed for the Dewey fault. However, if the fault did not represent a barrier, substantial pressure changes should have been observed during the test in the private Lakota wells located north of the fault. These wells are located at approximately the same radial distance as observation well

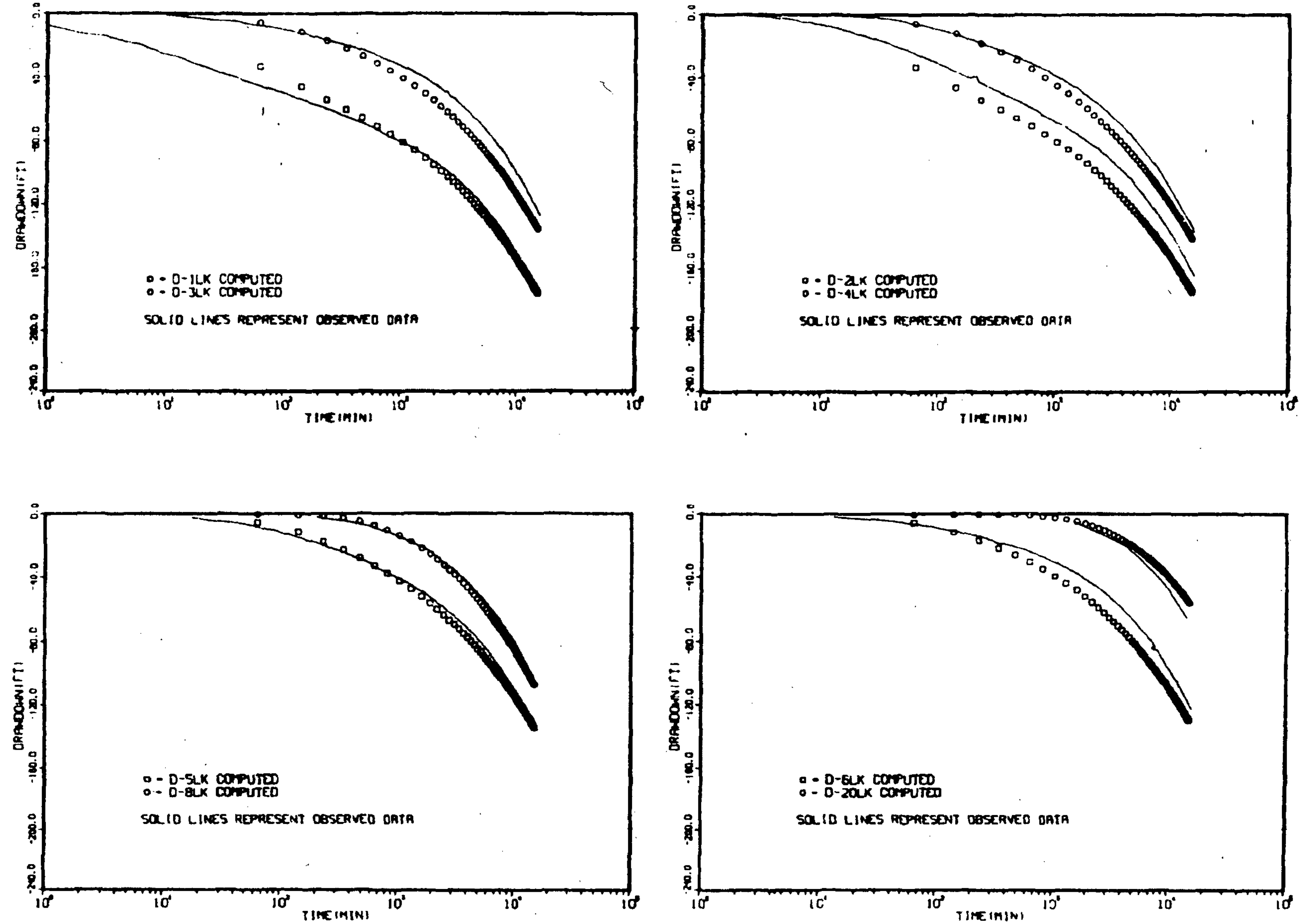


Figure 7. Comparison of Observed and Computed Drawdown, Case II

D-20LK which exhibited 66 feet of drawdown at the end of the test. As no drawdown occurred in these wells, it is concluded that the Dewey fault represents a hydrogeologic barrier.

The Case II simulation results support the concept of the Lakota as a patchy aquifer of relatively low-transmissivity overall but having within it localized zones of substantially higher transmissivity. The proposed mine site lies within one of these high transmissivity localities. Although the T distribution used in the Case II model is based upon reasonable assumptions, it is considered only an approximation of actual conditions in the test site area. Nevertheless, this approximation is adequate for assessing long-term mine depressurization impacts. The significance of the Case II model result is that it provides an interpretation of the test results which is consistent with what is known or suspected about the hydrogeologic conditions in the site region.

CONCLUSIONS

Hydrogeologic investigations in the Dewey area indicate that the proposed mine site lies within an area where the Lakota Formation is composed of relatively thick permeable sandstone. The transmissivity of the Lakota aquifer in this locality is estimated to be approximately 4,400 gpd/ft. Storativity of the aquifer is about 10^{-4}. Outside of this area the Lakota transmissivity decreases substantially. The variation in transmissivity over the region is consistent with geologic evidence of thinning of the Lakota sandstone away from the test site and a change to finer-grained sand and shale facies. The significance of this condition is that long-term mine depressurization rates and drawdown response in the Dewey vicinity will be governed by the lower transmissivity material. As a result, dewatering rates will be lower and the areal extent of drawdown impacts smaller than if the higher transmissivity prevailed.

There is evidence that hydraulic communication between the Fall River and Lakota aquifers occurred during the Dewey test. However, the degree of interconnection between these units is substantially less than that observed at the Burdock test site. The vertical hydraulic conductivity of the intervening Fuson aquitard estimated from the Dewey test data is approximately 10^{-4} ft/d. This value is about an order of magnitude lower than the estimate obtained at Burdock. The difference is somewhat surprising in that the Fuson aquitard is thinner in the Dewey area than at Burdock. A possible explanation may be that the direct avenues of hydraulic communication (e.g., numerous open pre-TVA exploration boreholes) believed to exist at Burdock, are not present in the Dewey area.

Evaluation of the drawdown responses recorded in test wells and private wells during the aquifer test and review of existing subsurface geologic data indicates that the Dewey fault zone acts as a hydrogeologic barrier to horizontal ground-water movement between the Inyan Kara aquifers located on opposite sides of the fault zone. Some upward vertical recharge to the Inyan Kara may occur in the fault zone as suggested by Gott, et al. (1968). However, rate of recharge from this source must be relatively small, otherwise recharge effects would be apparent in the aquifer test results and in the configuration of the steady-state potentiometric surface. It is expected that the fault will significantly reduce mining drawdown impacts on ground-water supplies located north of the fault zone.

3. The model should be calibrated by adjustment of hydraulic parameters to reproduce the existing steady-state potentiometric surface shown in Figure 1. The hydraulic properties for the Inyan Kara units measured at the Dewey and Burdock test sites should be held constant in the calibration process, while parameter adjustments are made in other areas to obtain a reasonable match between the computed and observed potentiometric levels. An estimate of net ground-water recharge can be obtained from the calibrated model by assigning observed potentiometric head values to the model nodes which lie within the aquifer recharge (outcrop) area. The aquifer recharge fluxes may be incorporated directly into the model to more accurately represent drawdown conditions in the outcrop areas during mine depressurization simulations.

4. Significant pumping stresses on the Inyan Kara aquifers other than the TVA mining operations should be identified and incorporated into the model.

REFERENCES

Boggs, J. M., and A. M. Jenkins, 1980, "Analysis of Aquifer Tests Conducted at the Proposed Burdock Uranium Mine Site, Burdock, South Dakota," TVA Report No. WR28-1-520-109.

Bouwer, H., 1969, "Planning and Interpreting Soil Permeability Measurements," ASCE Journal of Irrigation and Drainage Division, V. 95, No. IR3, pp. 391-402.

Gambolati, G., 1974, "Second-Order Theory of Flow in Three-Dimensional Deforming Media," Water Resources Research, V. 10, No. 6, pp. 1217-1228.

Gott, G. B., D. E. Wolcott, and C. G. Bowles, 1974, "Stratigraphy of the Inyan Kara Group and Localization of Uranium Deposits, Southern Black Hills, South Dakota and Wyoming," USGS Prof. Paper 763.

Trescott, P. C., 1975, "Documentation of Finite-Difference Model for Simulation of Three-Dimensional Ground-Water Flow," USGS Open File Report 75-438.

Walton, W. C., 1970, <u>Groundwater Resource Evaluation</u>, McGraw-Hill, New York.

FIGURE A-1: DRAWDOWN GRAPH FOR WELL D-PW

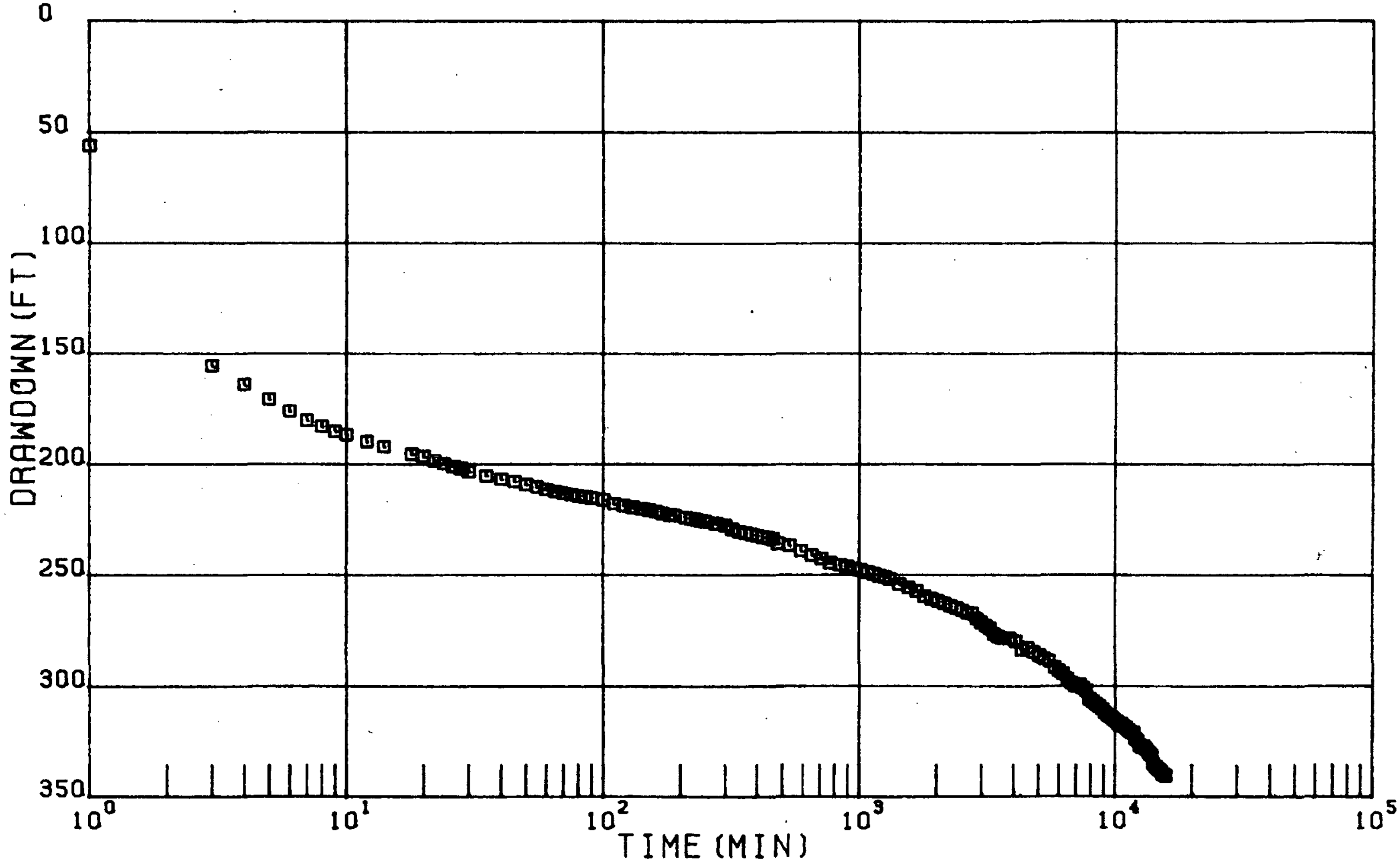


FIGURE A-2: DRAWDOWN GRAPH FOR D-1 WELL GROUP

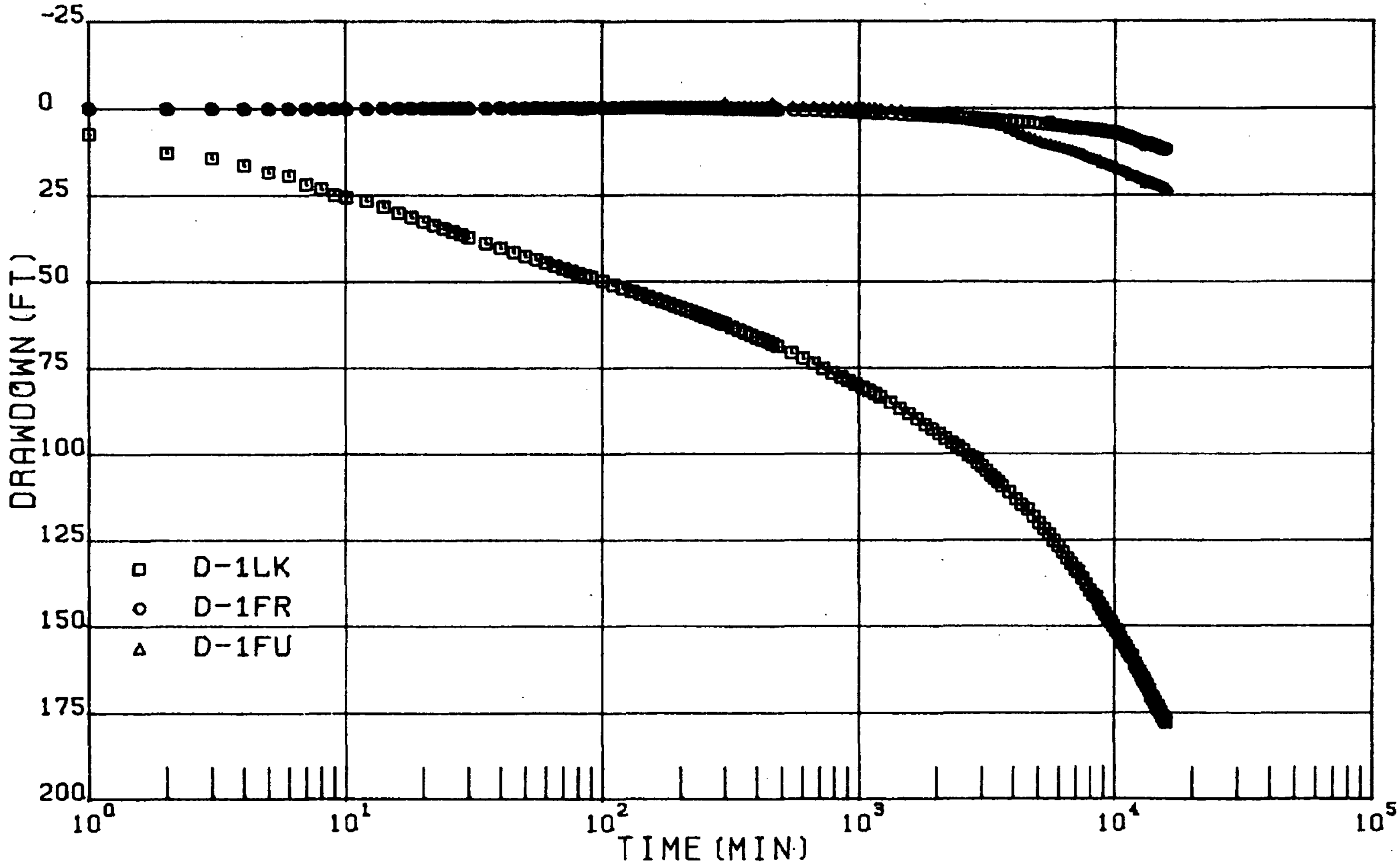


FIGURE A-3: DRAWDOWN GRAPH FOR WELL D-2LK

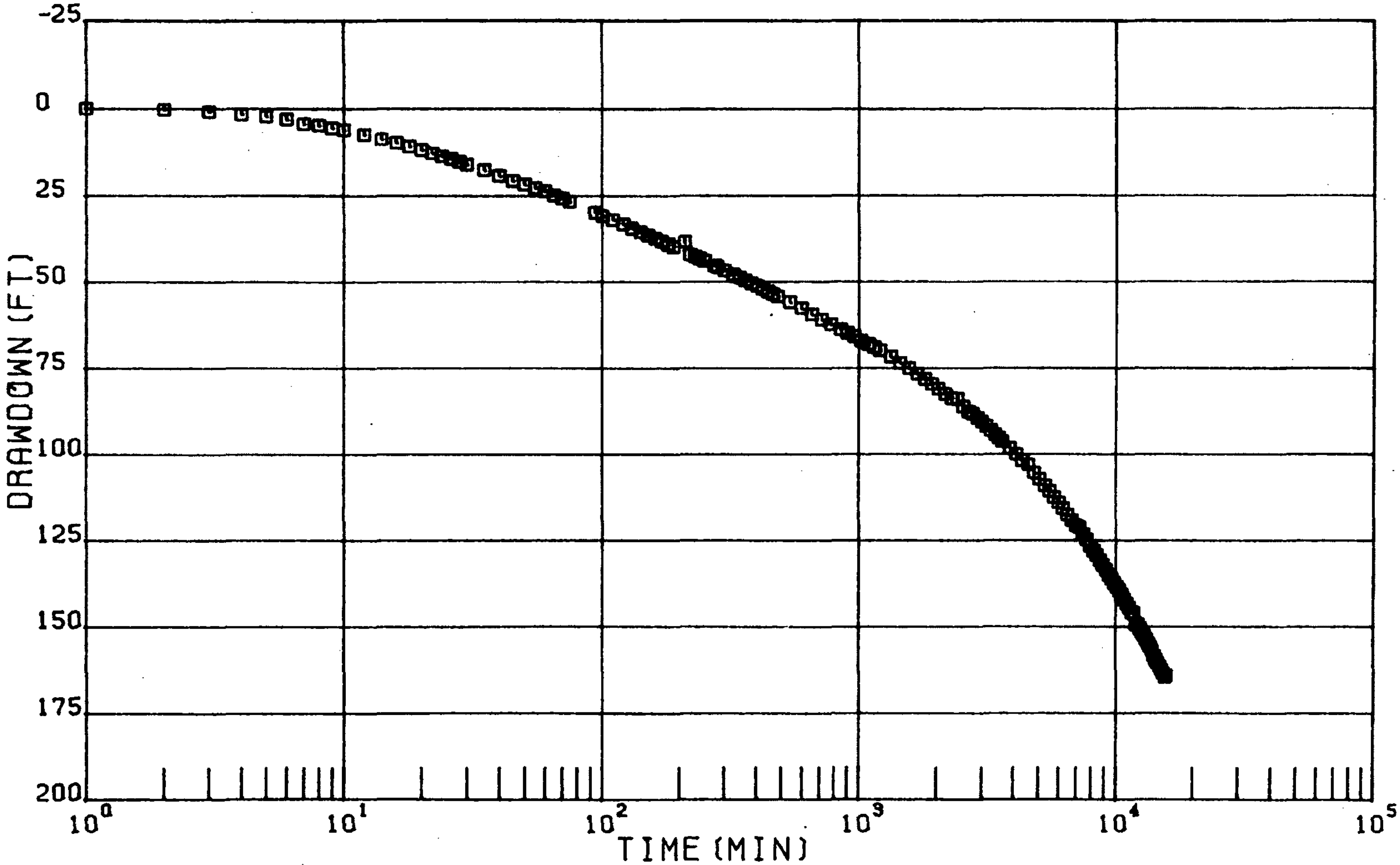


FIGURE A-4: DRAWDOWN GRAPH FOR D-3 WELL GROUP

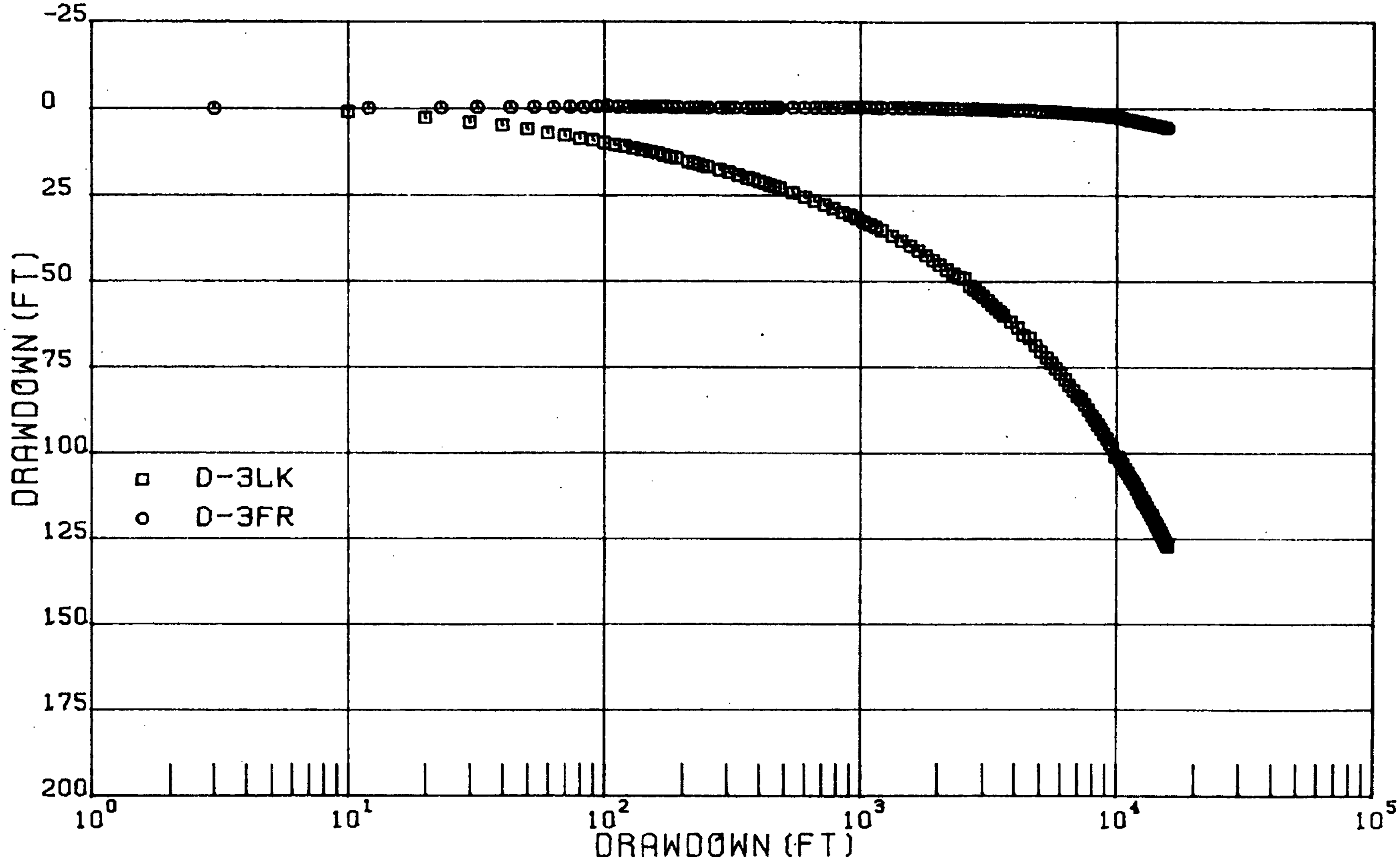


FIGURE A-5: DRAWDOWN GRAPH FOR D-4 WELL GROUP

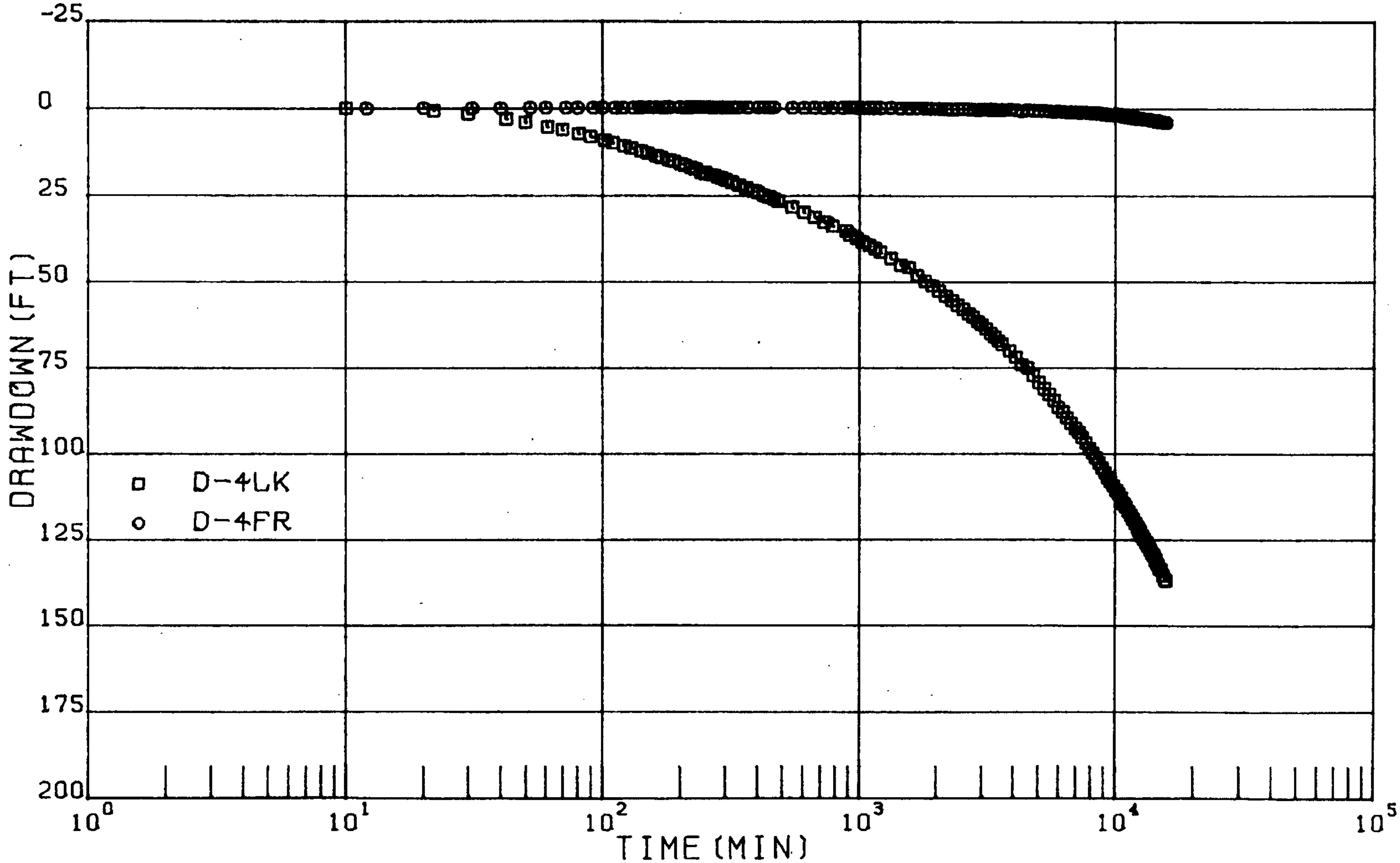


FIGURE A-6: DRAWDOWN GRAPH FØR WELL D-5LK

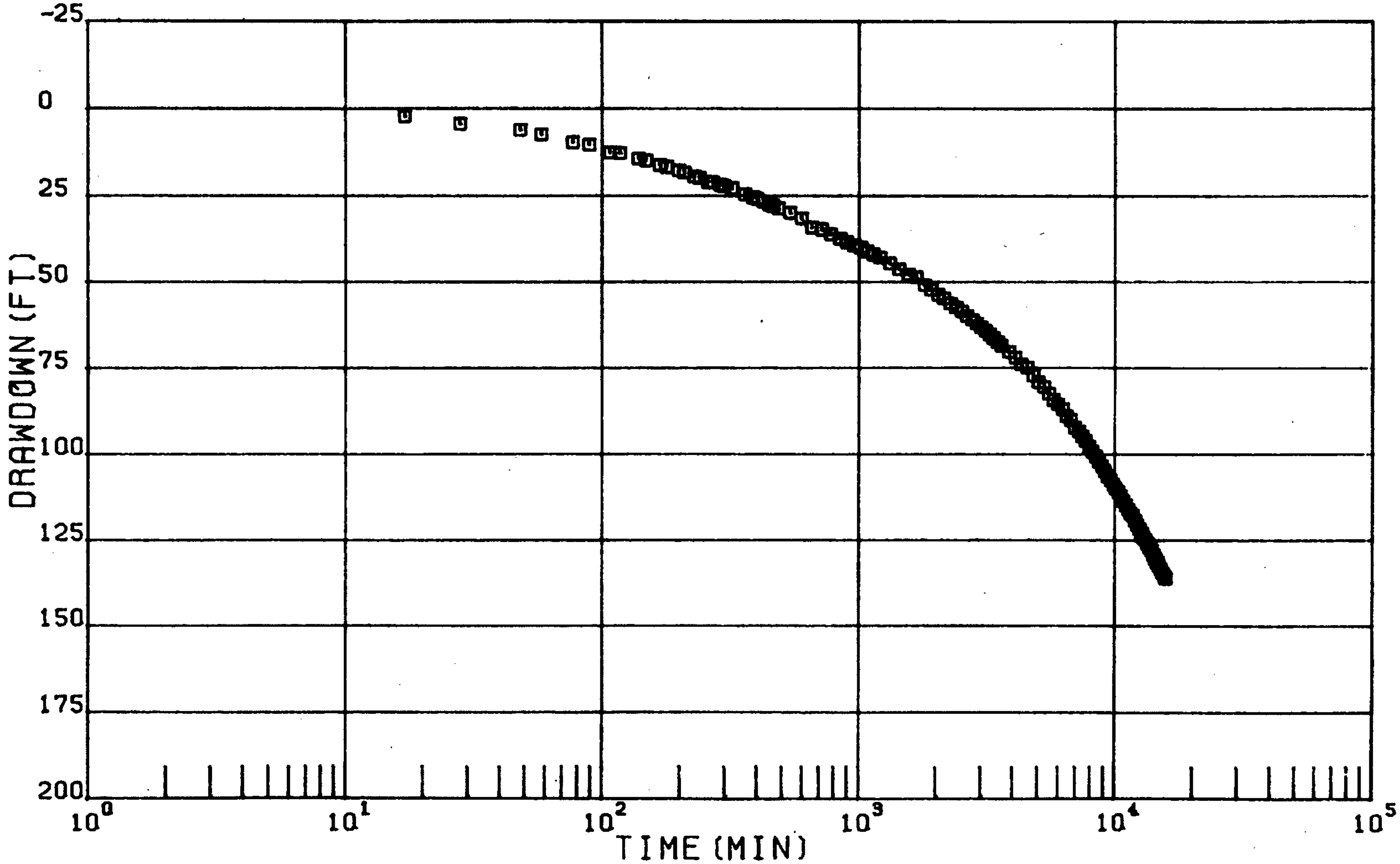


FIGURE A-7: DRAWDOWN GRAPH FOR WELL D-6LK

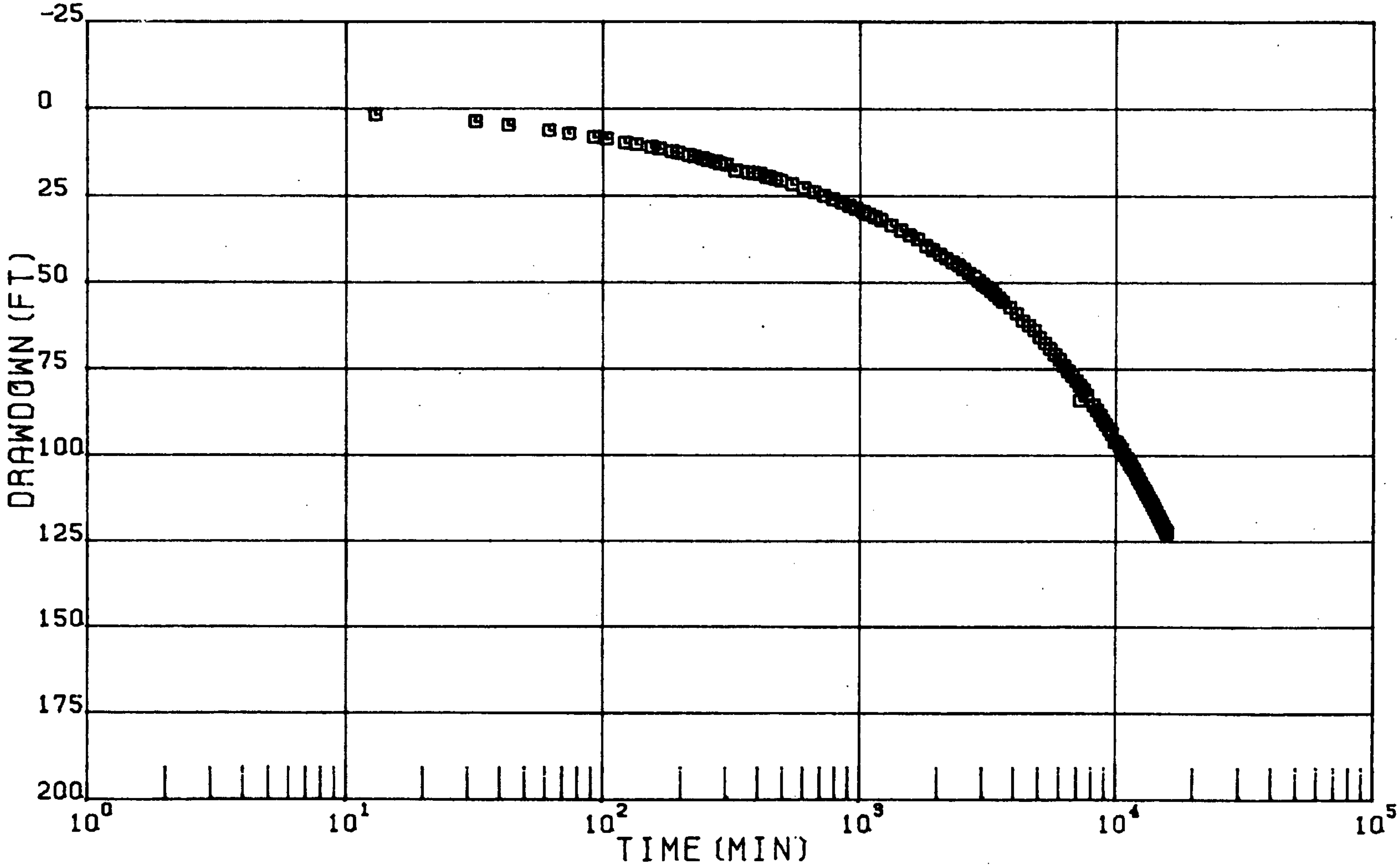


FIGURE A-8: DRAWDOWN GRAPH FOR WELL D-8LK

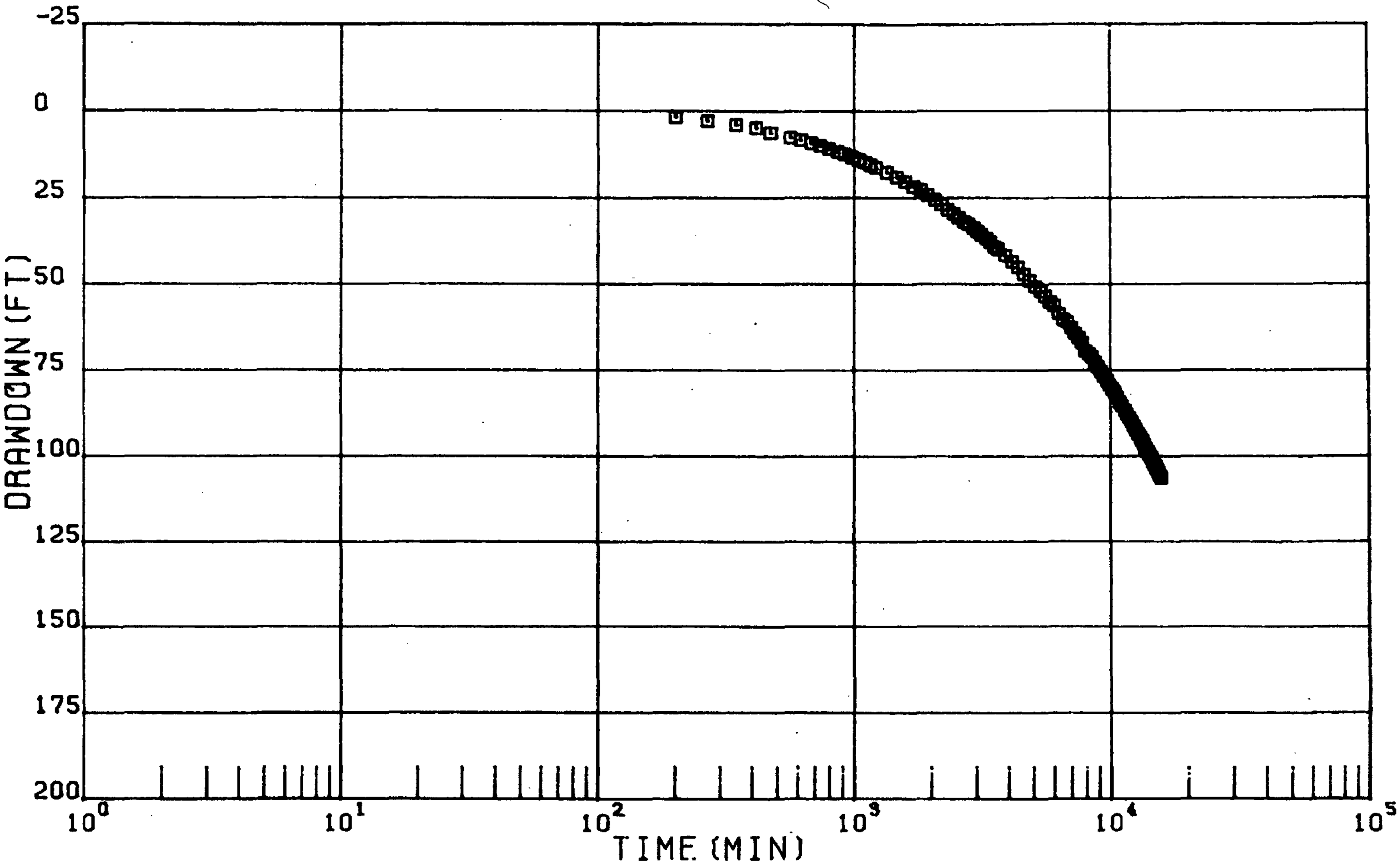
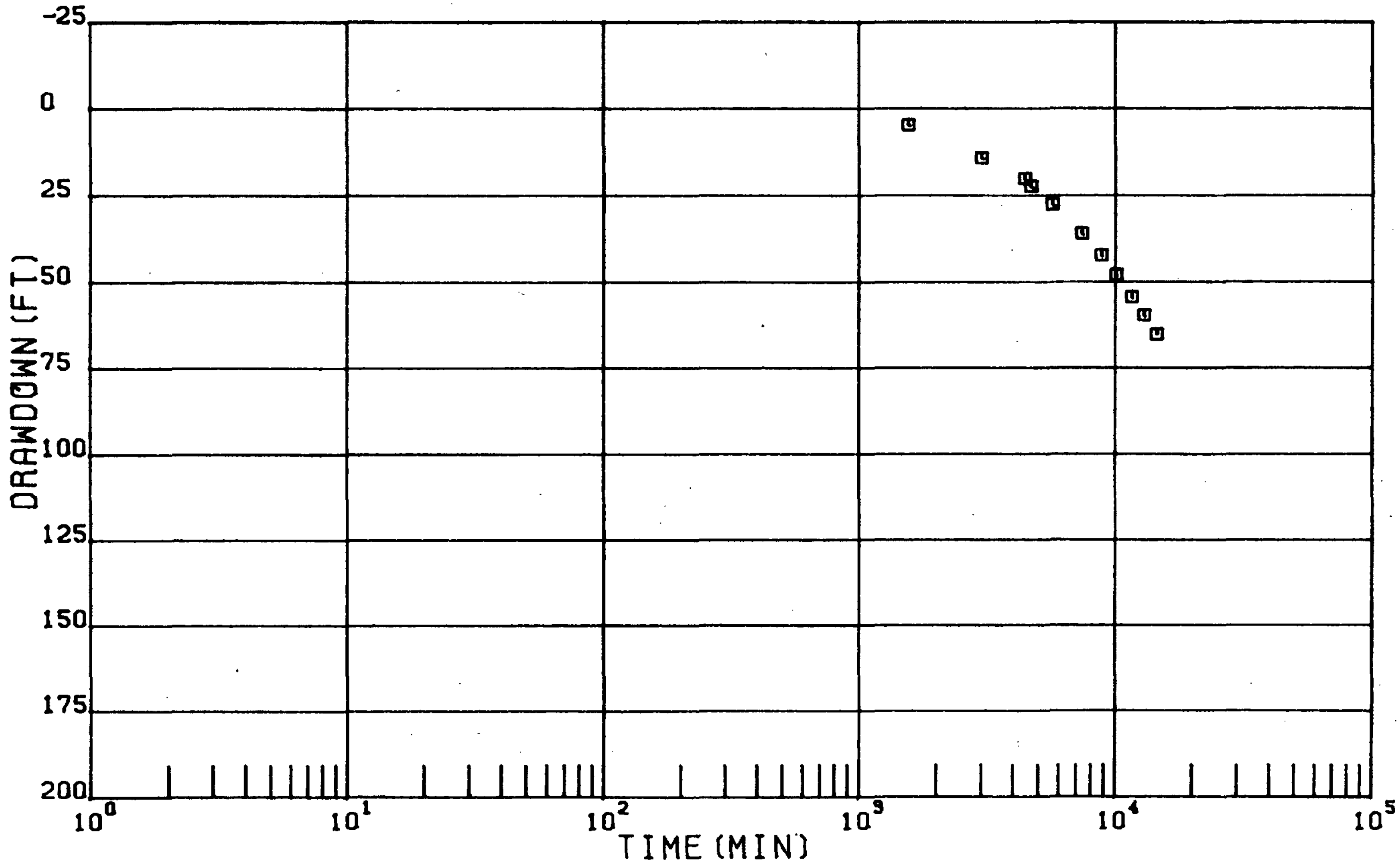


FIGURE A-9: DRAWDOWN GRAPH FOR WELL D-20LK



APPENDIX B

LOGARITHMIC TIME-DRAWDOWN GRAPHS

FIGURE B-1: DRAWDOWN GRAPH FOR WELL D-PW

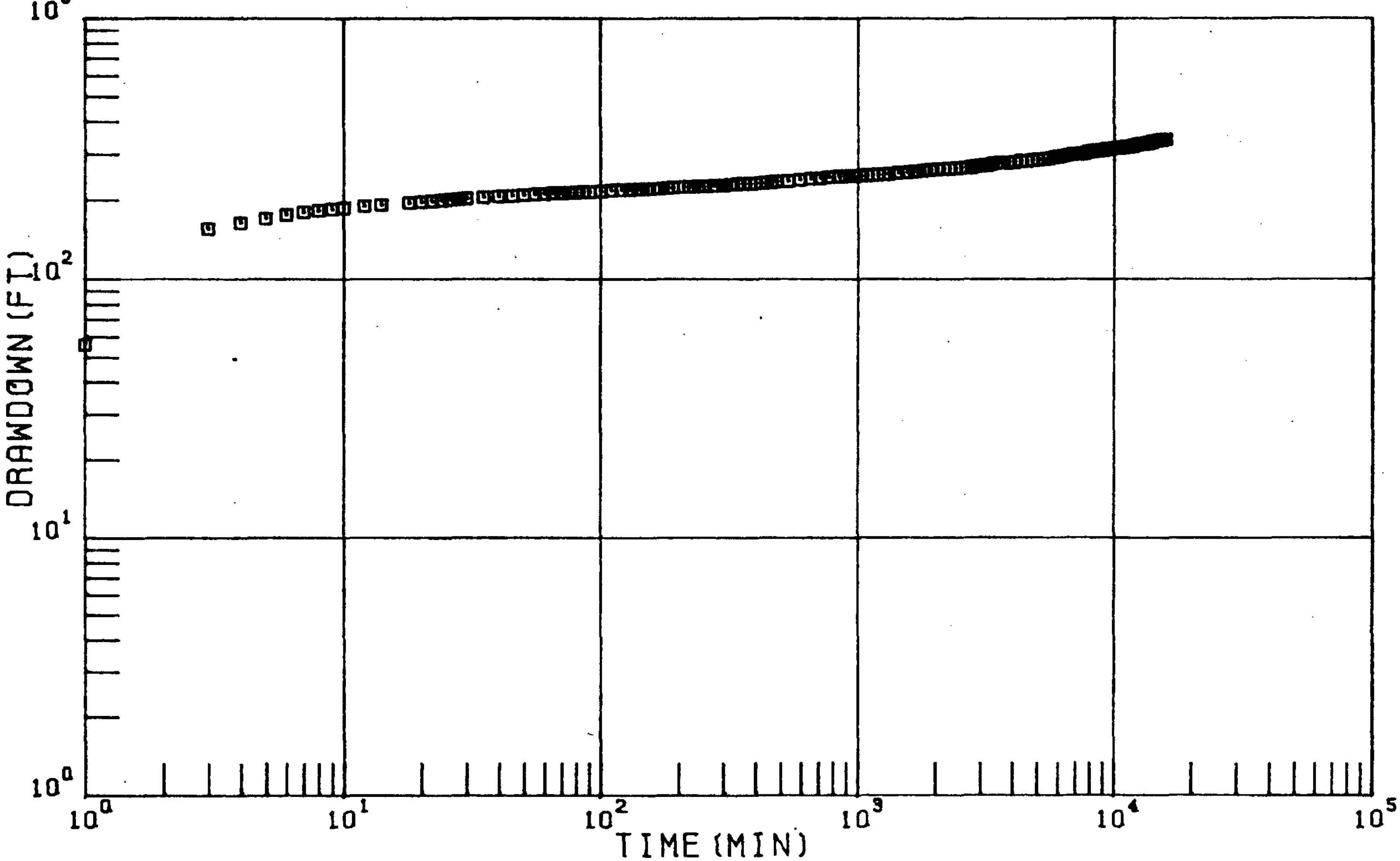


FIGURE B-2: DRAWDOWN GRAPH FOR D-1 WELL GROUP

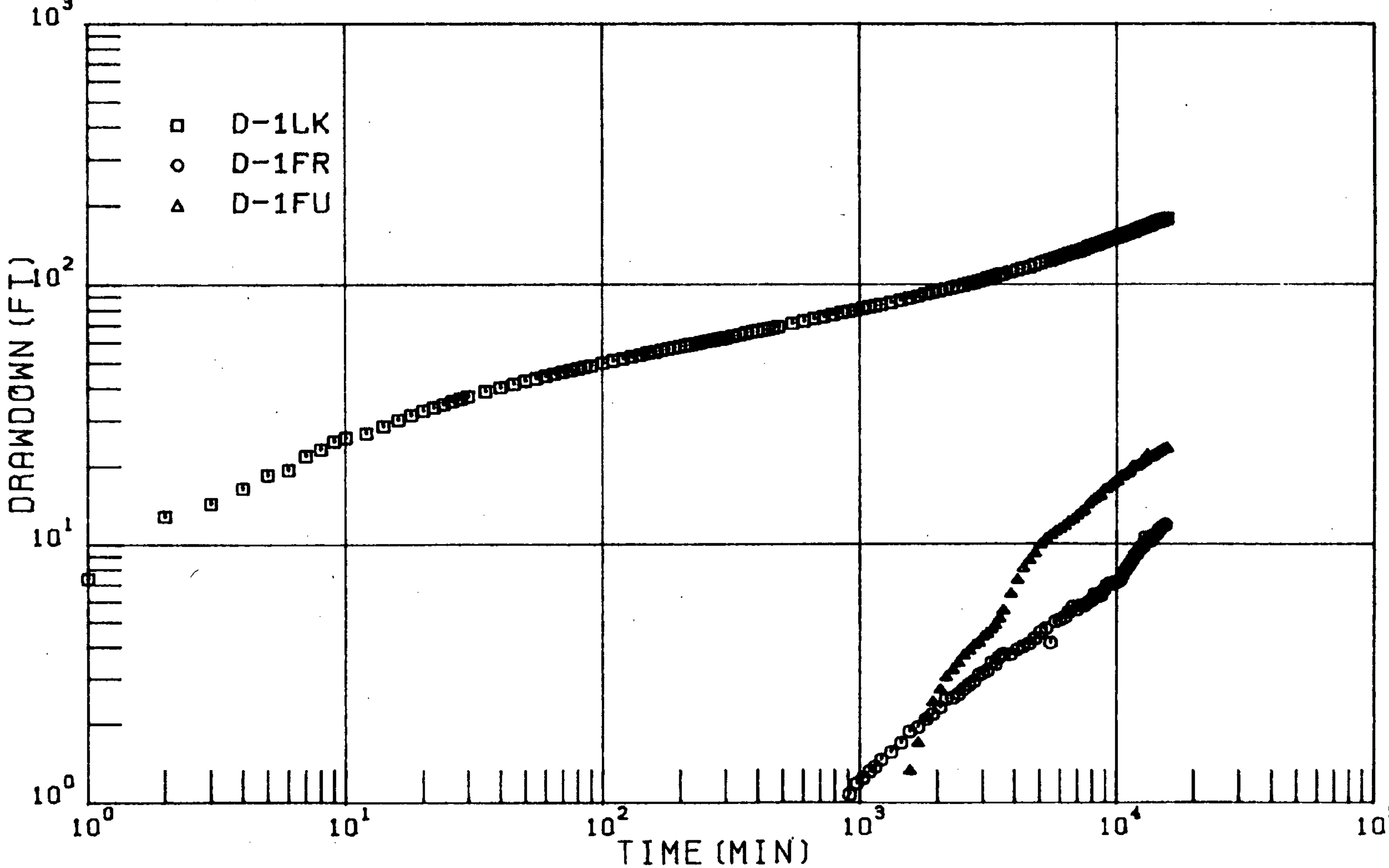


FIGURE B-3: DRAWDOWN GRAPH FOR WELL D-2LK

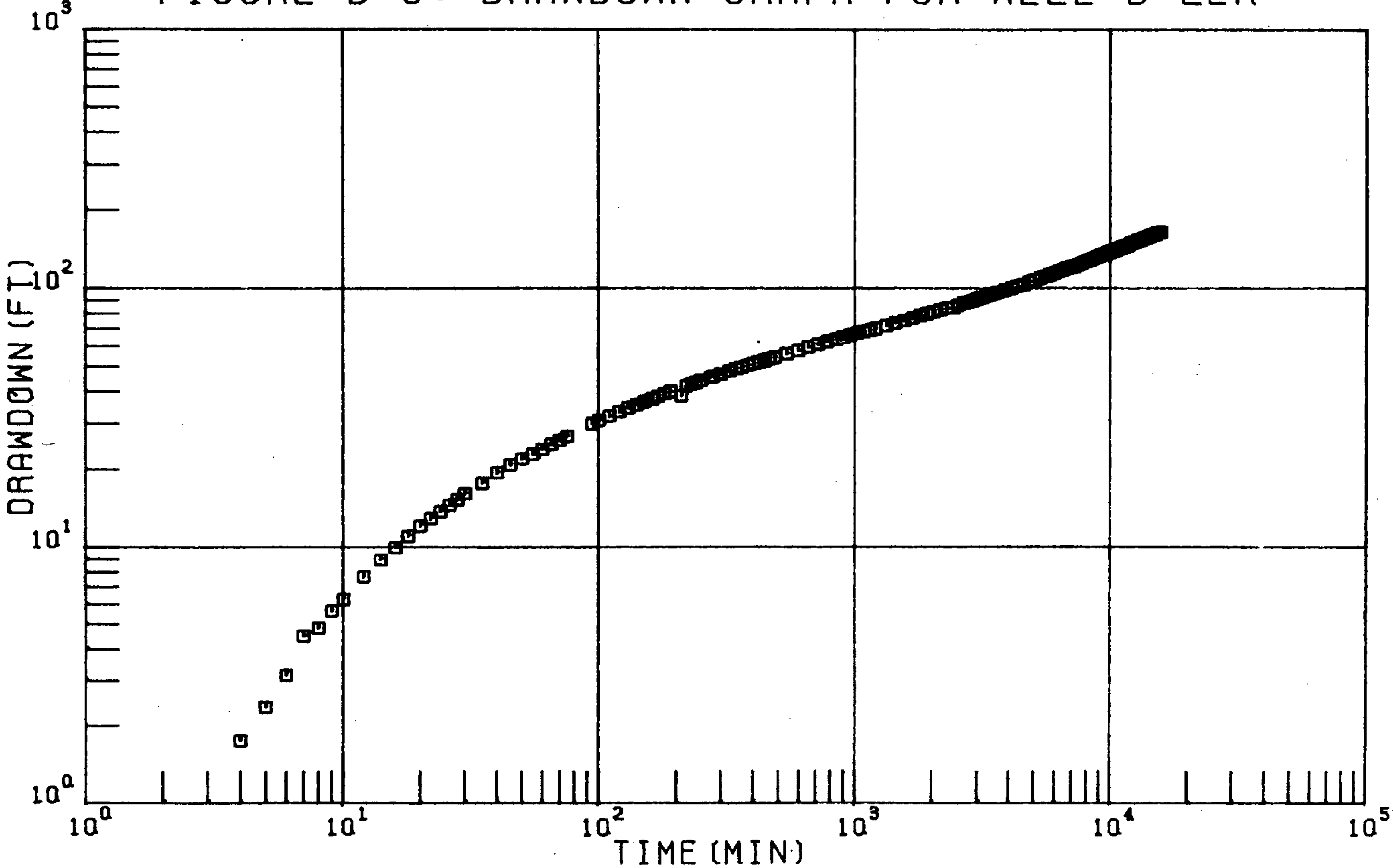


FIGURE B-4: DRAWDOWN GRAPH FOR D-3 WELL GROUP

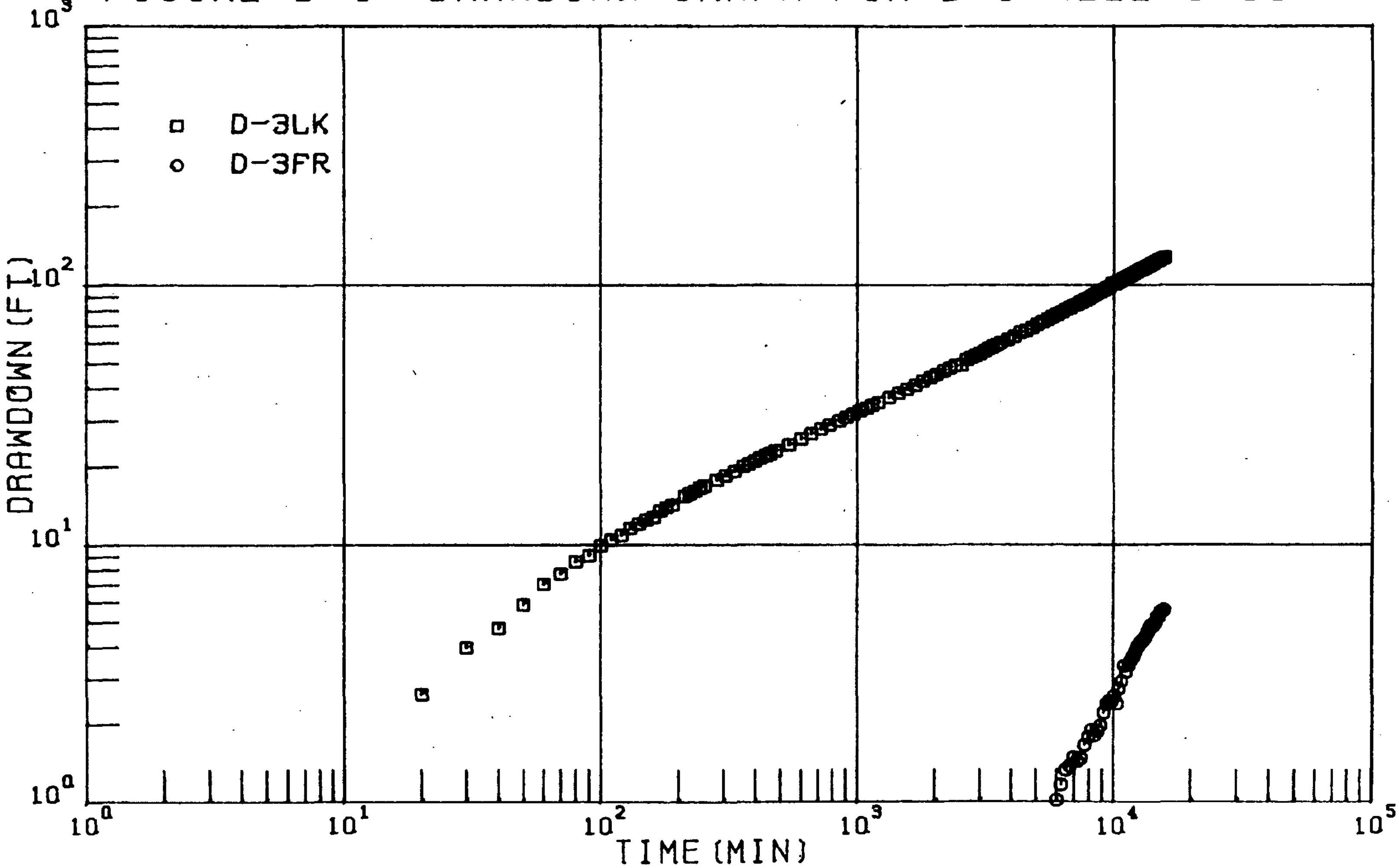


FIGURE B-5: DRAWDOWN GRAPH FOR D-4 WELL GROUP

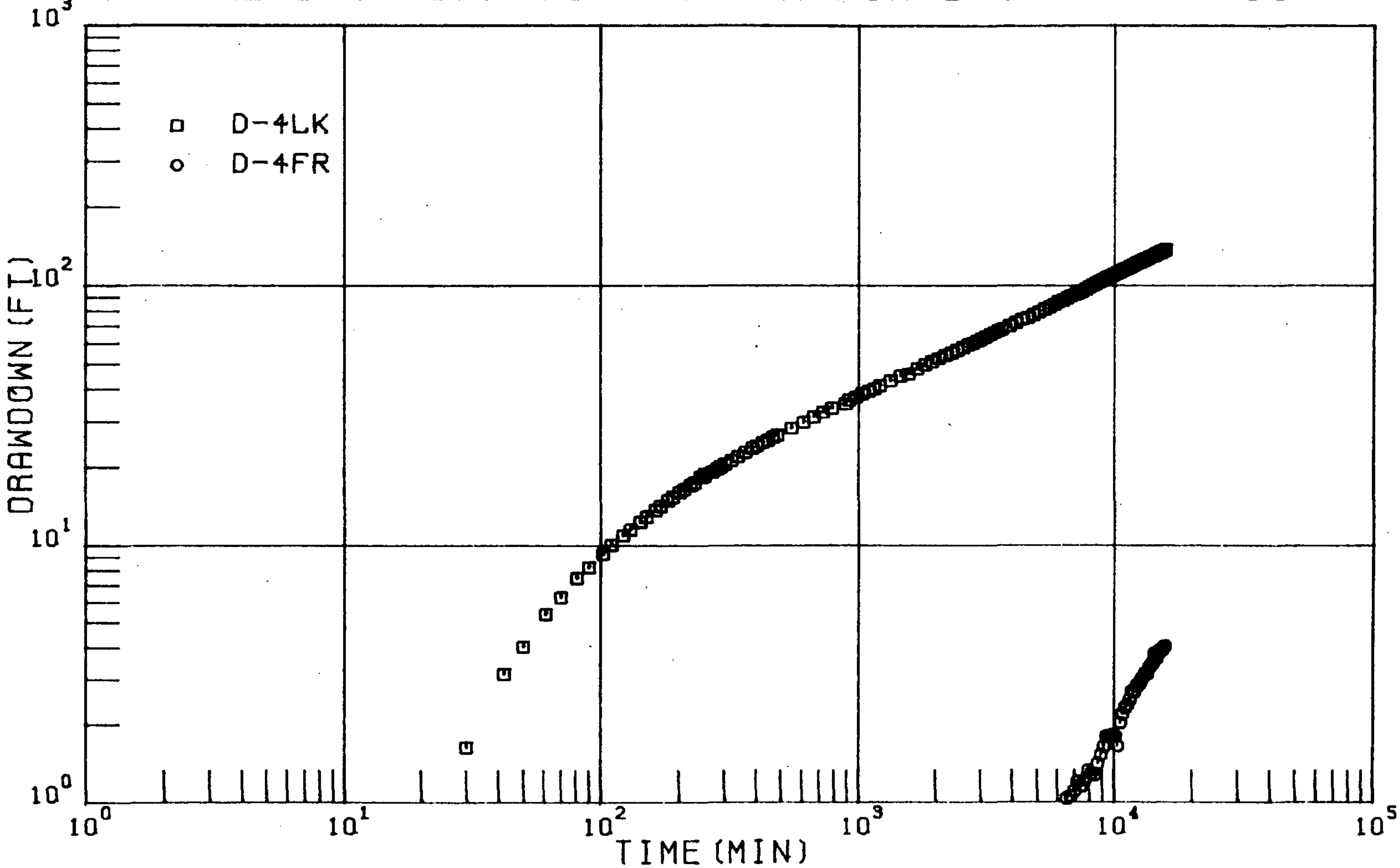
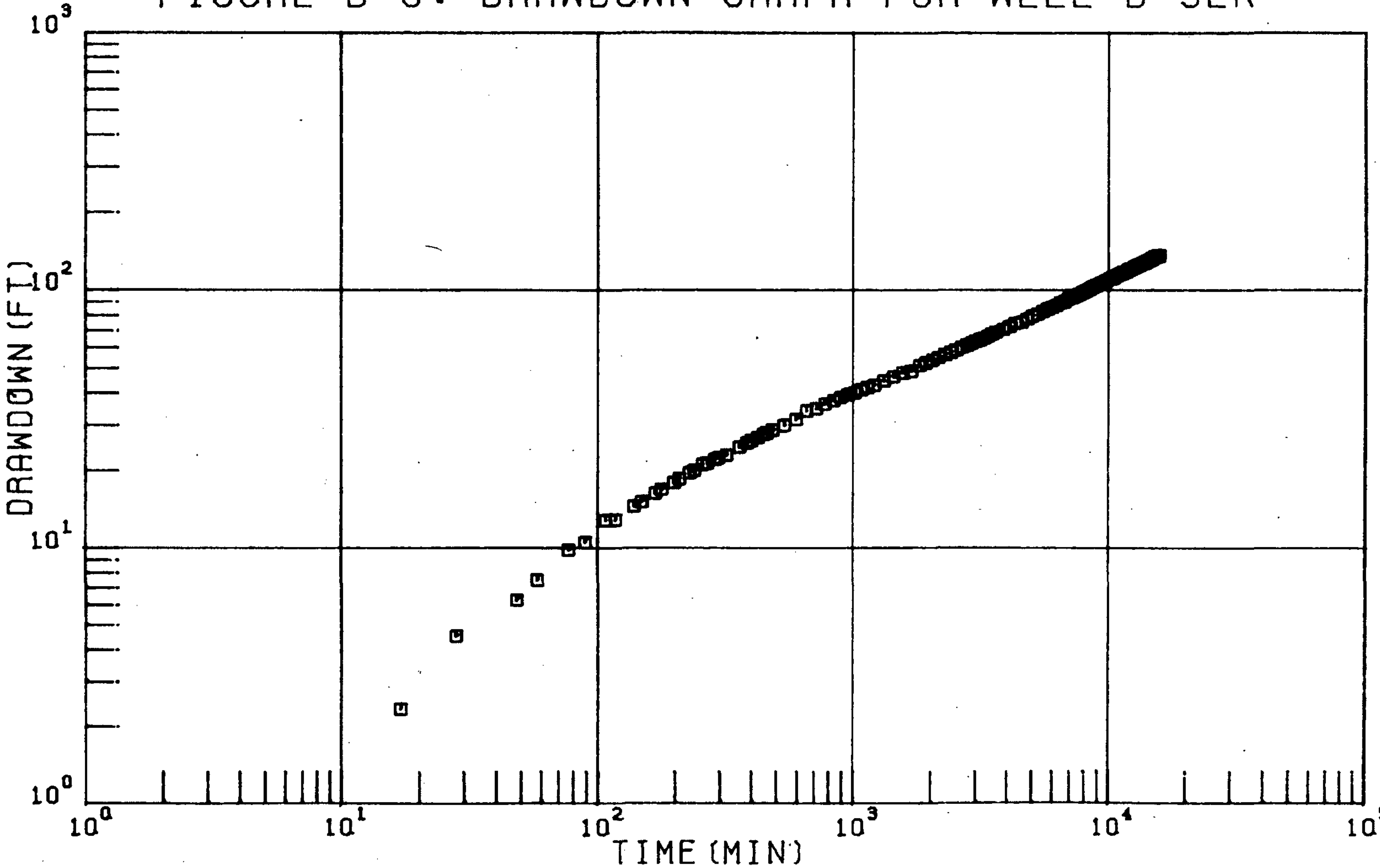


FIGURE B-6: DRAWDOWN GRAPH FOR WELL D-5LK



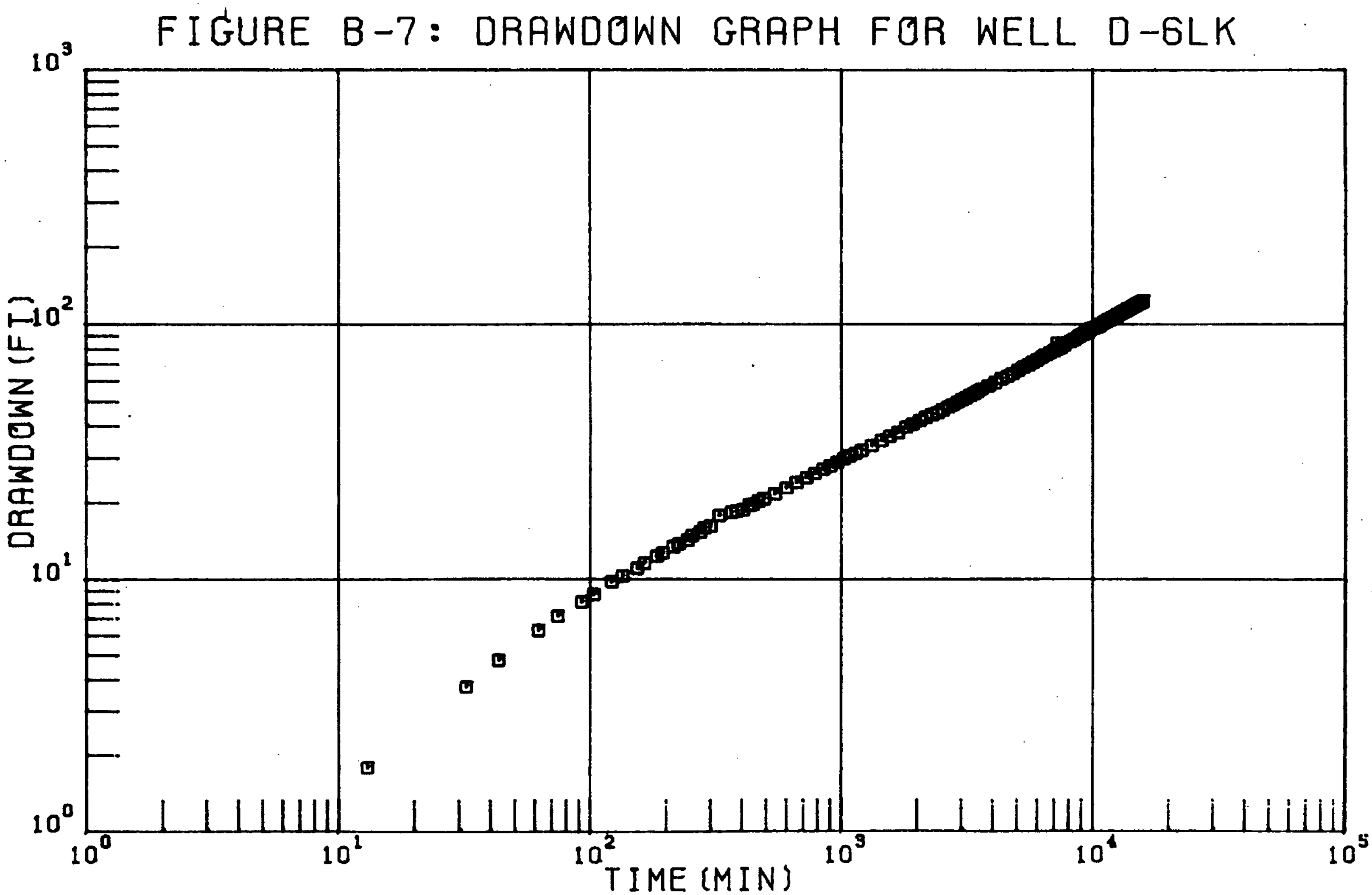


FIGURE B-7: DRAWDOWN GRAPH FOR WELL D-6LK
DRAWDOWN (FT)
TIME (MIN)
10^0
10^1
10^2
10^3
10^4
10^5

FIGURE B-8: DRAWDOWN GRAPH FOR WELL D-8LK

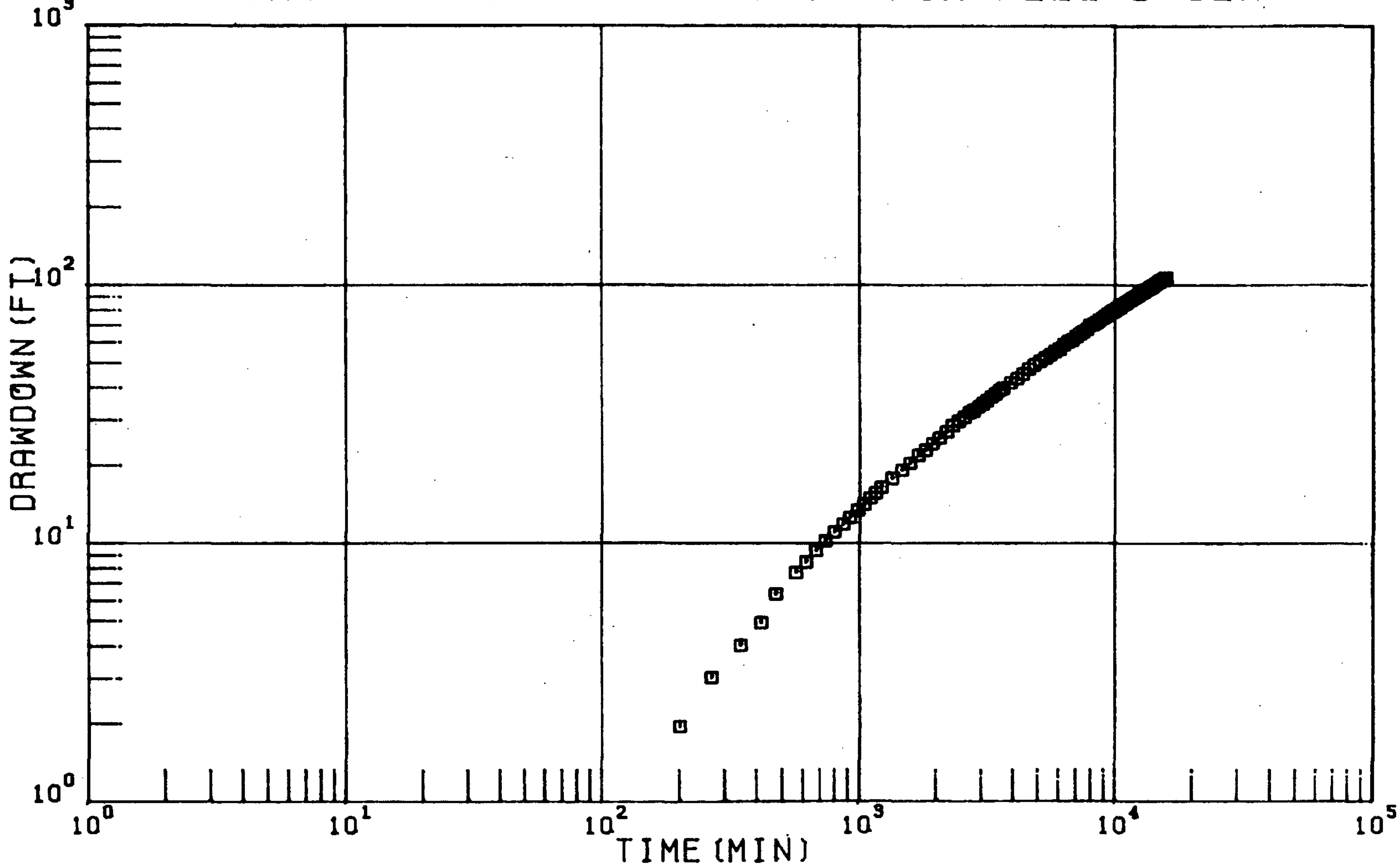
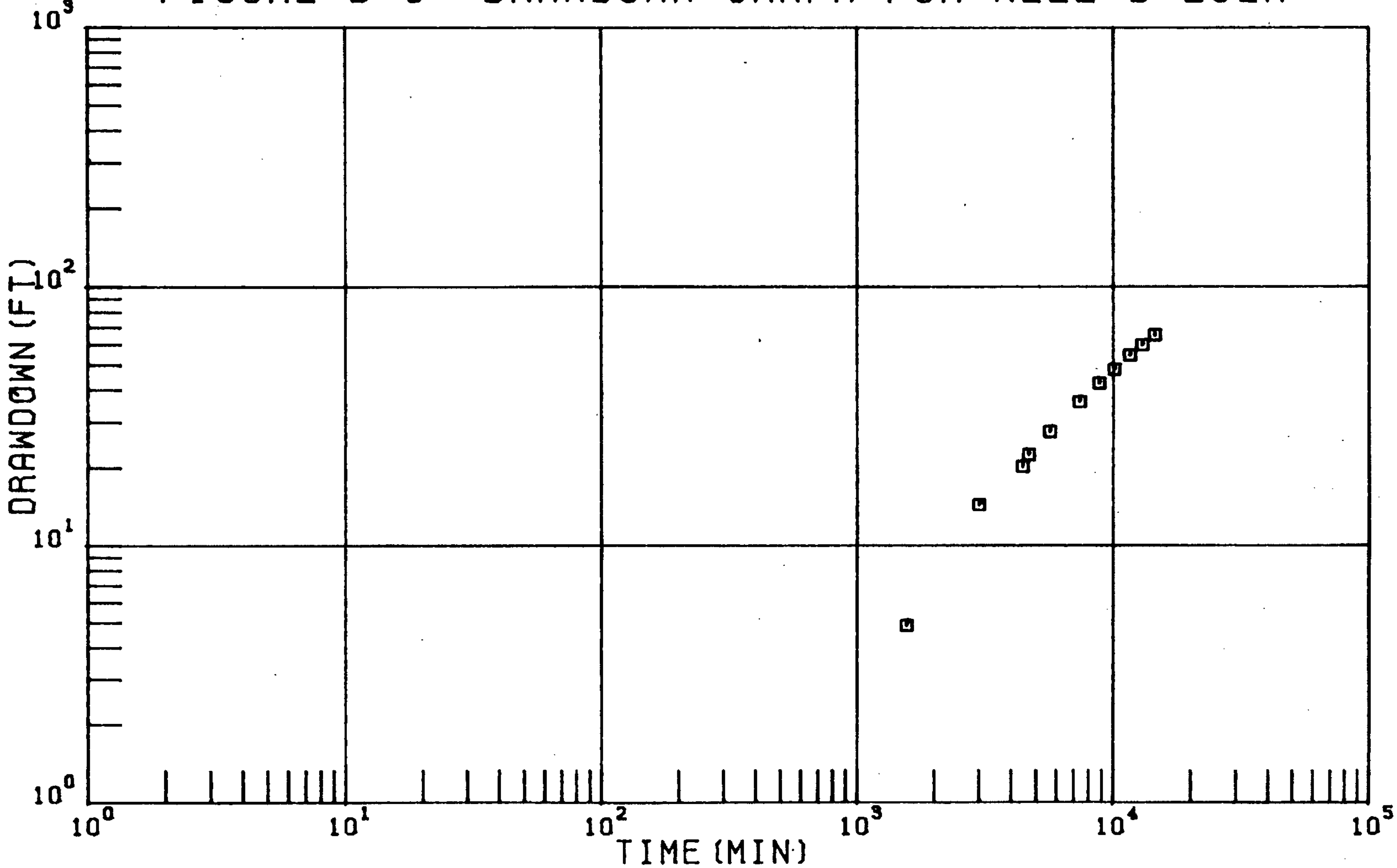


FIGURE B-9: DRAWDOWN GRAPH FØR WELL D-20LK



APPENDIX C

SEMILOGARITHMIC TIME-RESIDUAL DRAWDOWN GRAPHS

FIGURE C-1: RECOVERY GRAPH FOR WELL D-PW

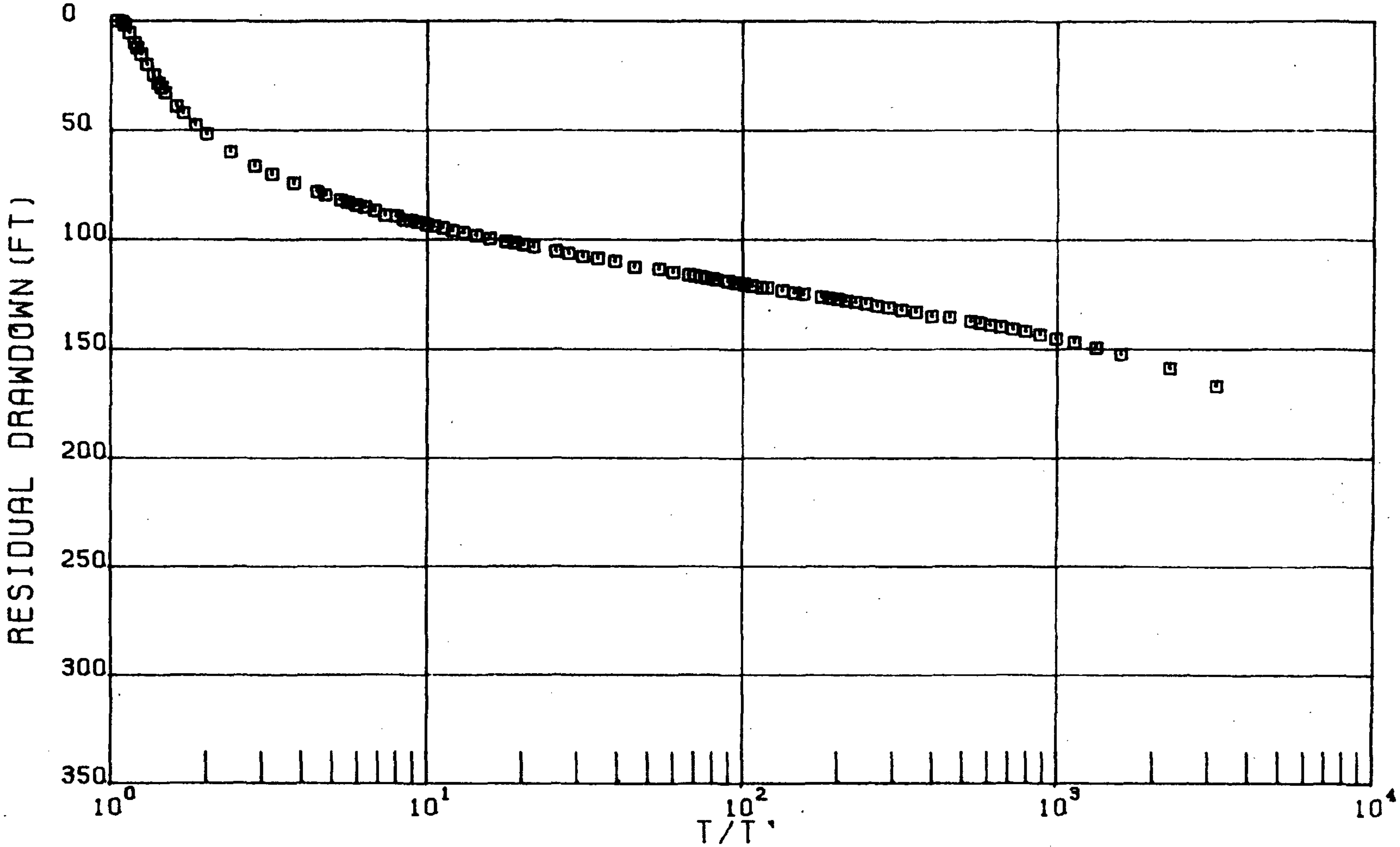


FIGURE C-2: RECOVERY GRAPH FOR D-1 WELL GROUP

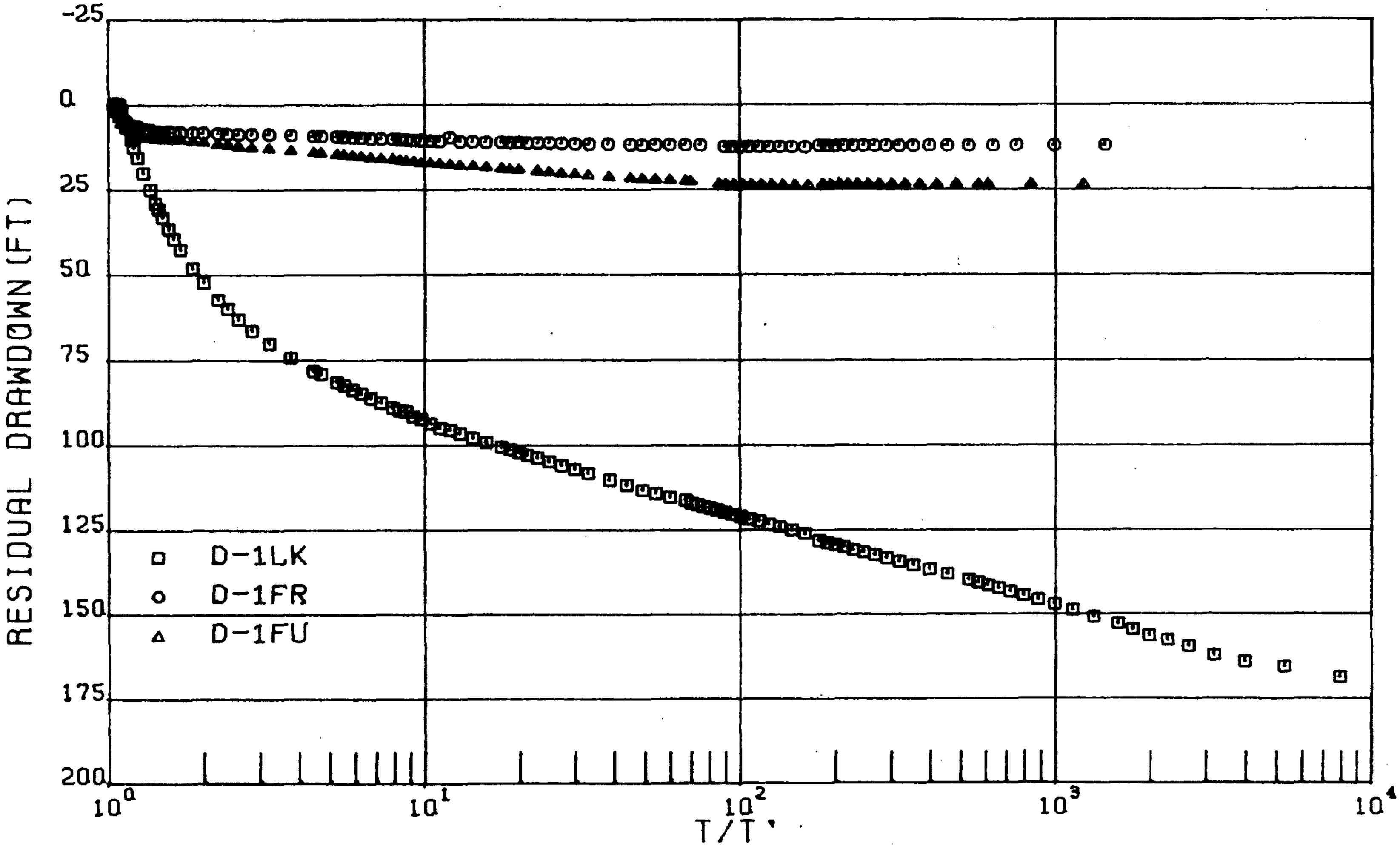


FIGURE C-3: RECOVERY GRAPH FOR WELL D-2LK

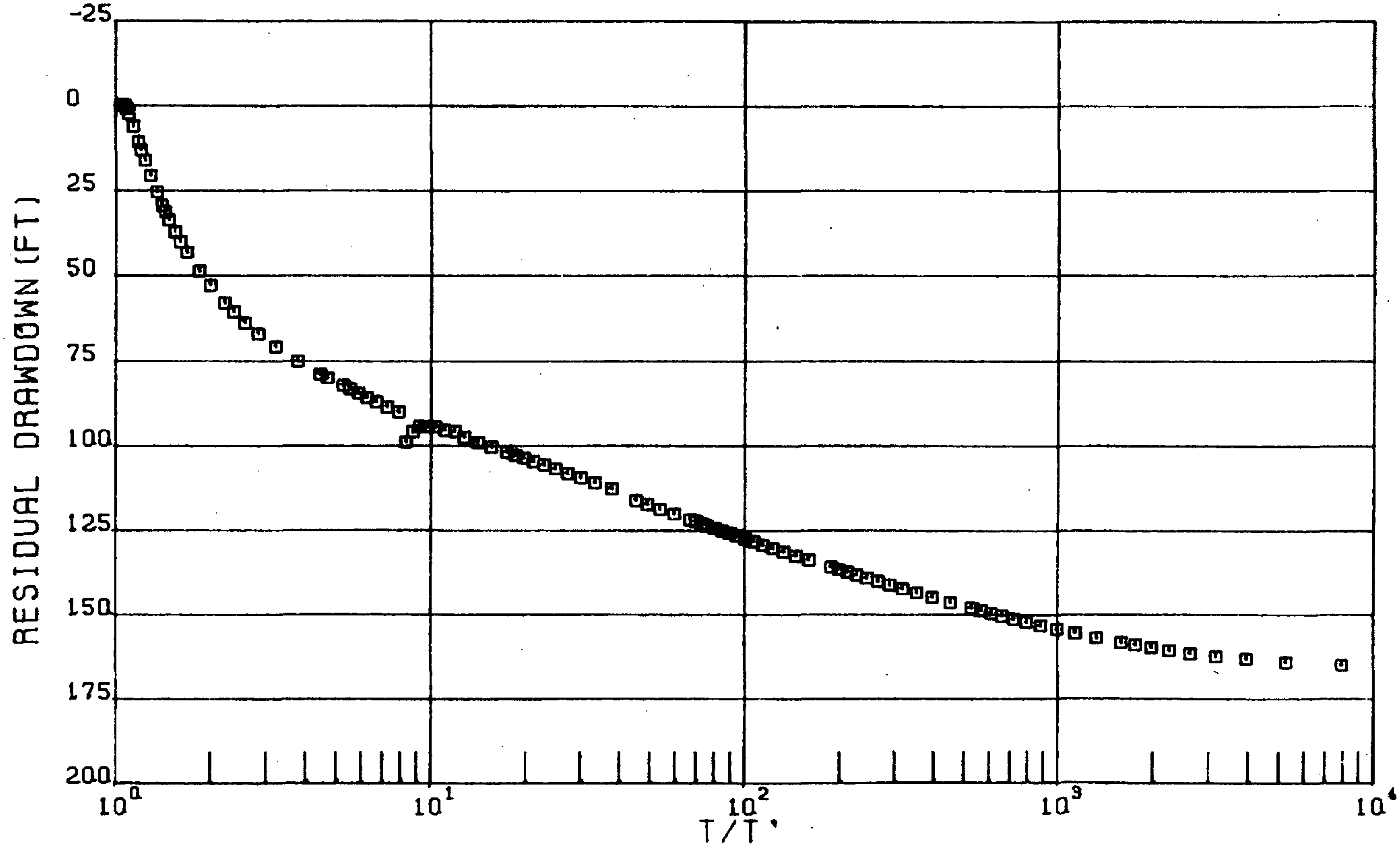


FIGURE C-4: RECOVERY GRAPH FOR D-3 WELL GROUP

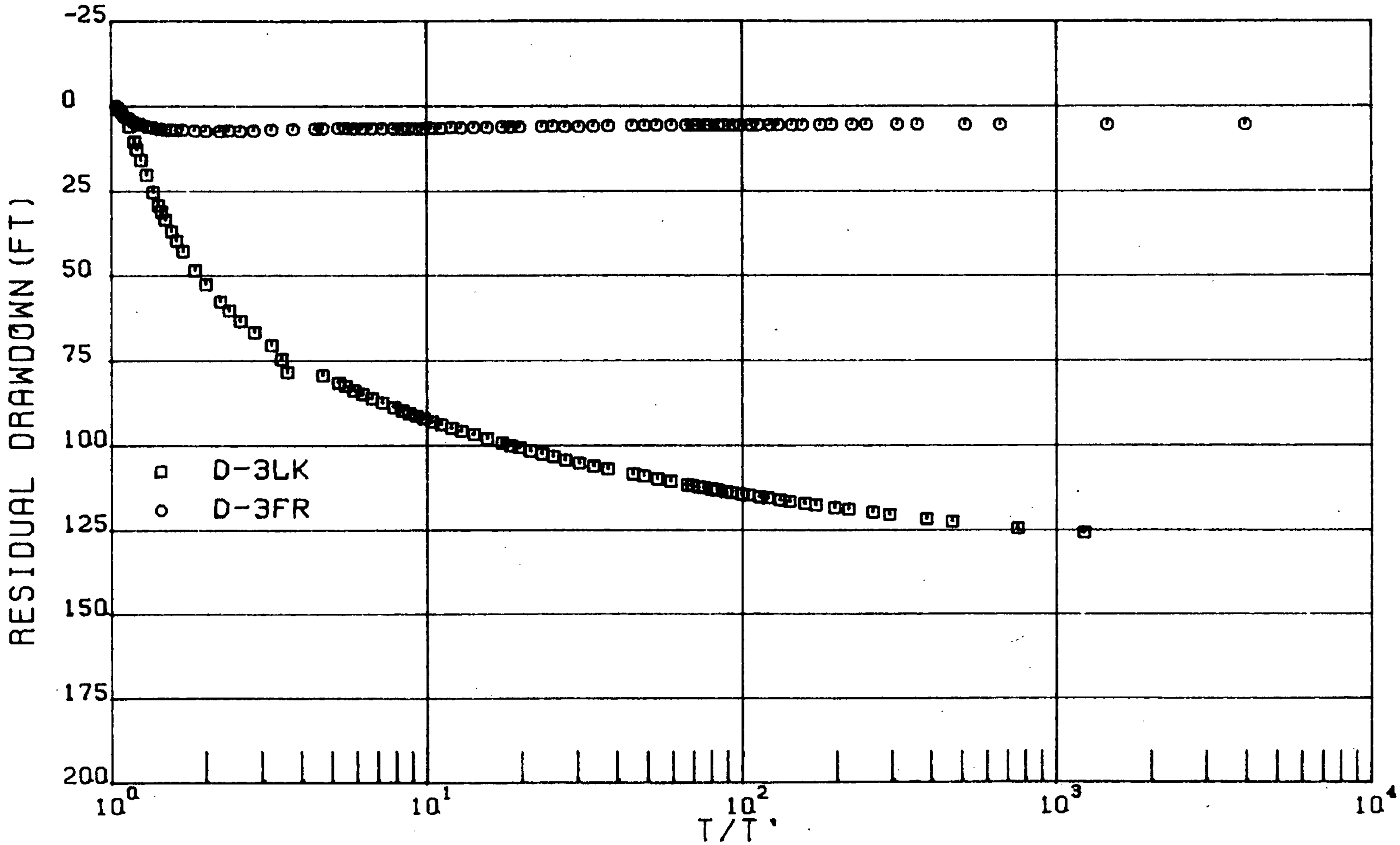


FIGURE C-5: RECOVERY GRAPH FOR D-4 WELL GROUP

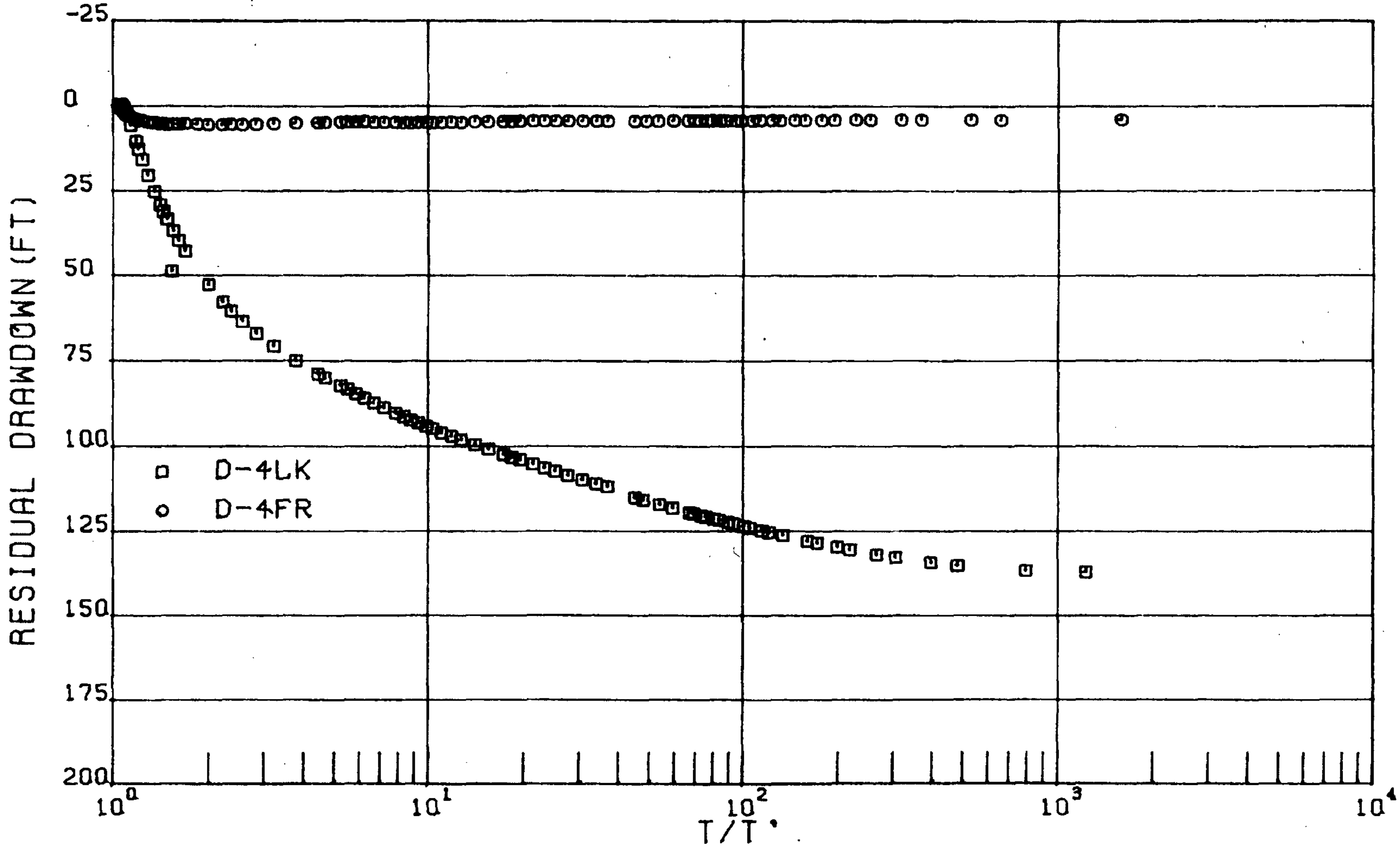


FIGURE C-6: RECOVERY GRAPH FOR WELL D-5LK

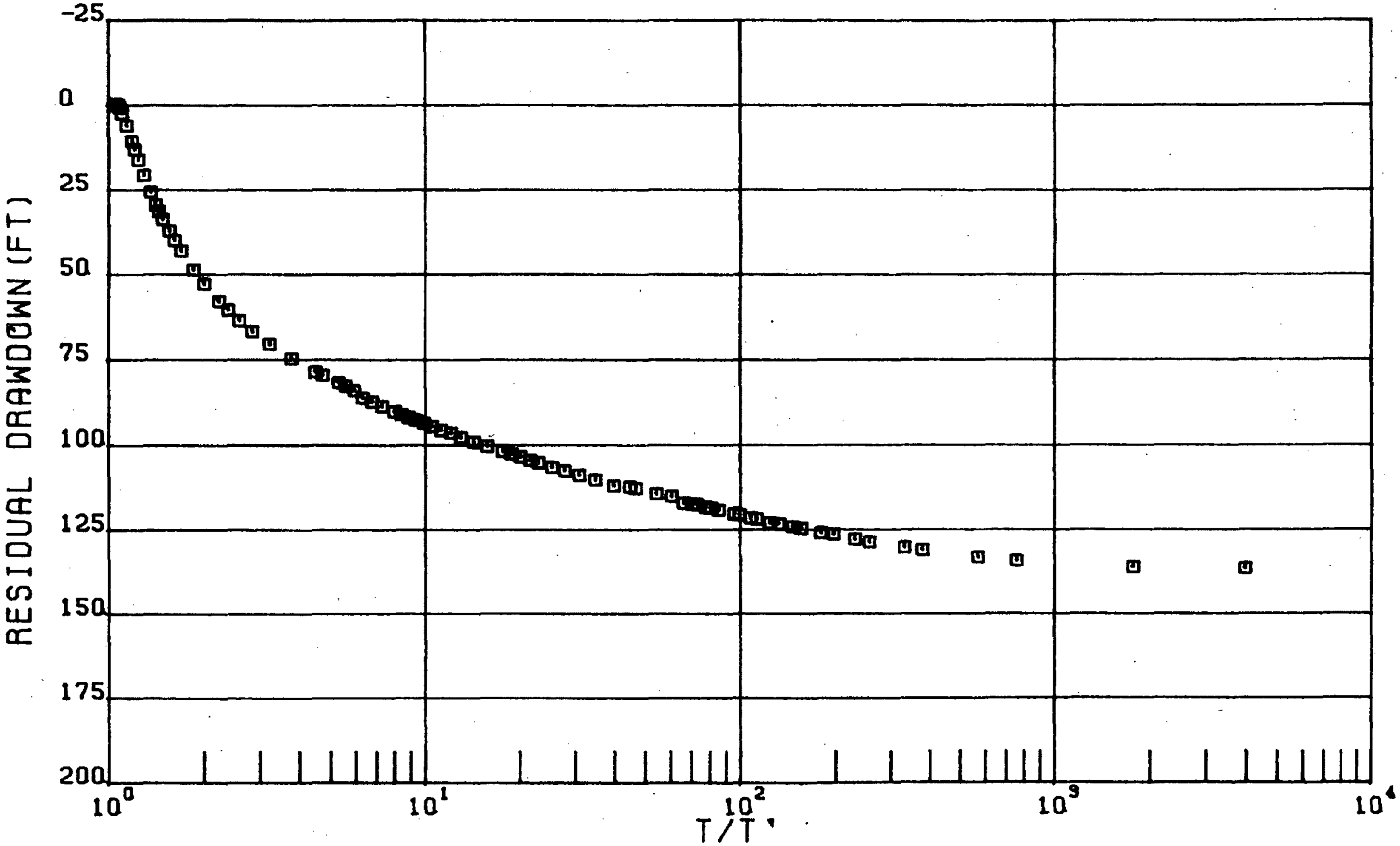
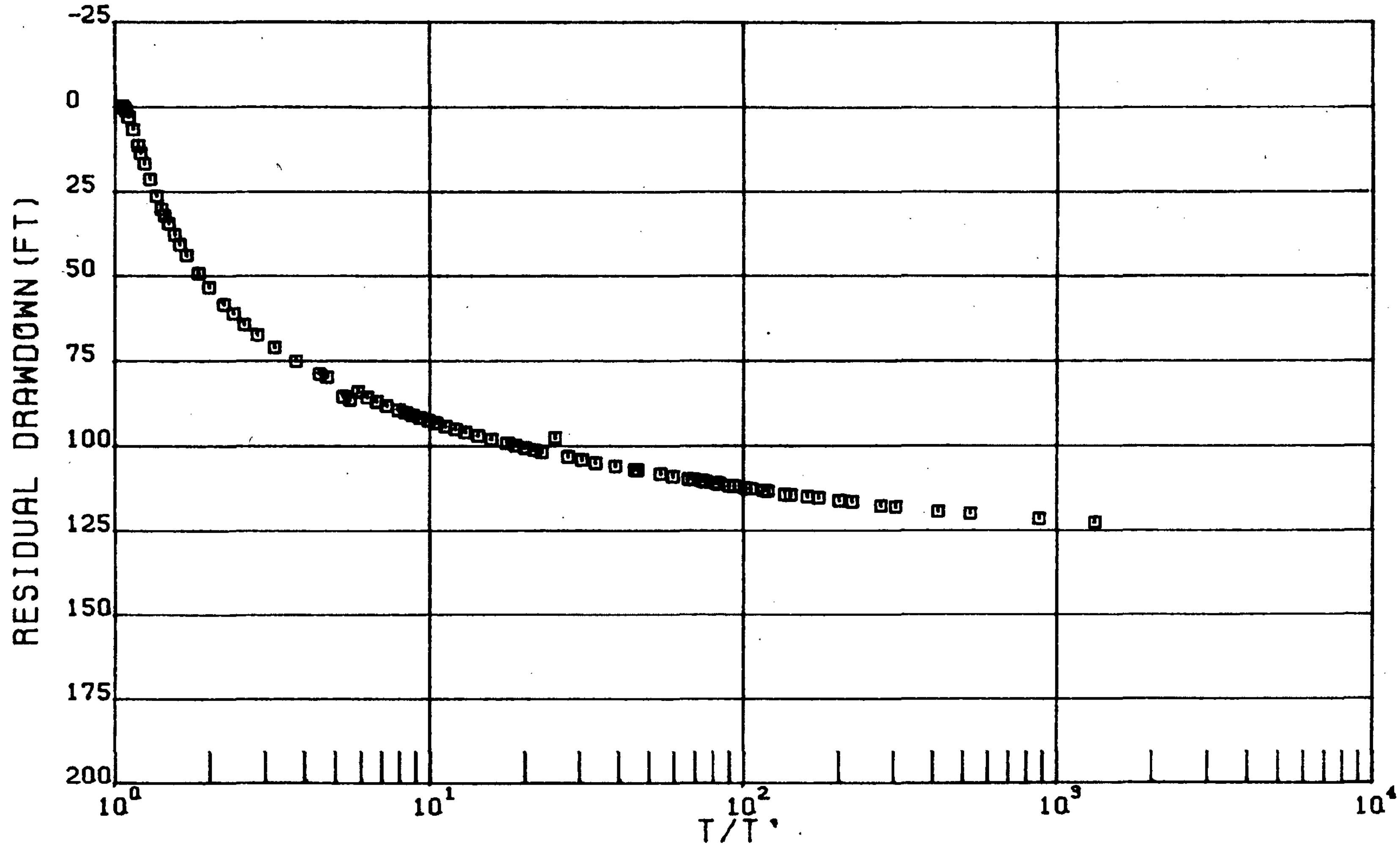
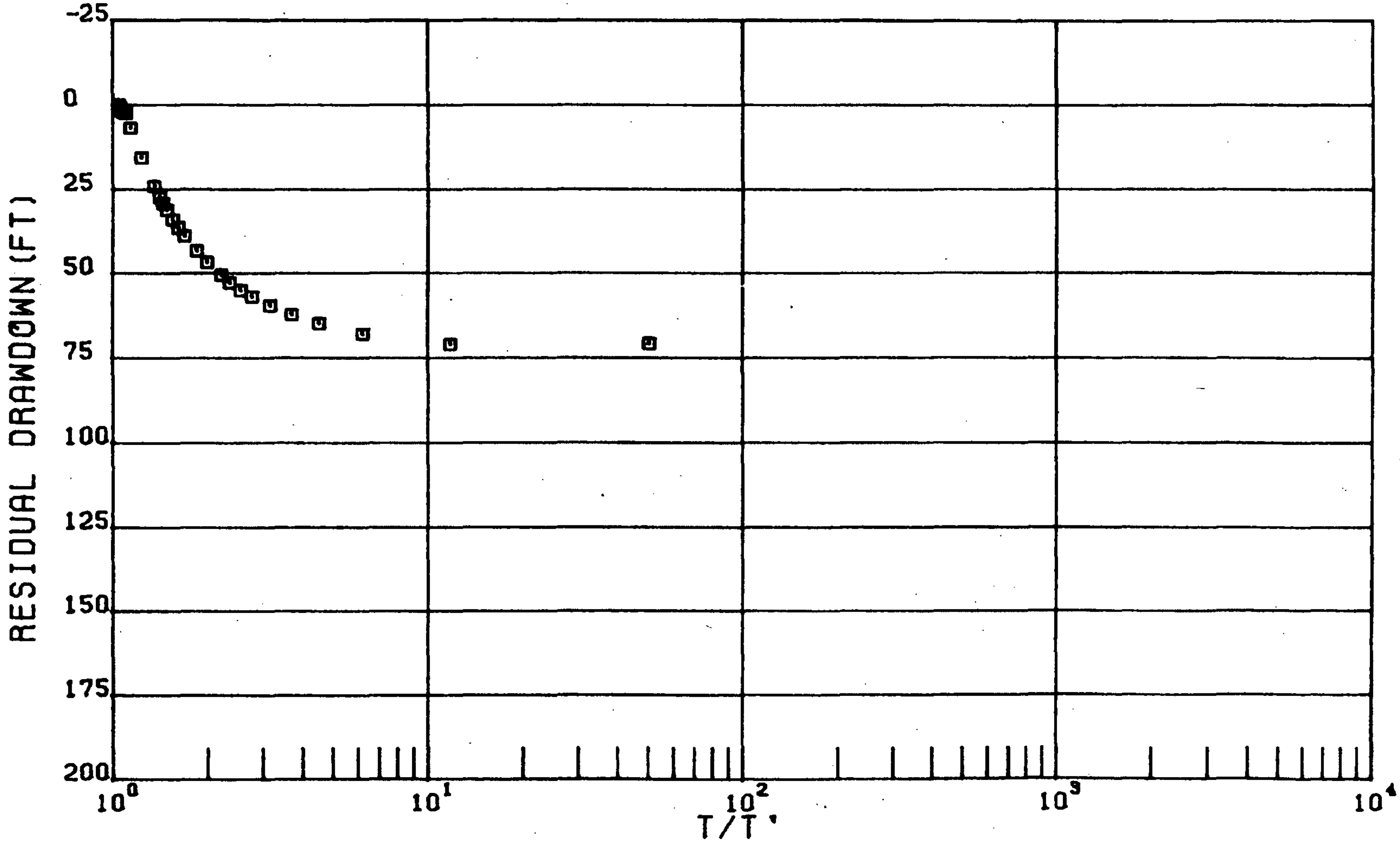


FIGURE C-7: RECOVERY GRAPH FOR WELL D-6LK



WR28-2-520-128.C-9

FIGURE C-9: RECOVERY GRAPH FOR WELL D-20LK



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Response: TR RAI-P&R-14(k)

Section 2.K. "Injection Procedures" of Appendix WR-7 "UIC Application, Class V Non-Hazardous Injection Wells (March 2010)" located in the ER_RAI Response package submitted to the NRC in August of 2010

POWERTECH (USA) INC.

Response: TR RAI-P&R-16(3)

TR Section 5.7.9

Quality Assurance Program Plan (QAPP)

5.7.8.2.2 ***Corrective Action and Monitoring***

Sampling frequency will be increased to weekly, pumping rates of production wells in the area of the excursion will increase, the net bleedwill increase individual wells will be pumped to enhance recovery of mining solutions, and an excursion report for NRC. If actions taken are not effective at retrieving the excursion within 60 days, Powertech will suspend injecting lixiviant into the production zone adjacent to the excursion until the excursion is retrieved and the UCL parameters are not exceeded.

5.7.8.2.3 Notification

In the event of an excursion Powertech will notify the NRC within 24 hours by telephone or email, and in writing with 30 days, and begin corrective actions.

Refer to ER Section 6.2.2.4.1 for more information regarding confinement for vertical excursions.

5.7.9 Quality Assurance Program

Powertech (USA) will establish a quality assurance program at the facility consistent with the recommendations contained in NRC Regulatory Guide 4.15 "*Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) -- Effluent Streams and the Environment*" (RG 4.15). The purpose of the program is to ensure that all radiological and nonradiological measurements that support the radiological monitoring program are reasonably valid and of a defined quality. These programs are needed (1) to identify deficiencies in the sampling and measurement processes and report them to those responsible for these operations so that licensees may take corrective action and (2) to obtain some measure of confidence in the results of the monitoring programs to assure the regulatory agencies and the public that the results are valid.

The quality assurance program will contain the following RG 4.15 elements:

- The organizational structure, responsibilities, and qualifications of both the management and the operational personnel.
- Specification and qualifications of personnel.
- The SOPs used in the monitoring programs.

- The records of samples, from collection to shipping to analysis.
- The records of quality control of the sample analyses, including results of quality control blanks, duplicates, and cross-checks performed by other laboratories.
- The calibration and operation of equipment used in obtaining samples, measuring radiation, etc.
- Data verification and validation procedures.
- The data and calculations used to determine concentrations of radioactive materials, radiation doses due to occupational exposure, etc.

Quality assurance procedures, as described in RG 4.14, Sections 3 will be defined for the following programs:

- External Monitoring Program
- Airborne Radiation Monitoring Program
- Contamination Control Program
- Airborne Effluent and Environmental Monitoring Program
- Management Control Program

The final QAPP requires site specific information that will not be available until the license is issued and without which the QAPP would not be complete. The applicant commits to prepare a final QAPP for review and approval prior to initiation of construction activities, and has provided below its draft outline for the requested QAPP (Table 5.7-2)

Table 5.7-2: Dewey - Burdock Project
Quality Assurance Program Plan - Draft Outline

1	Policy				
2	Table of Contents				
3	Introduction				
		3.1	Purpose		
		3.2	Scope		
		3.3	Relationship to Other Plans		
		3.4	Reference Documents		
4	Regulatory Requirements				
		4.1	Regulations		
		4.2	Regulatory Guidance		
5	Organization and Personnel				
		5.1	Organizational Structure		
		5.2	Personnel Responsibilities		
		5.3	Personnel Qualifications		
		5.4	Personnel Training and Certifications		
6	Procedures and Instructions				
7	Records and Recordkeeping				
		7.1	Records Management Plan		
		7.2	Record Retention Requirements		
8	Sampling and Analysis				
		8.1	Environmental Media		
				8.1.1	Sampling Methods and Procedures
				8.1.2	Sample Containers, Preservation and Holding Times
				8.1.3	Field Measurements
				8.1.4	Decontamination Procedures and Materials
		8.2	Occupational Health and Safety Monitoring		
9	Radionuclide Analysis				
		9.1.	Onsite Laboratory		
		9.2.	Contract Laboratory		
10	Instruments and Equipment				
		10.1	Calibration		
		10.2	Maintenance		
11	Data Management				
		11.1	Data Validation		

		11.2	Qualification of Data
		11.3	Anomalous Data
12	Assessment and Oversight		
		12.1	Review and Improvement
		12.2	Assessment and Corrective Actions

Additionally, quality assurance recommendations contained in RG 4.14 and RG 8.22 will be incorporated in to the environmental monitoring and bioassay programs, respectively. Generally, the quality control requirements for a specific activity will be incorporated into the SOP for that activity.

The quality assurance program will be audited periodically. The audits will be conducted by individuals qualified in radiochemistry and monitoring techniques. However, the auditors will not have direct responsibilities in the areas being audited. An example of an appropriate auditor is a consultant. The results of the audits will be documented and made available to members of management with authority to enact any changes needed (i.e. RSO, Mine Manager, etc.).

II. Radiological Issues

TR RAI-RI-1

Applicant needs to be consistent with the responsibilities and authority discussed in Regulatory Guide 8.31, Section 1.2, the applicant needs to provide a commitment that the Mine Manager cannot unilaterally override a decision of the RSO to suspend, postpone, or modify an activity.

Response: TR RAI-RI-1

See TR_RAI Response Replacement Pages; Section RI-1 for statement regarding limitation of mine manager to override an RSO decision; TR_Section 5.1.5.

TR RAI-RI-2 and 3

2. Provide the criteria by which the applicant will determine who is a qualified designee to replace the RSO (e.g., specialized training) in RWP review and approval activities and demonstrate how these criteria are consistent with Regulatory Guide 8.31.

3. Provide the criteria (e.g., specialized training) by which the applicant will determine who is a qualified designee to replace the RSO in radiation safety inspection activities and expected frequency of inspections performed by the designee.

Response: TR RAI-RI-2 and 3

See TR_RAI Response Replacement Pages; Section RI-2 and 3 for additional information concerning TR_Section 5.2.2 and Section 5.4.

TR RAI-RI-4

Sampling and analysis results

(a) In the Technical Report, no LLD or error values for fish are given in Tables 2.8-23 and 2.8-30 or in the lab report in Appendix 2.8-H.

(b) In Table 2.9-16 and 2.9-17 of the Technical Report, no LLD or error values are given for ground water.

(c) In Table 2.9-5 of the Technical Report, LLD values for soil samples are not provided.

(d) The results for sediment samples in Tables 2.9.8 and 2.9.9 of the Technical Report do not fully address reporting recommendations for LLD, error and quality assurance.

(e) In Table 2.9-12 of the Technical Report, LLD values for the radionuclide concentrations in air are reported. However, the LLD values are not reported on the corresponding laboratory report and NRC staff cannot locate the method of deriving these LLD values in the Technical Report.

Response: TR RAI-RI-4(a-e)

Description and Basis for Analytical Results and Reporting for LLD and Error; TR Section 2.8.4 under heading "Description and Basis for Analytical Results and reporting for LLD and Error". See Limits of Detection in TR Section 2.9.3.2.1.

Historical Knowledge:

Since the distribution of Regulatory Guide (RG) 4.14, NUREG-1576, 2004 Multi-Agency Radiological Laboratory Analytical Protocols Manual, (MARLAP) has been released and several analytical laboratories are implementing the guidance and concepts into their analytical programs. This multi-agency guidance was developed by a workgroup that included members representing EPA, DOE, DOD, DHS, and the NRC others include the NIST, USGS, FDA, the commonwealth of Kentucky and the state of California.

The information within Regulatory Guide 4.14 revision 1, 1980, states: "Regulatory Guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions different from those set out in the guides will be acceptable if they provide a basis for the findings requisite to the issuance or continuance of a permit or license by the Commission."

Minimum Detectable Concentration (MDC):

Definition of MDC from MARLAP 2004: Minimum detectable concentration (MDC): The minimum detectable value of the analyte concentration in a sample. ISO refers to the MDC as the minimum detectable value of the net state variable. They define this as the smallest (true) value of the net state variable that gives a specified probability that the value of the response variable will exceed its critical value i.e., that the material analyzed is not blank.

$$MDC = \frac{4.65\sqrt{\frac{CPM_B}{T_S} + \frac{2}{T_S^2}}}{2.22 \times E \times V \times R \times I}$$

Where:

MDC	=	Lower Limit of Detection (LLD or MDC)
CPM_B	=	Instrument Background count rate (min^{-1})
T_S	=	Count time (min) for the sample measurement
E	=	Standard efficiency
V	=	Sample volume in liters
R	=	Gravimetric recovery of $BaSO_4$
I	=	Ingrowth factor (see 8.4.4)
2.22	=	Unit conversion factor for pCi to DPM

The MDC functions as the sample specific detection limit (where the calculations have been vetted through Energy Laboratory Inc. (ELI)'s Radiochemistry consultant) where a response above that level is considered to meet the statistical criteria of 'likely to be a true detection' and not a potentially false positive. Where MDC is reported it is specific to the sample and its matrix (ISO, 1995; ANSI N42.23; NUREG-1576, 2004). For more information on detection limit terminology, concepts and principal approaches see NUREG – 4007, 1984.

Lower Limit of Detection (LLD):

Definition from MARLAP 2004: Lower limit of detection (LLD): (1) The smallest concentration of radioactive material in a sample that will yield a net count, above the measurement process (MP) blank, that will be detected with at least 95 percent probability with no greater than a 5 percent probability of falsely concluding that a blank observation represents a real signal (NRC, 1984). (2) An estimated detection limit that is related to the characteristics of the counting instrument (EPA, 1980).

The calculation referred to in several NRC documents for LLD is generally put this way:

$$LLD = \frac{4.66 \times \sigma_b}{2.22 \times E \times M \times R \times I}$$

Where:

LLD	=	Limit of detection as an a priori determination
σ_b	=	Standard deviation of the instrument background count rate (counts-min^{-1})
M	=	The sample weight (g) or volume (L)
E	=	Instrument efficiency for alpha or beta
R	=	Yield for the individual radionuclide as determined by tracer or carrier
I	=	Ingrowth factor
2.22	=	Conversion for dpm to pCi

Uncertainty/Error for a given measurement: (ELI reports it as precision of the analyte concentration).

Definition from Multi-Agency Radiological Laboratory Analytical Protocols Manual, MARLAP, 2004: Uncertainty (of measurement): Parameter, associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand (ISO, 1993a).

$$U_{95} = \pm \frac{1.96\sqrt{\dfrac{CPM_S + CPM_B}{T_S} + \dfrac{2}{T_S^2}}}{2.22 \times E \times V \times R \times I}$$

Where:

U_{95}	=	95% Confidence interval
1.96	=	z score for 0.975 coverage
CPM_S	=	Sample gross count rate (min^{-1})
CPM_B	=	Instrument Background gross count rate (min^{-1})
T_S	=	Count time (min) for the sample measurement
E	=	Standard efficiency
V	=	Sample volume in liters
R	=	Gravimetric recovery of $BaSO_4$
I	=	Ingrowth factor (see 8.4.4)

2.22 = Unit conversion factor for pCi to DPM

The error for a given measurement is shown on the analytical report as the analyte precision. It represents the 2 sigma (95%) confidence that the true activity is somewhere within the ± range of the reported value. The RL represents the LLD for a sample where sufficient volume is available and where the matrix presents minimal interference to the methods used for analysis.

RG 4.14 addresses guidelines for reporting sampling and analysis results in section 7, page. 4.14-6. A suggested format is shown in Table 3 of the guide. The analytical results submitted in Appendices via analytical reports provide the analytical information in table format similar to what is recommended in the RG 4.14.

Powertech (USA) (USA) Inc. followed Regulatory Guide 4.14 as a guidance document to develop the environmental baseline sampling program, conduct laboratory analysis and to report the analytical results. As stated by NRC in the introduction to Regulatory Guide 4.14, "The programs described in this guide are not requirements." Therefore, some variation from the exact format for presenting analytical results for radionuclides (i.e., error values and LLD values referenced in Regulatory Guide 4.14) resulted due to Energy Laboratories, Inc. (ELI) reporting nomenclature.

The ELI laboratory analytical reports provided in the appendices include error and LLD values the NRC is requesting under the nomenclature of precision (+/-) and RL (reporting limit) or MDC (in cases where a the RL was replaced with a sample specific LLD (minimum detectable concentration or MDC); effectively the MDC is the RL in these cases, such as is the case concerning analytical results of fish species.

TR RAI-RI-4(a-d) Statement of Clarification:

The tables referred to in the request for additional information such as 2.8-23; 2.8-30; 2.9-16; 2.9-17; 2.9.8; 2.9.9 are inserted as summary tables and were not meant for detailed review of all reporting values contained within an Analytical Report. The Appendices were provided within the application for a more detailed review of specifics regarding analytical results.

Appendix 2.8-H provides the laboratory analytical reports (QA/QC report included) for a variety of fish samples from Energy Laboratories, Inc. For each radionuclide, the error estimate is expressed as "precision (+/-)" immediately underneath the radionuclide result. The LLD for the radionuclide is shown in a separate column as RL (reporting limit) or MDC (minimum detectable concentration). See explanation above.

Appendix 2.9-A (Baseline Radiological Report) provides the laboratory analytical reports from Energy Laboratories, Inc. for air filter particulate matter, soils, vegetation and local food samples. For each radionuclide, the error estimate is expressed as "precision (+/-)" immediately underneath the radionuclide result. The LLD for the radionuclide is shown in a separate column under the RL (reporting limit) or MDC (minimum detectable concentration). See explanation above.

Supplemental Appendix to Section 2.7 (CD enclosed) provides the laboratory analytical reports from Energy Laboratories, Inc. for groundwater, surface water and sediment samples. For each radionuclide, the error estimate is expressed as "precision (+/-)" immediately underneath the radionuclide result. The LLD for the radionuclide is shown in a separate column as RL (reporting limit) or MDC (minimum detectable concentration). See explanation above for deriving LLD values.

The LLDs reported in Table 2.9-12 of the Technical Report were derived by dividing the reported MDC or RL on the laboratory report in units of activity per filter composite by the total volume of air in milliliters that was sampled for that period. It was assumed for radiological data that the MDC and RL on the laboratory reports were identical (see explanation above). For natural uranium, the mass per filter composite was converted to activity per filter composite by multiplying the mass result from the laboratory by 677 (pCi/mg), the specific activity for natural uranium.

<u>TR RAI-RI-5</u>

Consistent with Regulatory Guide 4.14, all radiological data should be reported as a value and its associated error estimate, including values less that the lower limit of detection or less than zero.

<u>Response: TR RAI-RI-5</u>

See TR_RAI Response Replacement Pages; Section RI-5 for TR_RAI Attachment RI-5 a Letter received from Energy Laboratory on 22 October 2010 concerning Powertech (USA)'s data consistency inquiry.

POWERTECH (USA) INC.

Response: TR RAI-RI-1

Additional Commitment
RSO Responsibilities and Authority

5.1.2 Chief Operating Officer

The COO is empowered by the Board of Directors to have the responsibility and authority for the radiation safety and environmental compliance programs at all Powertech (USA) facilities. The COO is directly responsible for ensuring that Powertech (USA) personnel comply with corporate industrial safety, radiation safety, and environmental protection programs. The COO is also responsible for company compliance with all regulatory license conditions/stipulations, regulations, and reporting requirements. The COO has the responsibility and authority to terminate immediately any activity that is determined to be a threat to employees, public health, or the environment, or a violation of state or federal regulations. The COO has the authority to assign corporate resources (e.g. capital equipment, personnel, budget) to ensure corporate environmental, health, and safety goals and directives are met.

5.1.3 Vice President of Environment, Health, and Safety

The Vice President of Environment, Health, and Safety is responsible for all radiation protection, health and safety, and environmental programs for Powertech (USA) and ensuring these programs meet applicable regulatory requirements and industry best management practices. The Vice President is responsible for ensuring that all company operations comply with all applicable laws and regulations. The Vice President reports directly to the COO.

5.1.4 Mine Manager

The Mine Manager will be responsible for all operations at the project facility. The Mine Manager will be responsible for compliance with all applicable laws and regulations as well as corporate health, safety and environmental programs. The Mine Manager will have the authority to terminate immediately any operation of the facility that is determined to be a threat to employees, public health, or the environment, or a violation of laws or regulations. The Mine Manager reports directly to the COO. The Mine Manager has the authority to assign facility resources (e.g. capital equipment, personnel, budget) to ensure corporate environmental, health, and safety goals and directives are met. The Mine Manager will act promptly on recommendations made by the Radiation Safety Officer to correct deficiencies identified in the radiation or environmental monitoring programs.

5.1.5 Radiation Safety Officer

The Radiation Safety Officer (RSO) will be the person in charge of and responsible for the radiation protection and as low as reasonably achievable (ALARA) program. The RSO will ensure that equipment and laboratory facilities are adequate for monitoring and evaluating the relative attainment of the ALARA objective. The RSO will develop, review, approve and enact changes in the program so that protection against uranium and its progeny and the ALARA principle are maintained during the operation of the facility. These changes include new equipment, process changes, and changes in the operating procedures.

The RSO will also have the authority to enforce regulations and administrative policies that affect the program and can raise issues concerning safety to Mine Manager and the Vice President of Environment, Health, and Safety as shown in Figures 5.1-1 and 5.1-2. A mine manager will not possess the authority to unilaterally override the RSO's decision to suspend, postpone or modify an activity. The RSO will possess the authority to enforce regulations and administrative policies that may affect any aspect of the radiological protection program. The RSO will also be a member of the SERP described in Section 5.2.3 and will meet the qualifications outlined in NRC guidance.

The RSO reports directly to the Vice President of Environment, Health, and Safety.

5.2 Management Control Program

This section describes administrative controls within the Powertech (USA) organization that are intended to ensure the facility is operated in a manner that is protective of human health and the environment, including the principle of ALARA. Powertech (USA)'s Management Control Program will ensure that all applicable procedures concerning evaluations of the consequences of a spill or incident against 10 CFR Part 20, Subpart M and 10 CFR 40.60 reporting criteria are met. Powertech (USA) has committed to procedures to avoid or mitigate potential effects on archaeological and historic sites. This commitment is incorporated by reference in ER Appendix 4.10B.

5.2.1 Routine Activities

All routine activities involving handling, processing, or storing of radioactive material at the Dewey-Burdock facility will be documented by written standard operating procedures (SOPs). In addition, written SOPs will be established for health physics monitoring, sampling, analysis, and instrument calibration. These SOPs involving radioactive material handling will incorporate pertinent radiation safety practices.

Each SOP will be reviewed and approved in writing by the RSO or the RSO designee prior to implementation. Any proposed changes to an SOP must also be reviewed and approved in writing by the RSO or the RSO designee. The RSO will review each SOP at least annually to ensure it follows any newly established radiation protection practices.

Up-to-date copies of the SOPs, along with accident response and radiological fire protection plans, will be made available to all employees. All SOPs will be managed in a manner which allows for tracking of revisions and dates of the revisions.

5.2.2 Non-Routine Activities

Any activities with potential for significant exposure to radioactive material and not documented by existing SOPs will require radiological work permits (RWPs). RWPs are job-specific permits that describe the following:

1. The details of the job to be performed,
2. Precautions necessary to maintain radiation exposures ALARA, and
3. The radiological monitoring and sampling necessary before, during, and following completion of the job.

The RSO or the RSO designee must review and sign off on the RWP before the associated work is to be performed. That work will be executed to the details specified in the RWP. The RSO designee shall be able to describe which locations, operations and jobs are associated with the highest exposures and why exposures may increase or decrease during work execution. See section 5.4 for radiation staff qualifications.

5.2.3 Safety and Environmental Review Panel

A SERP will be established. The SERP will consist of at least three members. One member will be the RSO. Another member will be someone with authority to implement managerial and financial changes (e.g. the Mine Manager). Another member will be someone with authority to make operational changes (e.g. the Production Superintendent). The SERP may include others on a temporary or permanent basis whenever the SERP requires additional technical or scientific expertise and may be other employees or consultants. At least one member of the SERP shall be designated as chairman.

The purpose of the SERP will be to evaluate, discuss, approve, and record any changes to any SOP, the facility, or tests and experiments involving safety or the environment. The changes will not require a license amendment pursuant to 10 CFR 40.44 as long as the changes do not:

POWERTECH (USA) INC.

Response: TR RAI-RI-2 and 3

RSO Designee Qualifications and Training

- Assessment of whether equipment for exposure control is being properly used, maintained, and inspected

- Recommendations on ways to further reduce personnel exposures from uranium and its progeny

5.4 Qualifications for Personnel Implementing the Radiation Safety Program

The minimum qualifications for the RSO are:

- A bachelor's degree in the physical sciences, industrial hygiene, or engineering from an accredited college or university or an equivalent combination of training and relevant experience in radiation protection at a uranium recovery facility. Two years of relevant experience will generally be considered equivalent to one year of academic study.

- At least one year of uranium recovery work experience in applied health physics, radiation protection, industrial hygiene, or similar area. This experience should involve hands-on work with radiation detection and measurement equipment, not strictly administrative work.

- At least four weeks of specialized classroom training in health physics.

- A thorough knowledge of the health physics instrumentation used in the facility, the chemical and analytical procedures used for radiological sampling and monitoring, methods used to calculate personnel exposure to uranium and its progeny, the uranium recovery process, and the facility hazards and their controls.

The minimum qualifications for a RSO designee will include:

- Training equal to the minimum qualifications of the appointed RSO as specified in Section 2.4 of RG 8.31.

- Must pass with an 80 percent score or better regarding the minimum training of the RSO.

- The level of experience required will be commensurate with the type, form and the anticipated radiation hazards to be encountered while acting as a designee for the appointed RSO.

On-the job training overseen by the lead RSO will provide expertise regarding implementation of site specific radiological safety protocols and any necessary specialized radiation safety training concerning a specific RWP. For more information see section 5.2.2.The minimum qualifications for a Health Physics Technician are one of the following combinations:

- An associate's degree or two or more years of study in the physical sciences, engineering, or a health-related field; at least four weeks of generalized training in radiation health protection applicable to uranium recovery facilities (up to two weeks may be on-the-job training); one year of work experience using sampling and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures that apply to uranium recovery facility operations.
- A high school diploma; at least three months of specialized training in radiation health protection relevant to uranium recovery facilities (up to one month may be on-the-job training); two years relevant work experience in applied radiation protection.

5.5 Radiation Safety Training

This section describes minimal training requirements to ensure all employees and visitors have an adequate level of knowledge to recognize and are aware of potential radiological and non radiological hazards associated with activities they will be involved with at the facility.

5.5.1 Initial Training

Prior to working at the facility, all facility workers and supervisors subject to occupational radiation dose limits (i.e. radiation workers) will be instructed by means of a documented training class in the risks of radiation exposure and the fundamentals of protection against exposure to uranium and its progeny. Other guidance to be provided as appropriate is found in NRC Regulatory Guide 8.13 *"Instruction Concerning Prenatal Radiation Exposure"* and NRC Regulatory Guide 8.29 *"Instruction Concerning Risks From Occupational Radiation Exposure"*. The course of instruction will include the following topics:

- Fundamentals of Health Protection
  - The radiological and toxicological hazards of exposure to uranium and its progeny
  - How uranium and its progeny enter the body (inhalation, ingestion, and skin penetration)
  - Why exposures to uranium and its progeny should be kept ALARA
- Personal Hygiene
  - Wearing protective clothing

POWERTECH (USA) INC.

Response: TR RAI-RI-5

Energy Laboratory Letter
22 October 2010

ENERGY LABORATORIES

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10/22/2010

Timothy D. Bailey, Ph.D.
Energy Laboratories, Inc
PO Box 30916
Billings, MT 59107

Amy L. Thurlkill
E.H.S. Manager; RSO – Corporate
Powertech (USA) Inc.
5575 DTC Parkway Suite # 140
Greenwood Village, CO 80111

Dear Ms. Thurlkill:

Linda Larson, manager of our Rapid City laboratory, and Dave Blaida, radiochemistry supervisor for our Casper laboratory have requested my assistance in evaluating our ability to comply with Powertech's request to reprocess our original analytical data for results from early portions of the Dewey-Burdock project. I understand your goal of providing analytical results from across the project in a fully consistent fashion.

During the course of your project there was a nationwide movement to follow the recommendations of the Multi-Agency Radiological Laboratory Analytical Protocols (MARLAP). One area covered by the MARLAP manual is redefining governmental agencies' expectations from radiological laboratories. MARLAP recommends that radioanalytical data be presented as a numerical result combined with an uncertainty estimate specific to the conditions of the analysis. We were introduced to MARLAP in 2005 at a seminar at the USGS office in Denver and we have since worked under the direction of Dr. Robert Litman to implement the recommended MARLAP changes at Energy Labs. Dr. Litman was one of the authors of the MARLAP manual and is a nationally recognized expert in the field of radiochemistry.

A central element of the MARLAP recommendations is that analytical concentrations always be presented as a numerical result combined with an uncertainty estimate specific to the conditions of the analysis. To evaluate such a result, it is also necessary to have a measure of detectability under the same analytical conditions. This is the minimum detectable concentration, or MDC. The guidance provided in MARLAP that we have now incorporated into our methods discontinues the practice of the detect/non-detect reporting formats that were used for your early data. Consequently we are not able to reprocess the original analytical data as you have requested. Even if it were possible for us to recalculate specific values on the previous data, there would be no reasonable way to make a direct comparison between the analytical results.

Let me reassure you that all results reported to Powertech for this project were generated with attention to the same high quality standards. The inherent differences between the lab procedures designed to produce the "ND at reporting limit X" result format and the procedures designed to produce the "numeric result / uncertainty / MDC" result format currently used by our radiochemistry department simply preclude reprocessing the data in a meaningful fashion.

The decision to make the transition between these reporting formats in our radiochemistry operations was not made lightly. We recognized that the change would necessarily cause discontinuities in some customers' data sets. But this transition was an essential element in a process of continuous improvement.

We regret any inconvenience the discontinuities in analysis reporting formats may cause you. Please understand that these changes were implemented to provide the best available service for Powertech and all our customers as the regulatory community redefines reporting for radiochemical analysis.

Sincerely,

Timothy D. Bailey

Timothy D. Bailey, Ph.D.
Senior Chemist
Energy Laboratories, Inc.

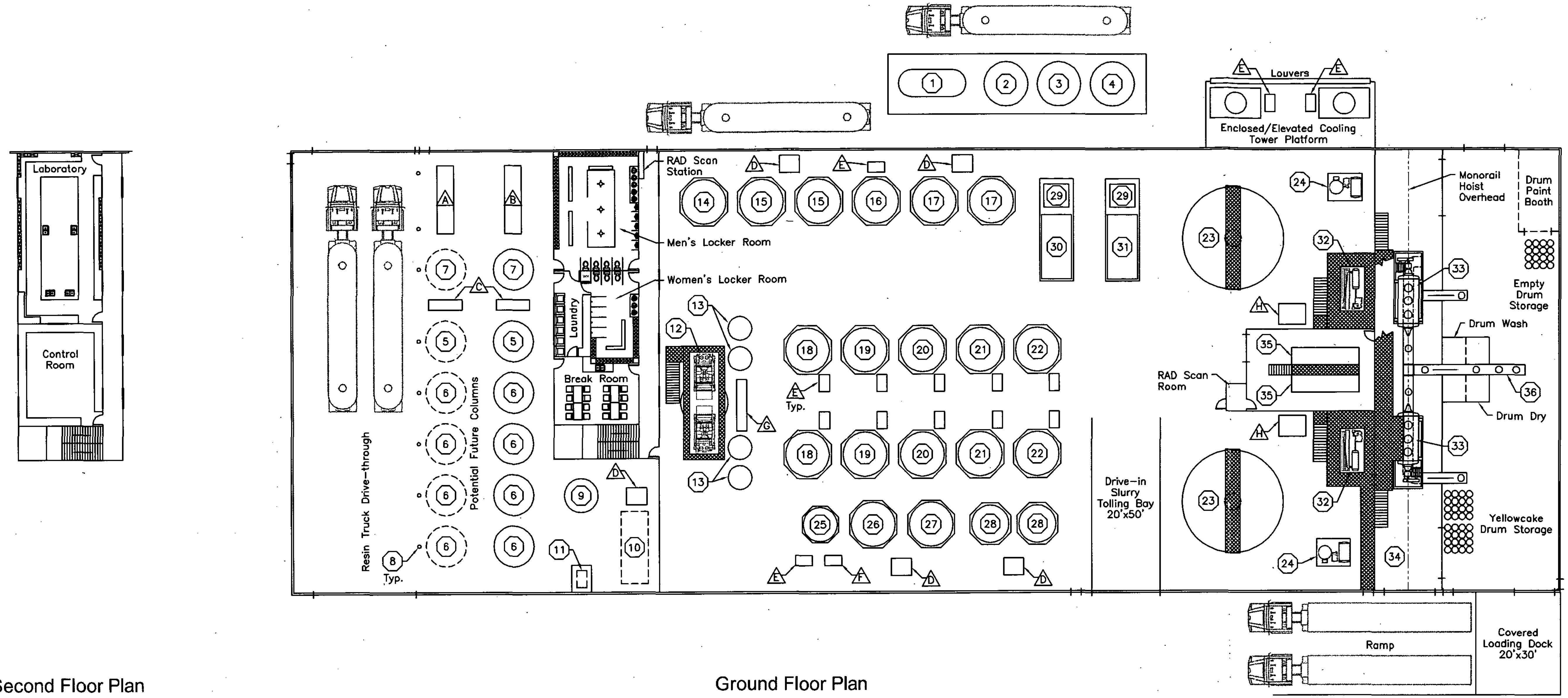
Within this response e-mail the question presented to Energy Laboratory is in Black and the response from the laboratory is in Blue.

"Laboratory analytical reports for Ra-226 soil sample analyses are located in Appendix 2.9-A of the TR. It is not clear what type of gamma analysis was performed on the soil samples to determine the Ra-226 concentration.[Dave Blaida] EPA 901.1 is reference method. Closed can gamma analysis per a three(3) inch can filled with about 150-200 grams of soil. Soil is dried, ground, split. canned and taped. For example, the testing method for sample R07100004-003 (SMA-B03) is annotated as "Gross Gamma" on the Analytical Summary Report, but the results are listed as "Ra-226 Gamma" on the Laboratory Analytical Report.[Dave Blaida] The results are listed as radium 226 gamma which is ascertained by measuring the 609 kev peak of bismuth 214. Far and away the best photo peak to use since it's branching ratio(relative strength) is higher than any other pertinent energies. The radium 226 photo peak cannot be used due to it's overlap with the uranium 235 photo peak. Lead 214 has two(2) quantifiable energies at 295 and 352 kev that are used by some but bismuth 214 is cleaner with less background issues relating to Compton scatter. Consistent with Regulatory Guide 4.14, please provide laboratory documentation that specifies the photopeak energies used to determine the Ra-226 activity of the soil samples as reported in the Laboratory Analytical Report."

POWERTECH (USA) INC.

Response: TR RAI-MI-1(a)

TR Section 3.2.8.1
Chemical Incidents and Radiological Safety



Second Floor Plan

Ground Floor Plan

Key Notes

1. CO_2
2. NaOH
3. H_2SO_4
4. H_2O_2
5. Reclamation IX Column 12'ø
6. Process IX Column 12'ø
7. Bleed IX Column 12'ø
8. Pipe Bollard Guard Post
9. Resin Transfer Water 10'ø
10. Resin Supersack Storage
11. Standby Generator in Sound Insulated Room
12. Shaker Screens with Shaker Overflow Collection Tank Below
13. Elution Column 7'ø
14. Reclamation Make-up Water 13'ø
15. NaCl 13'ø
16. Na2CO3 13'ø
17. Utility Water 13'ø
18. Fresh Eluant 13'ø
19. Lean Eluant 13'ø
20. Intermediate Eluant 13'ø
21. Rich Eluant 13'ø
22. Precipitation 13'ø
23. 30'ø Thickener, 5'ø Shear Tank Below
24. Hot Oil Boiler
25. Potable Water 10'ø
26. High TDS Wastewater Tank 13'ø
27. Low TDS Wastewater Tank 13'ø
28. Solids Removal Tank 11'ø
29. RO Pre-treatment
30. Recovery RO Unit
31. Restoration RO Unit
32. Elevated Condenser/Vacuum Pump Skid 7'x13'
33. Vacuum Dryer 8'x24'
34. Dryer Room 20'x130'
35. Filter Press and Transfer Pump 5'x20'
36. Drum Conveyor

Housekeeping Pads

- A: 5'x20' – PC Booster Pumps
- B: 5'x20' – IC Booster Pumps
- C: 3'x10' – Pump
- D: 6'x5' – Pump
- E: 3'x5' – Pump
- F: 3'x5' – Disinfectant
- G: 3'x15' – Pump
- H: 6'x8' – Pump

0 15 30 60
Scale in Feet

Central Processing Plant Detail

Dewey-Burdock Project

DRAWN BY	Cadd Services, S.Hetrick
DATE	30-Jun-2010
FILENAME	CPP-Detail - rev 1.dwg

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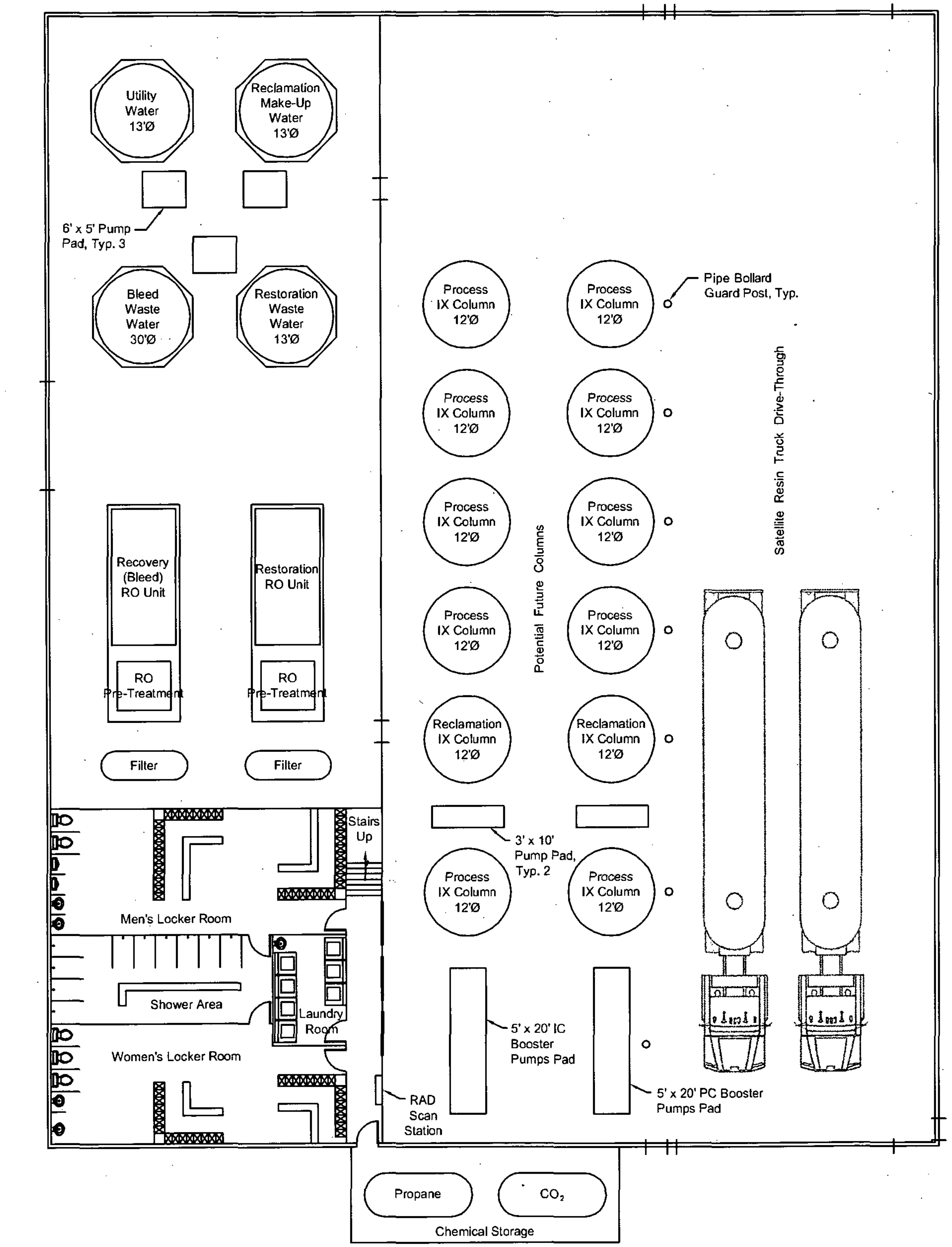
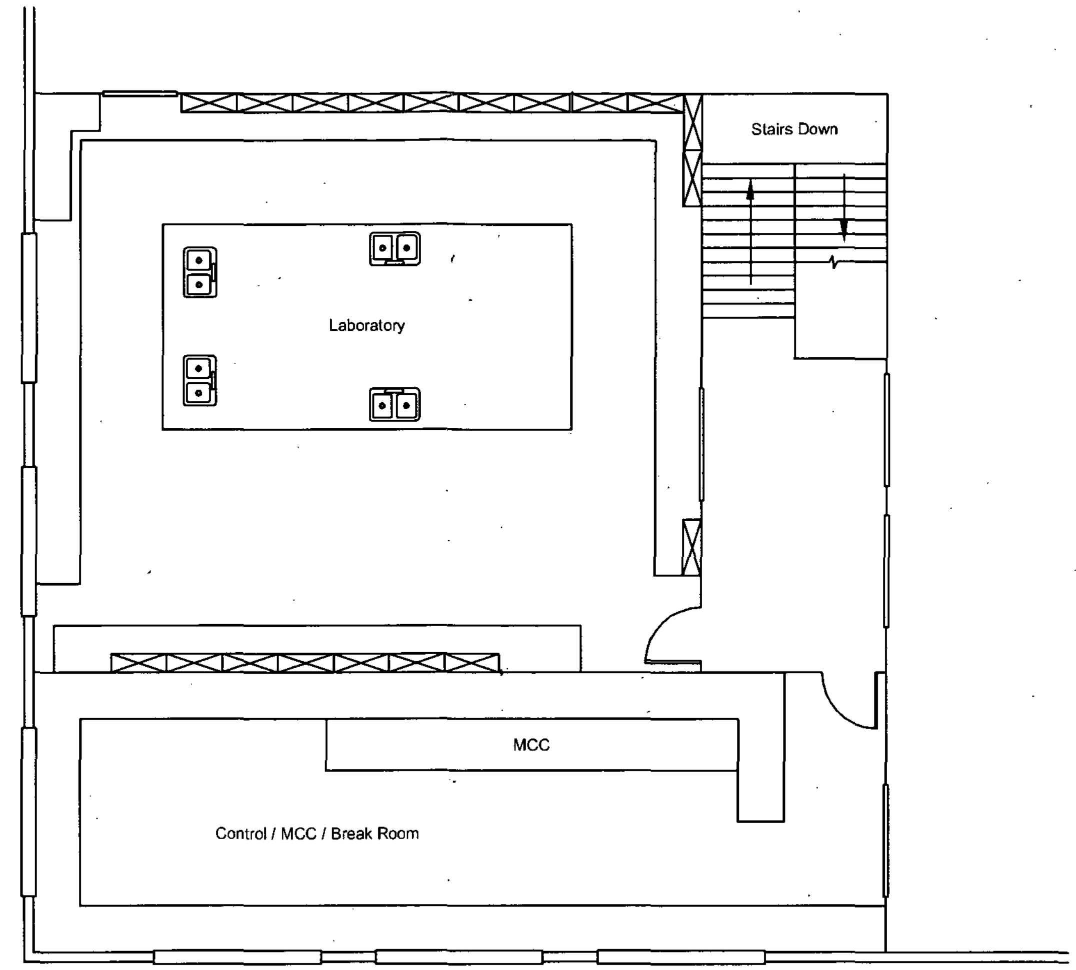


Ground Floor Plan

0 10 20 40

Scale: 1" = 20'



Second Floor Plan

0 5 10 20

Scale: 1" = 10'

Satellite Processing Plant Detail

Dewey-Burdock Project

DRAWN BY Cadd Services, S.Hetrick

DATE 17-Jun-2010

FILENAME Sat-Detail - rev 1.dwg

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the control room. The measured flow will be used to control pump motor speed via a variable frequency drive.

Restoration Reverse Osmosis System

The restoration RO system at each site will be a packaged system capable of treating approximately 500 gpm and producing a permeate stream and a reject brine. This system will include necessary pretreatment, including multi-media or sand filters and feed conditioning.

3.2.8 Chemical Storage and Feeding Systems

The ISL process requires chemical storage and feeding systems to store and dose chemicals at various stages in the extraction, processing, and waste treatment processes. Chemical storage and feeding systems will include chemicals listed in Table 3.2-1 and propane. Each chemical storage and feeding system will be designed to safely store and accurately deliver process chemicals to their intended delivery point in the process. Design criteria for chemical storage and feeding systems include applicable sections of the international building code, international fire code, OSHA regulations, RCRA regulations, and Homeland Security.

3.2.8.1 Chemical Incidents and Radiological Safety

Risk assessments completed by the NRC in NUREG-6733 Section 4 for ISL facilities focused on indirect interactions between the chemicals used in ISL mining and other substances and the potential of operational hazards to workers. Powertech will, via engineering design and implementation of safety standards utilized in the chemical process industry, ensure that risk from chemical events are lower or at the acceptable industry standard. The radiological risks are minimal when considering specific chemicals that would directly interact with radionuclides to cause a hazardous event (NUREG/CR-6733, 2001). With that stated, Powertech will implement applicable regulations such as:

- 40 CFR Part 68, Chemical Accident Prevention Provisions
- 29 CFR 1910.119, Occupational Safety and Health Administration Standards
- 40 CFR Part 355, Emergency Planning and Notification
- 40 CFR 302.4, Designation, Reportable Quantities, and Notification

Also, see Table 4-1 in NUREG-6733 for a list of pertinent regulations for the chemicals used at ISL facilities.

Appropriate engineering controls and implementation of the appropriate design, compliance with applicable regulatory standards will ensure safe handling procedures, operating practices, and will serve to prevent a chemical event from impacting radiological safety. Acceptable safeguards will be implemented to ensure that if such an event were to occur, the impact would be small and quickly addressed by trained spill response staff.

See section 7.5 for information regarding potential radiological safety impacts of chemicals utilized at ISL facilities.

The CPP will be designed in such a manner as to comply with industry building codes and concrete containment designed to hold the contents of the largest tank inside the facility. Any spill would be directed into a floor sump and back into the process circuit or into a waste disposal system. Tanks located outside the CPP will utilize a similar containment system. Some tanks may be reinforced via a double wall.

Table 3.2-1: Process-related chemicals and quantities stored on-site

BURDOCK				
Chemical Name	**No. Tanks**	**Unit Storage Capacity**	**Units**	**Consumption Rate ton/yr**
Sodium Chloride (NaCl)	2	20000	gal	2250
Sodium Carbonate (Na_2CO_3) i.e. Soda Ash	1	20000	gal	450
Hydrochloric Acid (HCl, 32%, or Sulfuric Acid ($H_2SO_4$98%)	1	7000	gal	487
Sodium Hydroxide (NaOH 50%)	1	7000	gal	446
Hydrogen Peroxide ($H_2O_2$40%)	1	7000	gal	177
Oxygen (O_2, liquid)	1	11000	gal	979
Carbon Dioxide (CO_2)	1	6000	gal	245
Barium Chloride ($BaCl_2$)	1	275	50kg sacks	7
DEWEY				
Oxygen (O2, liquid)	1	11000	gal	653
Carbon Dioxide	1	6000	gal	163
Barium Chloride	1	138	50-kg sacks	7

3.2.8.2 Sodium Chloride Storage

Sodium chloride will be used to make up fresh eluant and will be stored in tanks as a saturated solution (approximately 26 percent by weight) in equilibrium with a bed of crystals in each storage tank. Dry sodium chloride will be delivered by truck and will be blown into the storage tanks using air pressure. Sodium chloride is classified as a non-flammable. Sodium chloride react vigorously with H_2SO_4, therefore the storage areas are located in separate areas of the CPP where unintentional contact is unlikely to occur (Figures 3.2-4 and 3.2-5). Sodium chloride can be moderately toxic if inhaled, therefore precautions are taken to ensure that inhalation of the dust is avoided via good housekeeping, and appropriate ventilation.

Sodium Chloride Tanks

Sodium chloride will be stored as a saturated solution in equilibrium with a bed of solid crystals within the storage tank. The sodium chloride tanks will each be a vertical cylindrical atmospheric tank with a sloped bottom and flat cover. Each tank will be constructed of Fiberglass reinforced plastic (FRP), and will be approximately 13 ft in diameter with a height of 20 ft. Each tank will be equipped with a level indicator/transmitter which will measure and indicate tank level both locally and in the control room. Each tank will be connected to a vent header which exhausts through a vent stack on the building roof, and will be equipped with a scrubber to prevent emission of particulates during truck unloading.

Sodium Chloride Pumps

There will be two sodium chloride pumps that will have wetted parts constructed of FRP. Each pump will be equipped with a pressure indicator on the pump discharge line, and a flow meter and flow indicator transmitter in the discharge line. Flow will be indicated both locally and in the control room. The measured flow will be used to control pump motor speed via a variable frequency drive.

3.2.8.3 Sodium Carbonate Storage

Sodium carbonate will be used to make up fresh eluant and will be stored in tanks as a saturated solution in equilibrium with a bed of crystals in the storage tank. Sodium carbonate react vigorously with HCL therefore the storage areas are located in separate areas of the CPP where unintentional contact is unlikely to occur (Figures 3.2-4 and 3.2-5). Sodium carbonate can be moderately toxic if inhaled, therefore precautions are taken to ensure that inhalation of the dust is avoided via good housekeeping, and appropriate ventilation. Sodium carbonate solution will be maintained at a temperature of 105 F to prevent precipitation in the tank and piping. This will be accomplished by circulating liquid from the tank through a heat exchanger. Dry sodium

POWERTECH (USA) INC.

Response: TR RAI-MI-1(b)

TR Section 3.2.8.4 and TR Secgtion 7.5.1

Acid Storage Tank Location and Ventilation

Consequences, Preventative and Mitigation Measures of a Potential Fire or Explosion

Powertech (USA) Inc.

Response: TR RAI-MI-1(c)

TR Section 3.2.8.4
Acid Storage Tank Location and Ventilation

Response to the U.S. NRC's Request for Additional Information
Dewey-Burdock Uranium Project-Source Material License Application
Technical Report Submitted August 11, 2009.

carbonate will be delivered by truck and will be blown into the storage tanks using air pressure. Sodium carbonate is also known as soda ash and is classified as a non-flammable material.

Sodium Carbonate Tank

The sodium carbonate tank will be constructed of FRP, and will be equipped with a level indicator/transmitter which will measure and indicate tank level both locally and in the control room. The tank will be connected to a vent header which exhausts through a vent stack on the building roof, and will be equipped with a scrubber to prevent emission of particulates during truck unloading.

Sodium Carbonate Pumps

The sodium carbonate pumps will have wetted parts constructed of FRP. Each pump will be equipped with a pressure indicator on the pump discharge line, and a flow meter and flow indicator transmitter in the discharge line. Flow will be indicated both locally and in the control room. The measured flow will be used to control pump motor speed via a variable frequency drive.

3.2.8.4 Acid Storage and Feeding System

The acid storage and feeding system will include a storage tank and delivery pump. The storage tank will be located outside of the CPP building in a lined concrete secondary containment basin designed to contain 110 percent of tank volume plus a 25 year, 24 hour storm event. This secondary containment basin will be separate from the containment basins for other chemical systems. The acid feed pump will be located inside the building, directly adjacent to the outside storage tank. Proper ventilation will prevent a significant inhalation hazard should a leak or spill occur inside the CPP. If the ventilation system is inoperable and a spill occurs, personnel would be directed to exit the building immediately. Spill response according to standard operating procedures will be implemented upon discovery of a potential leak or spill.

Acid Storage Tank

The acid storage tank will be designed to store sulfuric or hydrochloric acid. The tank will be constructed of HDPE, and will be equipped with a level indicator/transmitter which will measure and indicate tank level both locally and in the control room. The tank will be located outside and vented to the atmosphere. Sulfuric and hydrochloric acids are classified as non-flammable materials. Sulfuric and hydrochloric acids are corrosive materials. Pertinent requirements for Sulfuric acid and Hydrochloric acid for Threshold Planning Quantities (TPQs) and Threshold

Quantities from Clean Air Act (CAA) 40 CFR will be implemented. There is no direct impact to radiological safety from the storage and use of these chemicals.

Acid Transfer Pump

The acid feed pump will have wetted parts constructed of FRP. The pump will be equipped with a pressure indicator on the pump discharge line, and a flow meter and flow indicator transmitter in the discharge line. Flow will be indicated both locally and in the control room. The measured flow will be used to control pump motor speed via a variable frequency drive.

3.2.8.5 Sodium Hydroxide Storage and Feeding System

The sodium hydroxide system will include a storage tank and delivery pump. The storage tank will be located outside of the CPP building in a concrete secondary containment basin designed to contain 110 percent of tank volume plus a 25-year, 24-hour storm event. This secondary containment basin will be separate from the containment basins for other chemical systems. The sodium hydroxide feed pump will be located inside the building, directly adjacent to the storage tank. Sodium hydroxide will be purchased as aqueous caustic soda, and will be pumped directly into the storage tank from the supplier's tanker trucks. Sodium hydroxide reacts vigorously with acid, therefore pertinent regulations for use and storage under 40 CFR will be implemented. Personnel will follow design and operating practices published in the accepted codes and standards that govern sodium hydroxide systems in order to prevent harm via contact with skin and/or inhalation. Sodium hydroxide is classified as a non-flammable material. Sodium hydroxide is considered a strong base.

Sodium Hydroxide Storage Tank

The sodium hydroxide storage tank will be constructed of carbon steel. The tank will be equipped with a level indicator/transmitter which will measure and indicate tank level both locally and in the control room.

Sodium Hydroxide Pump

The sodium hydroxide feed pump will have wetted parts constructed of alloy 20 stainless steel. The pump will be equipped with a pressure indicator on the pump discharge line, and a flow meter and flow indicator transmitter in the discharge line. Flow will be indicated both locally and in the control room. The measured flow will be used to control pump motor speed via a variable frequency drive.

3.2.8.6 Hydrogen Peroxide Storage and Feeding System

The hydrogen peroxide system will include a storage tank and delivery pump. The storage tank will be located outside of the CPP building in a concrete secondary containment basin designed to contain 110 percent of tank volume plus a 25 year, 24 hour storm event. This secondary containment basin will be separate from the containment basins for other chemical systems. The hydrogen peroxide feed pump will be located inside the building, directly adjacent to the storage tank. Hydrogen peroxide is classified as a non-flammable material. Personnel will implement design and operating practices published in accepted codes and standards that govern hydrogen peroxide systems. TPQs for 40 CFR will be implemented.

Hydrogen Peroxide Storage Tank

The hydrogen peroxide storage tank will be constructed of 304L stainless steel, 5254 Aluminum or HDPE, and will be equipped with a level indicator/transmitter which will measure and indicate tank level both locally and in the control room.

Hydrogen Peroxide Pump

The hydrogen peroxide feed pump will have wetted parts constructed of 304L stainless steel. The pump will be equipped with a pressure indicator on the pump discharge line, and a flow meter and flow indicator transmitter in the discharge line. Flow will be indicated both locally and in the control room. The measured flow will be used to control pump motor speed via a variable frequency drive.

3.2.8.7 Oxygen Storage and Feeding System

Oxygen is typically stored near or within well field areas, where it is centrally located for addition to the injection stream in each header house. Since oxygen readily supports combustion, fire and explosion are the principal hazards that must be controlled. The oxygen storage facility will be located a safe distance from the CPP and other chemical storage areas for isolation. The storage facility will be designed to meet industry standards in NFPA-50. Automatic shutoffs will be utilized in case of a power failure. Ventilation in each header house will prevent build up of oxygen inside. Industrial practices for compressed gases will be followed along with appropriate isolation and barrier of the system will be implemented.Carbon Dioxide Storage and Feeding System.

The carbon dioxide storage and feeding system will be used to dissolve carbon dioxide into the pregnant lixiviant to improve recovery of uranium in the IX vessel. This system will be a vendor supplied packaged system including tank, vaporizer, pressure gauges, and pressure relief devices. Carbon dioxide is nonflammable. Carbon dioxide will be stored in tanks located outside of the

CPP and satellite facilities Personnel will follow appropriate design and operating practices published in accepted codes and standards that govern carbon dioxide systems.

3.2.8.8 Barium Chloride Storage and Feeding System

The barium chloride storage and feeding system includes a storage tank, agitator, and chemical metering pump. This system will be designed to dissolve solid barium chloride in water to make up the saturated solution for feeding into the wastewater stream just upstream of the radium precipitation tank at each site. This system will be located in a metal building located adjacent to the wastewater pond. Barium chloride is classified as a noncombustible, nonflammable material. This substance can be incompatible with acids and oxidizers. Safeguards will be designed to prevent the formation of mists and sprays from a leak in piping system and the formation of dust in order to avoid airborne contamination.

3.2.8.9 Byproduct Storage

Prior to transportation to a licensed disposal facility, byproduct material will be stored in designated storage buildings (also referred to as "byproduct storage buildings"), one located at the CPP site and one located at the SF site. These buildings will consist of a concrete slab with a containment curb surrounding the perimeter. Storage of byproduct material will be within "roll-off" containers (bins) which are both liquid tight and fully enclosed. As each storage building can accommodate two 20 cubic yard bins, the volume of byproduct material could accumulate to 30 to 40 cubic yards at each of the two storage locations prior to transport. There are two bays in each storage building, each accessed by an overhead roll-up door and allowing exchange of containers necessary for transport to a licensed 11e.(2) disposal site. The concrete slabs will be designed to allow external decontamination of the roll-off bins prior to transport.

The byproduct storage buildings will allow for control of byproduct materials and specific segregation of these wastes from other non-11e.(2) wastes. Typically these wastes are expected to consist of contaminated used equipment parts, personal protective equipment, and wastes from cleanup of spills or other housekeeping activities. Other waste not in contact with the uranium production process will be disposed of in regular dumpsters situated at a separate location.

Containment of these byproduct wastes within a designated, fully enclosed building will allow for proper control of the materials, monitoring, and necessary restricted access. These measures will ensure best possible control of 11e.(2)solid and liquid wastes to minimize any potential exposures or contamination.

3.2.9 Utility Water

The utility water system will be used to extract, store, and distribute water for consumptive process uses and potable uses. Water will be extracted from wells drilled in a suitable formation in the vicinity of the SF and CPP. Water for potable uses will be chlorinated and stored in a pressurized tank.

3.2.9.1 Utility Water System Equipment

The utility water system equipment will include the utility water tank and utility water pumps.

Utility Water Tank

The utility water tank will be constructed of FRP, and will be equipped with a level indicator/transmitter which will measure and indicate tank level both locally and in the control room.

Utility Water Pump

The utility water pump will have wetted parts constructed of FRP. Each pump will be equipped with a pressure indicator on the pump discharge line, and a flow meter and flow indicator transmitter in the discharge line. Flow will be indicated both locally and in the control room. The measured flow will be used to control pump motor speed via a variable frequency drive.

3.2.10 Wastewater

The wastewater system will be designed to receive, treat, and discharge wastewater generated at various stages of the process. The wastewater system will be divided into two main categories of wastewater, high TDS wastewater, and low TDS wastewater. High TDS wastewater consists of waste eluant brine from the CPP and the reject streams from process bleed or restoration reverse osmosis systems if these systems are in use. Low TDS water sources include process bleed and extracted restoration water that have not been concentrated by a reverse osmosis process.

High TDS wastewater will flow by gravity from the solids removal tank to the high TDS wastewater tank. This wastewater will then be pumped to an onsite deep disposal well. or to the high TDS wastewater holding pond.

Low TDS wastewater will be collected in the low TDS wastewater tank and then pumped to a radium precipitation tank where barium chloride will be added to co-precipitate barium and radium sulfates. Treated wastewater will flow from the radium precipitation tank to the low TDS wastewater pond for removal of the precipitate by settling.

3.2.10.1 Wastewater System Equipment

Wastewater system equipment includes the solids removal tank, the high TDS wastewater tank, the low TDS wastewater tank, the wastewater pumps, the radium precipitation tank and agitator.

Solids Removal Tank

The Solids Removal Tank will be constructed of FRP, and will be equipped with a level indicator/transmitter which will measure and indicate tank level both locally and in the control room. Each tank will be connected to a vent header which exhausts through a vent stack on the building roof.

High TDS Wastewater Tank

The High TDS Wastewater Tank will be constructed of FRP, and will be equipped with a level indicator/transmitter which will measure and indicate tank level both locally and in the control room. Each tank will be connected to a vent header which exhausts through a vent stack on the building roof.

Low TDS Wastewater Tank

The Low TDS Wastewater Tank will be constructed of FRP, and will equipped with a level indicator/transmitter which will measure and indicate tank level both locally and in the control room.

Wastewater Pumps

Wastewater pumps will be provided for both high TDS wastewater and for low TDS wastewater, as needed, depending on the processing option selected in the final design. Each pump will have wetted parts constructed of FRP. Each pump will be equipped with a pressure indicator on the pump discharge line, and a flow meter and flow indicator transmitter in the discharge line. Flow will be indicated both locally and in the control room. The measured flow will be used to control pump motor speed via a variable frequency drive.

Radium Precipitation Tank

The radium precipitation tank will be used to add barium chloride to the wastewater and provide thorough mixing prior to discharge to a radium settling pond.

3.2.11 HVAC System

The heating, ventilating and air conditioning (HVAC) systems in the SF and CPP will be designed to provide routine heating, cooling and required air changes in occupied areas, as well as mitigate the potential for human exposure to radionuclides. The primary exposure concerns will be radon gas and uranium oxide dust or particulates.

The HVAC system for the main plant area will be designed both for controlling the temperature in the main plant area, and for preventing the buildup of fugitive radon emissions by ensuring a minimum number of air changes.

Radon gas is a daughter product of radium, which is present in the orebody, and thus is mobilized and dissolved into the pregnant lixiviant during production. The potential for radon emissions from the process arises when the pressurized flow from the extraction wells and booster pumps is exposed to atmospheric pressure. The two process systems with the potential for radon emissions are the IX vessels via the air/vacuum relief valves, and the shaker screens where the loaded resin and resin transfer water will be pumped onto an open screen at atmospheric pressure.

The shaker screens will each have a dedicated vent hood directly overhead. The vent hoods will be connected to an exhaust fan designed to create sufficient air flow and velocity to minimize the emission of radon in the vicinity of the shaker screens. The exhaust fans will discharge the air through a vent stack in the roof of the building. The vent stack will be located away from air intakes for the building.

Systems that have the potential to emit dust particles containing uranium include the filter presses, the dryers, and the drum filling stations.

The filter presses will be installed in a dedicated filtration room, and the vacuum dryers will be installed in a dedicated dryer room. These two rooms will be serviced with dedicated HVAC equipment that includes particulate filtration to minimize the potential for personnel exposure within the rooms and to prevent the emission of particles.

3.2.12 Instrumentation and Control

The plant facilities and equipment at the PA will consist of standard design, construction, and materials for uranium in-situ recovery extraction. Powertech intends to install automated control and data recording systems within the plants to augment the oversight provided by the operators Most of the automated devices will be programmed to control operating parameters according to pre-determined schedules and pre-set operating ranges. The automated systems will include alarms and shutoffs to prevent overflow and overpressure situations and provide centralized monitoring of the process variables.

Powertech (USA) Inc.

Response: TR RAI-MI-2

TR Section 4.1.2.2
Monitoring of Yellowcake Dryer Controls

POWERTECH (USA) INC.

Response: TR RAI-MI-3

TR Section 3.2.12.1
Backup Protection for Operating System

The control systems will continuously monitor the process variables, and will provide alarms to notify operators when operating parameters are outside of the specified operating ranges. Operators will refer to SOPs to determine the corrective actions to take in order to return the parameter back to its specified operating range.

The control system for both the SF and CPP will include a programmable logic controller (PLC), personal computer (PC) based operator interface stations, and remote digital and analog input/output (I/O) racks. Instruments and devices that send or receive digital or analog signals to/from the control system will be wired to the remote I/O racks. The remote I/O racks will be connected to the PLC via Ethernet cables. The control systems at the SFs and the CPP will receive critical process variable signals such as header pressure and flowrate from header houses via radio frequency signal.

The control system will enable operators to use the operator interface in the control room to configure flowpaths for process streams by opening and closing valves. Operators will also be able to use the operator interface to start and stop pumps and other equipment, monitor and control liquid levels, flowrates, pressures, and temperatures in process equipment. The control system will also allow operators to monitor process variables and trouble alarms from packaged equipment systems in the control room. Control interlocks will be provided to prevent overfilling of tanks during liquid transfers within the CPP and from tanker trucks filling storage tanks. Control interlocks will also be configured to prevent overpressure conditions in equipment and piping both inside the SF or CPP, as well as in the header houses and pipelines.

The header houses, pipelines, and deep disposal wells may pose the greatest risk for fluid spills of radioactive material; consequently, these systems will have high and low pressure, and flow alarms for automatic shutdown of related equipment. For more information concerning timely detection of releases or spills see section 5.7.1.3.

3.2.12.1 Backup Protection for Operating System

Loss of power to the project site may result in the following: production wells stop operating, resulting in shutdown of all production and injection flows. This condition avoids any flow imbalance within the well fields though a well field bleed is not maintained during the power failure. The time span for the aquifer to recover from operational drawdown back to its natural groundwater gradient is typically much longer than the duration of typical power outage. Since the maximum rate at which lixiviant could travel to the monitoring ring would equal the rate which the groundwater returns to its natural gradient, excursions are not likely to occur within the short time period of a power outage.

Backup generators will be installed such that in event of power failure instrumentation maybe be monitored to confirm conditions in the CPP, SF, and well fields.

Shutdown due to power failure during winter months is not expected to be problematic as well field pipelines are buried sufficiently below the frost line. In addition, heating of the SF and CPP is will be maintained by propane or natural gas and will be unaffected by power loss.

3.3 OSHA Design Criteria

In addition to the design criteria discussed in the preceding subsections worker health and safety measures identified in 29 CFR Part 1910 will be incorporated into design of the ISL production and processing facilities, as discussed below.

- Walking and working surfaces (Subpart D) - Aisles, passageways, and storage areas will be designed to be free of obstruction such that emergency egress will not be hindered. Wet areas in the plant will be provided with drainage, platforms, mats, or other dry walking surfaces, as necessary. All open-sided platforms or other working areas greater than 4 feet high will be equipped with standard railings. Flights of stairs more than 4 risers high will be equipped with standard hand railings in accordance with OSHA requirements.

- Means of egress (Subpart E) – Building will be designed and maintained to facilitate emergency egress. Exits will be clearly marked with illuminated exit signs.

- Occupational Health and Environmental Control (Subpart G) – Facilities will be designed with adequate ventilation systems to control worker exposure to vapors and temperature extremes. Noise will be minimized using engineering and administrative controls to ensure worker noise exposures are maintained below the permissible limits. As necessary, air compressors will be isolated to minimize noise levels within the processing facilities.

- Hazardous Materials (Subpart H) –Acid, caustic, and hydrogen peroxide storage areas will be individually curbed to provide secondary containment for each chemical. Sodium chloride, sodium carbonate, and barium chloride storage tanks will also have secondary containment, but do not need to be individually segregated. Operators will be provided hazard communication training, will have an MSDS onsite for these chemicals, and will have appropriate personal protective equipment (PPE) available for tank system maintenance and spill cleanup. An emergency eyewash/shower will be located adjacent to the storage areas. Spill response procedures will be included in the plant operating procedures. If used, flammable materials will be stored in the flammable storage locker.

- Personal Protective Equipment (PPE) (Subpart I) - The standards associated with respiratory, electrical, head, foot, and eye protection will apply. A workplace hazard assessment will be performed and documented. PPE is not expected to be required

7.4 Potential Non-Radiological Effects

NUREG-1569 requires that estimates of concentrations of nonradioactive constituents in effluents at the points of discharge be compared to natural ambient concentrations with applicable discharge standards. There will be two effluents from the project; a gaseous airborne effluent and a liquid effluent.

The gaseous airborne effluent will consist of the ventilated air from the plant's ventilation system, originating from the process vessels and tanks. Radon gas will be present in this effluent as discussed in Section 7.2.1 above. No non-radiological effluents will be present in the gaseous airborne effluent. Non-radioactive airborne effluents from the project will be composed of fugitive dust from site roads and well field activities. Dust suppressants will be used to mitigate fugitive dust emissions if deemed necessary depending on-site conditions.

Powertech (USA) is currently considering two scenarios for liquid effluent disposal. The first involves management of well field "bleed" water and well field restoration water on-site using evaporation ponds and land application. The second scenario involves management of well field "bleed" water, well field restoration brine water, and CPP brine water in a waste disposal wells. As the project moves forward, the feasibilities of either scenarios or some combination of two scenarios will be evaluated and a determination will be made based on effectiveness, implementability, and cost.

7.5 Potential Effects of Accidents

The NRC has determined that the effects of all accidents that are the most probable to occur at an ISL facility are minor, provided that effective emergency procedures exist and are utilized in the event of an accident, and that personnel are properly trained to handle the situations. When compared with conventional underground and open pit mining methods, accidents associated with ISL uranium production typically have far less severe consequences. An assessment of potential accidents are discussed in the following sections.

7.5.1 Consequences, Preventative and Mitigation Measures of a Potential Fire or Explosion

Accident Consequences - Explosions

An explosion, although unlikely, could result from: a prematurely sealed drum of yellowcake, in a dryer, from the use of propane in the thermal fluid heater or space heaters, or from the mixing of oxygen gas with combustible materials. Of these, an explosion from the drum of yellowcake has the greater potential to impact radiological safety of the workers. An explosion in a sealed drum would be contained within the dryer room. According to the NRC, multiple hearth dryers posed a greater hazard than vacuum dryers. Multiple hearth dryers operate at higher temperatures and may be directly fed with gas. The vacuum dryers proposed in this application operate at lower temperatures and are not directly fed by gas therefore posing less of a hazard for explosion. In the unlikely event of an unmitigated explosion accident of a yellowcake dryer, doses to the workers could have a MODERATE impact depending on the type of accident, but exposure to the general public would result in a dose below the 10 CFR Part 20 public dose limit (NRC, 2009, § 4.2-56).

Preventative and Mitigation Measures

As noted in TR Section 3.2.8, design criteria for chemical storage and feeding systems, includes applicable sections of the international building code, international fire code, OSHA regulations, RCRA regulations, and Homeland Security.

Propane fired heating devices will be installed to meet applicable NFPA/FM safety standards. Additional measures for preventing fires and explosions within process facilities include:

- As noted in TR 3.2.8.6, the oxygen tanks will be located a safe distance from the CPP and other storage tanks, and will be designed to meet industry standards of NFPA-50.
- Header houses will be ventilated by continuously in order to prevent any buildup of oxygen.
- The oxygen lines to each header house will be equipped with low pressure shut-off valves to minimize the delivery of oxygen to a fire.
- Procedures will be in place for confined space work or hot work for monitoring of oxygen build-up prior to start of work.
- Fire extinguishers will be placed at accessible locations in all buildings and vehicles for quick response and training will be provided for appropriate personnel in use of fire extinguishers.

- Personnel will receive training for responding to a fire or explosion.

The CPP facilities are designed to contain and reduce the exposures to individual in the event of an accident. Emergency response procedures would be implemented and employees would be directed as to what actions to perform in the event of an accident. For instance, respiratory protection program in place and executed as necessary as part of the worker protection during assessment and cleanup phases. In addition to the above mentioned protections other safeguards and mitigatory protocols are always in place during operation of a CPP facility. For example, bioassay program for worker safety and contamination control programs involving personnel survey, clothing survey and equipment survey before release to unrestricted areas are common practices workers are subject to on a regular basis. These types of protocol are also utilized to assess if an accidental exposure took place during the course of an unintentional incident.

Preventative and mitigating measures-Wildfire

In order to protect facilities from wildfires, all facility building will be located within an area that is maintained in a vegetation-free state by the use of a crushed aggregate or asphalt surface and by appropriate weed-control measures if necessary. The creation of this buffer zone is expected to prevent any significant damage to equipment that could cause a chemical accident by acting as a firebreak if needed.

Within the well fields, vegetation will be removed, mowed or sprayed around each header house and around each well head cover to reduce the amount of combustible material adjacent to these structures. In the event of an approaching wildfire, operators will be trained to shut down well field operations and, if necessary, to evacuate facilities until the danger to personnel has passed. Damage, if any, will be assessed and remediated prior to re-starting operations.

The emergency response plan will include descriptions of the following provisions of 29 CFR Part 1910:

- Notification and evacuation procedures
- Personal protective equipment
- General fire fighting safety rules
- Reporting procedures
- Electrical and gas emergencies

7.5.2 Potential Chemical Risks

In general, most ISL facilities utilize hazardous chemicals during the extraction process, to process wastewater, and during restoration of groundwater quality. Several hazardous chemicals will be used in the project ISL process. Bulk hazardous chemicals will be stored on-site in areas at a distance that will pose no significant hazard to the public or workers' health and safety. Powertech (USA) will have strict standard operating procedures regarding receiving, storing, handling, and disposal of hazardous chemicals to ensure the safety of the public and workers. Industrial safety aspects associated with the use of these hazardous chemicals will be regulated by several agencies including the EPA, SD DENR and OSHA.

Risk assessments completed by the NRC in NUREG-6733 for ISL facilities focused on indirect interactions between the chemicals used in ISL mining and other substances and the potential of operational hazards to workers. Powertech will, via engineering design and implementation of safety standards utilized in the chemical process industry, ensure that risk from chemical events are lower or at what is considered acceptable for the industry. The radiological risks are minimal when considering specific chemicals that would directly interact with radionuclides to cause a hazardous event (NUREG/CR-6733, 2001). Therefore, engineering controls and implementation of the appropriate design, operating practices, codes and standards will serve to prevent a chemical event from impacting a radiological event. Acceptable safeguards will be implemented to ensure that if the two types of events were to impact one another the result would be small and quickly addressed by trained staff.

The largest potential health and safety impact would result from an accidental release of these chemicals. Releases of these chemicals at levels greater than the reportable quantity level under the Community Right to Know Act (40 CFR 355) will be reported to the National Response Center, US EPA, SD DENR, and NRC. Specific quantities or uses of chemicals that require certain controls, procedures, or safety measures are defined by statutes:

- 29 CFR Part 1910.119 and 1910.120
- 40 CFR Part 68, 302.4, and 355

Compliance with these necessary requirements will reduce the likelihood of a release. Offsite potential impacts would be SMALL, while impacts to workers involved in response clean up could receive MODERATE impacts that would be mitigated by implementing procedures and training requirements (NUREG-1910, 2008).

Restoration activities will at times overlap with some operational activities such as operation of well fields, wastewater treatment, and disposal. The potential occupational health and safety impacts are expected to be less than operational impacts due to the absence of some operational activity, such as yellowcake drying operations and IX.

Further information on preventative measures, consequences and action implemented in the case of a major pipe rupture in the CPP or SF is provided in the following paragraphs.

Major pipe or tank ruptures in the CPP or Satellite facility

a. Preventative measures: Facilities will be designed and operated according to 40 CFR part 68. In addition, the applicant will comply with 40 CFR Part 355 in disclosing the reportable quantities of sulfuric acid and sodium hydroxide, the only chemicals used in the facilities that are expected to be present in quantities greater than the minimum reportable amounts. Also, see TR Section 4.2.3.2 "Central Processing Plant."

b. Consequences: The rupture of a major pipe or tank within either the CPP or Satellite facility may result in the release of process liquids onto the floor of the facility. The spilled material would be directed to the trench drains and sumps, from which it could be pumped to the wastewater tanks and ultimately to disposal. Alternatively, the spilled materials could be transferred to the central plant pond for possible reprocessing prior to eventual disposal. No air-dried material would be present due to a leak from a pipe or tank and, consequently, no airborne radionuclides to be inhaled by the operators.

Preventative and Mitigative Measures

Because outdoor winter temperatures at the PAA will be below freezing, all tanks and pipelines that will contain fluids and are located outside the facilities will be heat traced to maintain the contents above the freezing point of the material. In particular, the sulfuric acid and sodium hydroxide (caustic) pipelines and tanks will fall into this category. Freezing of the sulfuric acid or caustic pipelines would prevent flow in those lines, but would not likely lead to a pipe or tank rupture. Pipelines between the facilities and the well fields, as well as pipelines within well fields, will be buried to a depth below the frost line in order to prevent freezing of the aqueous solutions within those lines. Header houses, valve vaults, and wellhead covers will contain electric heaters in order to prevent freezing temperatures from occurring in these structures.

Windstorm/winter storm

All facilities, including buildings, storage tanks, and well head covers will be designed and constructed to withstand the highest wind velocities that are reasonably expected to occur in the within the PAA. During winter months, winter storms with high winds and snowfall may cause blizzard conditions, but these events do not present a higher potential for chemical accidents.

Personnel will be trained in the hazards associated with process chemicals and solutions present at each facility, and the proper procedure to follow in the clean-up of a spill of the materials within the plant facilities. In particular, for tank ruptures, operators will be trained to close valves on any pipelines connected to the ruptured tank. In the case of a pipe rupture, personnel will be trained to shut down pumps and close valves in order to isolate the section of pipe containing the rupture from other parts of the process.

Capacities of sumps and bermed areas

The central plant and satellite facilities are designed with trench drains, sumps and a concrete curb at the perimeter of the floor designed to contain the contents of the largest vessel in the facility. For the central plant, the largest vessel is the yellowcake thickener, which has an operating volume of 5,050 ft^3. For the satellite facility, the largest vessel is the utility water tank with a volume of 16,000 gallons, or approximately 2,140 ft^3. For Both facilities, a containment curb along the perimeter wall of each slab with internal trench drains and sumps is sufficient to contain a spill of 150% of the largest tank volume in each facility. Sumps and sump pumps will be operable for the removal of spilled materials to waste holding tanks or the central plant pond and ultimately to the wastewater disposal system. See also, TR Sections 3.2.8 "Chemical Storage and Feeding Systems and TR 5.7.1.3 "Spill Provision Plans."

POWERTECH (USA) INC.

Response: TR RAI-MI-4(a)

See RAI Information in Section 6.6

TR Section 6.6
Additional Comitment for Financial Assurance

POWERTECH (USA) INC.

Response: TR RAI-MI-4(b)

TR Section 6.6
Commitment to Update Decommissioning Costs Prior to Licensing

POWERTECH (USA) INC.

Response: TR RAI-MI-4(c)

See RAI Information in Section 6.6

TR Section 6.6
Summary of Financial Assurance Amounts

POWERTECH (USA) INC.

Response: TR RAI-MI-4(d)

See RAI Information in Section 6.6

TR Section 6.6
Justification for Flare Factor and Pore Volume
and
TR Appendix 6.6-B: Numerical Modeling of Groundwater Conditions

Response: TR RAI-MI-4(e)

TR Section 6.6
Additional Commitments for Financial Assurance

POWERTECH (USA) INC.

Response: TR RAI-MI-5

TR Sections 2.7.1.4.2 and 2.7.1.4.3

Water Levels from Floodplain Analysis
HEC-RAS Beaver Creek and Pass Creek Output Tables

and

Additional Information Concerning Hydrologic Modeling System (HEC-HMS)
Data and Methodologies

Response: TR RAI-MI-6

Please refer to MI-5 on peak flood calculations, peak water level and velocity calculations.

Detailed site drawings showing detailed local topography and pond construction features as well as erosion protection design features are included in the document, "Pond and Land Application Technical Specifications and QA/QC Plan" which is included as Appendix 3-A of this document.

Knight Piésold
CONSULTING

Powertech (USA) Inc.
Dewey-Burdock Project
Pond and Land Application
Technical Specifications and QA/QC Plan
Part 1 – Earthworks

July 2010

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KP Project No. DV102.00279.09

Rev. No.	Date	Description	Knight Piésold	Client
0	July 2010		Paul Bergstrom	Powertech (USA) Inc.

Knight Piésold
CONSULTING

Powertech (USA) Inc.
Dewey-Burdock Project
Pond and Land Application
Technical Specifications and QA/QC Plan
Part 1 – Earthworks

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Powertech (USA) Inc.
Dewey-Burdock Project
Pond and Land Application
Technical Specifications and QA/QC Plan
Part 1 – Earthworks

Section 1.0 - General

1.1 Introduction

This Specification stipulates materials and construction requirements for earthworks related to the construction of the Ponds and Land Application Systems at Powertech's Dewey-Burdock project.

1.2 Limitations and Disclaimer

This Specification titled Dewey-Burdock Project Pond and Land Application Technical Specifications and QA/QC Plan Part 1 - Earthworks has been prepared by Knight Piésold and Co. (Knight Piésold) for the exclusive use of Powertech (USA) Inc. (Client). No other party is an intended beneficiary of this Specification or the information, opinions, and conclusions contained herein. Any use by any party other than the Client of any of the information, opinions, or conclusions is the sole responsibility of said party. The use of this Specification shall be at the sole risk of the user regardless of any fault or negligence of the Client or Knight Piésold.

The information contained herein have been completed to a level of detail commensurate with the objectives of the assignment and in light of the information made available to Knight Piésold at the time of preparation. This specification and its supporting documentation have been reviewed and/or checked for conformance with industry-accepted norms and applicable government regulations. To the best of the information and belief of Knight Piésold, the information presented in this Specification is accurate to within the limitations specified herein.

This Specification is Knight Piésold pdf file: Dewey-Burdock Pond and Land Application Technical Specifications and QA/QC Plan Part 1 - Earthworks Rev 0.pdf. Any reproductions or modifications of this Specification are uncontrolled and may not be the most recent revision.

Knight Piésold
CONSULTING

1.3 Contributors and Approvals

This specification was prepared, reviewed, and approved by the undersigned.

Prepared by:

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Project Engineer

Approved by:

Paul D. Bergstrom, C.E.P.
Sr. Executive Project Manager

Reviewed by:

Jaye Pickarts, P.E.
Sr. Vice President

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Section 2.0 - Scope and General Description of the Work

This Specification stipulates material and construction requirements for the earthworks related to the construction of the Ponds and Land Application Systems at Powertech's Dewey-Burdock project. Should the Contractor wish to deviate from these Specifications, he shall notify the Engineer in writing, providing a description of the deviation. The description shall include data indicating the magnitude of the deviation, justification for the deviation, and any possible short or long-term impacts of the deviation on the project. Deviations to these Specifications shall be subject to the approval of the Engineer and Owner.

2.1 Definition of Terms

"Owner" is defined as an authorized representative of Powertech.

"Engineer" is defined as representative appointed and authorized by the Owner. The Engineer shall be a Registered Professional Engineer, or a designated site representative under the supervision of a Registered Professional Engineer.

"Contractor" is defined as the party that has executed a contract agreement for the specified Work with the Owner.

"Technical Specifications" is defined as this document, prepared by Knight Piésold and Co. and all supplemental addenda.

"Drawings" is defined as the Drawings, in conjunction with these Technical Specifications, prepared by Knight Piésold and Co. for the ponds and land application system at Powertech's Dewey-Burdock Project.

"Work" is defined as the entire completed construction, or the various separately identifiable parts thereof, as shown on the Drawings, and required to be furnished under the Contract Documents.

"Site" is defined as the project area where the work is to be performed.

"Contract Documents" are defined as the Agreement, Addenda, Contractor's Bid (when attached as an Exhibit to the Agreement), Bonds, General Conditions, Special Conditions, Technical Specifications, Drawings and all modifications issued after execution of the Agreement.

"Modifications" are defined as changes made to the Technical Specifications or the Drawings, that are approved by the Owner and Engineer, in writing, after the Technical Specifications and Drawings have been finalized.

All slopes are defined as horizontal to vertical distances.

2.2 General Technical Requirements

The general technical requirements specified herein shall apply to all activities and operations relating to carrying out the Work or as required by the Engineer or Owner for the earthworks associated with the construction of the ponds and land application system at Powertech's Dewey-Burdock Project, South Dakota.

In the event of an inconsistency in the Technical Specifications and Drawings, the Contractor shall refer all questions to the Engineer for final decision. Work that concerns the inconsistency shall not be performed until the contradiction is remedied or explained by the Engineer. In all events, the decision of the Engineer is final.

2.2.1 General Specifications

The contractor will be required to submit to the Engineer or Owner, at a minimum, the following plans and comply with training requirements associated with their project tasks, as may be applicable:

- Occupational Safety and Health Administration (OSHA)
  - Healthy and Safety Plan in accordance with 29 CFR Part 1910 – Occupational Safety and Health Standards
  - Hazardous Communication Plan in accordance with 29 CFR Part 1910.1200 – Toxic and Hazardous Substances
  - Material Safety Data Sheets (MSDS) for all chemicals in accordance with 29 CFR 1910.1200 (g)
- Spill Prevention, Control and Countermeasure (SPCC) Plan in accordance with 40 CFR Part 112.3 – Requirement to prepare and implement a Spill Prevention, Control, and Countermeasure Plan
- Training
  - Mine Safety and Health Administration – 24-hour class plus 8-hour refresher course in accordance with 30 CFR
  - HAZWOPER – 40-hour class plus 8-hour refresher course in accordance with 29 CFR 1910.120

2.3 Scope of Work

The Work to be carried out shall include supplying all supervision, labor, plant and materials required to complete the Work as shown on the Drawings, as described in these Technical Specifications, and as required by the Owner and Engineer.

Section 3.0 - Mobilization and Demobilization

3.1 Scope

The Work covered by this section consists of the Contractor's mobilization to the Site of all the equipment and temporary facilities required for the successful completion of the Work, and shall include, but not necessarily be limited to, the following:

- Establish the Contractor's maintenance facilities, temporary workshops, temporary office accommodation and sanitary facilities.
- Maintain equipment and temporary facilities for the duration of the Work.
- All items required to be moved onto the Site for execution of the Work.
- On completion of the Work, remove all equipment and temporary facilities from the Site, and clean up the Site to the satisfaction of the Owner and the Engineer.

3.2 Mobilization

The Contractor shall mobilize to the Site sufficient labor, materials, and equipment to allow commencement of the Work. The Contractor shall bring on to the Site, as and when necessary, any additional equipment, labor and materials which may be required to complete the remainder of the Work in the time specified in the General Terms and Conditions.

3.3 Contractor's Workshops, Stores, and Offices

The Contractor shall erect, in the area designated by the Owner and Engineer, adequate workshops, offices and other buildings and structures for the completion of the Work as designated in the Contract Documents. Such workshops, offices and etc., shall be maintained in a neat and tidy condition throughout the duration of the Work to the satisfaction of the Engineer and Owner.

3.4 Sanitation

The Contractor shall provide and maintain adequate sanitary facilities for the personnel at the Site, including the Contractor's offices and Engineer's offices, in compliance with local health regulations and to the satisfaction of the Engineer and Owner.

3.5 Construction Roads

All temporary construction roads, which the Contractor may require to complete the Work shall be constructed at the Contractor's expense.

The location of any temporary roads, or portions thereof, on the Site shall be subject to the Owner's and Engineer's approval prior to construction. Any roadways that are not wide enough to accommodate 2-way traffic shall be clearly marked to indicate the direction of travel, or shall be closed to traffic by suitable barriers that have been approved by the Engineer.

Unless otherwise approved by the Owner, all temporary roads shall be reclaimed at the Contractor's expense upon completion of the Work.

3.6 Drainage

Adequate drainage facilities in the form of ditches, culverts or other conduits shall be installed as necessary to protect the Work and to maintain temporary construction or access roads. These temporary drainage facilities shall be constructed to the satisfaction of the Engineer and Owner.

3.7 Demobilization

On completion of the Work, the Contractor shall remove all of the Contractor's equipment, temporary facilities and materials from the Site. The Site shall be left in a clean and tidy state, to the satisfaction of the Engineer and Owner. All waste and refuse shall be disposed of in a legal manner acceptable to the Owner.

Section 4.0 - Earthwork – General

4.1 Survey

The Contractor shall provide all surveying services required for the initial staking of the Work and for staking during construction.

The Contractor shall provide sufficient surveying to control excavation and fill placement, to ensure that the Work is constructed to the lines and grades set forth in the Drawings, and to demonstrate that the work is completed to the required lines and grades.

The Owner will provide survey control for the project, and will provide periodic surveys as required to verify the Contractor's quantities for pay estimates. The Owner will provide the final as-built survey of the project.

The Contractor, in scheduling his Work, shall allow sufficient time in his construction schedule for the completion of such surveys and for the Owner's and Engineer's proper consideration thereof, prior to his authorization to proceed with the Work in the area.

4.2 Clearing, Stripping, Grubbing and Stockpiling

The natural ground surface shall be cleared and stripped and/or grubbed of all organic and objectionable materials by the Contractor to the limits shown on the Drawings or as required by the Owner. The limits of stripping shall generally be 10.0 feet outside of the work activity areas as shown on the Drawings. All usable topsoil, as determined by the Owner, shall be properly stockpiled in locations shown on the Drawings or as designated by the Owner.

Clearing and grubbing shall mean removal of vegetation and roots. Clearing and grubbing may generally be conducted as a single operation together with stripping.

Stripping shall mean the removal of topsoil, which shall be defined as soil of any gradation or degree of plasticity which contains significant quantities of visually identifiable vegetable matter, sod, roots or humus, as determined by the Engineer. In general, this is expected to have an approximate depth of between 0.3 to 1.5 feet. Varying depths will be determined by the Engineer, based on the character and thickness of material encountered.

Prior to stripping, the topsoil shall be moisture conditioned to the satisfaction of the Engineer in order to prevent the loss of fines and maintain dust control. The Contractor shall allow sufficient time after pre-wetting for the moisture to be evenly distributed throughout the soil layer prior to removal. The topsoil may need to be ripped prior to moisture conditioning to allow the moisture to be evenly distributed throughout the topsoil layer. The decision of how often and when to rip the topsoil for purposes of moisture conditioning, will be determined by the Engineer. Additional moisture conditioning may be required on stockpiled materials as determined by the Engineer.

Any stripping beyond the limits shown on the Drawings, or as required by the Owner, shall be subject to the approval of the Owner. Unapproved stripping will be subject to remediation at the sole expense of the Contractor.

Stripping will be carried out using whatever method is deemed necessary, providing it is consistent with producing an acceptable end result as determined by the Owner.

After stripping of the required area, the surface shall be treated as specified on the Drawings or in these Technical Specifications. This activity can involve trimming and shaping the surface, scarifying, moisture conditioning, and compacting borrow material. Prior to any surface treatment on a stripped area, the Engineer shall be notified to inspect the stripped area and designate the method of treatment.

4.3 Excavation

Excavation shall consist of excavating to the lines and grades shown on the Drawings and hauling materials to designated fill or stockpile areas. Excavation methods, techniques and procedures shall be developed by the Contractor with due consideration of the nature of the materials to be excavated and shall include all precautions that are necessary to preserve, in an undisturbed condition, all areas outside the lines and grades shown on the Drawings or required by the Owner. The work shall be carried out by whatever method is considered most suitable, providing it is consistent with producing an acceptable end result as determined by the Engineer.

No excavation beyond the lines and grades shown on the Drawings, or as required by the Engineer, shall be done without the prior written approval of the Owner. If such additional excavation is done without the prior written approval of the Owner and, in the opinion of the Engineer, requires backfilling in order to satisfactorily complete the Work, such backfilling shall be completed at the Contractor's cost. All such backfilling will be subject to approval by the Engineer.

Pockets of unsuitable materials within the limits of an excavation shall be removed and disposed of as directed by the Owner and Engineer. Unsuitable materials may include, but not be limited to, ash, boulder or gravel zones, soft saturated zones, highly organic zones, drilling mud pits and other deleterious material.

The Contractor shall protect and maintain all excavations until all work is completed and approved.

Any damage resulting from the Contractor's operations during site preparation or excavation, including damage to foundations and excavated surfaces, shall be repaired at the expense of the Contractor, and to the satisfaction of the Engineer.

Waste and topsoil piles shall be leveled, trimmed and shaped as required by the Owner to prevent the occurrence of ponding or concentrations of surface runoff, and to provide a neat appearance. Finished slopes of the topsoil stockpiles shall be graded to 3.0:1 (horizontal:vertical) for interim reclamation. All surface water runoff shall either be directed to surface water diversion structures, or to existing streams downstream of the ponds.

4.4 Anchor Trenches

The Contractor shall excavate and backfill all anchor trenches required for the installation of all geosynthetics. Anchor trenches shall be backfilled with the material that was excavated from them, as described in Section 5.3. The excavations shall be to the lines and grades shown on the Drawings, or as directed by the Engineer.

4.5 Fill Placement

The intent of this specification is to use material excavated from the ponds for the construction of embankments and the soil liner, in a manner that satisfies the technical requirements and minimizes construction costs. Material that is excavated from the ponds will be used as fill in various locations, depending on the nature of the material and the discretion of the Engineer.

All material used for fill shall be loaded and hauled to the placement site, dumped, spread and leveled to the specified layer thickness, moisture conditioned, if required, and compacted to form a dense integral fill, per the Technical Specifications, and to the approval of the Owner and the Engineer. Care shall be taken at all times to avoid segregating the material being placed.

Under most conditions, the fill shall be constructed in near horizontal layers with each layer being completed over the full length and breadth of the zone before placement of subsequent layers. Each zone shall be constructed with materials meeting the specified requirements, and shall be free from lenses, pockets and layers of materials, which are substantially different in gradation from the surrounding material in the same zone, as determined by the Engineer. All fill placed shall be free from organic debris, frozen soil, ice, or other unsuitable materials. All over-sized material shall be removed from the fill material either prior to it being placed, or after it is dumped and spread but prior to compaction.

All particles that have dimensions that will interfere with compaction in the specified layer thickness, as determined by the Engineer, shall be removed from the zone in which they were placed, either prior to or during compaction.

Moisture conditioning is the operation required to increase or decrease the moisture content of material to within the specified limits. If moisture conditioning is necessary, it may be carried out by whatever method the Contractor deems is suitable, provided it produces the moisture content specified in these Technical Specifications or designated by the Engineer. The moisture shall be distributed uniformly throughout each layer of material being placed, immediately prior to compaction. Measures shall be adopted as necessary to ensure that the designated moisture content is preserved after compaction, and until the succeeding layer is placed.

Under no circumstances shall fill be placed in water. During construction, the surface of the fill shall be maintained with a crown or cross-slope that will ensure effective drainage to the extent possible. Adequate drainage facilities in the form of ditches or culverts shall be installed to direct surface flow away from the fill zone.

Should the surface of the fill become rutted or uneven subsequent to compaction, it shall be regraded and recompacted before the next layer of fill is placed.

To permit suitable bonding with the subsequent layer, the surface material shall be loosened by scarifying or disk harrowing, as approved by the Engineer, and if necessary, it shall be moisture conditioned before an additional lift is placed.

Fill shall not be placed on frozen soil or when air temperatures drop below 32º F, unless otherwise approved by the Engineer.

All areas with completed surfaces are to be protected from detrimental effects of weather using methods that have been approved by the Engineer. Any areas that are damaged by adverse weather conditions as determined by the Engineer shall be removed and replaced, reconditioned or reshaped, and recompacted to the requirements of the Specifications at the Contractor's expense.

Areas that become unstable due to excessive moisture shall be reworked, brought to the required moisture content, and recompacted to the required density before subsequent fill placement. This includes the repair of any underlying materials damaged as a result of pumping.

4.6 Compaction Equipment

Sufficient compaction equipment, of the types and sizes specified herein, shall be provided as necessary for compaction of the various fill materials. If alternative equipment is to be used, a submittal shall be made to the Engineer for approval of the equipment, and the submittal shall give complete details of such equipment and the methods proposed for its use. The Engineer's approval of the use of alternative equipment will be dependent upon completion of suitable test fills, to the satisfaction of the Engineer, to confirm that the alternative equipment will compact the fill materials to the specified density.

Compaction of each layer of fill shall proceed in a systematic, orderly and continuous manner that has been approved by the Engineer, to ensure that each layer receives the compaction specified.

Compaction equipment shall be routed parallel to the embankment axis or the long axis of the fill zone, and overlap between roll patterns shall be a minimum of 12 inches.

The rolling pattern for compaction of all zone boundaries or construction joints shall be such that the full number of roller passes required in one of the adjacent zones, or on one side of the construction joint, extends completely across the boundary or joint.

Compaction equipment shall be maintained in good working condition at all times to ensure that the amount of compacted effort obtained is a maximum for the equipment.

Before commencing Work with the proposed compaction equipment the Owner and the Engineer shall be provided with a list of each piece of equipment to be used together with the Manufacturer's specification.

4.6.1 Smooth Drum Vibratory Roller

Smooth drum vibratory rollers shall be equipped with a suitable cleaning device to prevent the accumulation of material on the drum during rolling. Each roller shall have a total static weight of not less than 10 ton at the drum when the roller is standing on level ground. The drum shall be not less than 5.0 feet in diameter and 6.5 feet in width. The vibration frequency of the roller drum during operation shall be between 1,100 and 1,500 vibrations per minute, and the centrifugal force developed by the roller, at 1,250 vibrations per minute, shall not be less than 38,250 pounds. The power of the motor driving the vibrator shall be sufficient to maintain the specified frequency and centrifugal force under the most adverse conditions, which may be encountered during the compaction of the fill.

4.6.2 Sheepsfoot Roller

On fine-grained cohesive soils the Contractor will be required to compact the fill with a sheepsfoot roller. The soil liner will require compaction with a sheepsfoot roller, and it is expected that much of the random fill will also consist of fine-grained cohesive soils. Placement of these materials will not be allowed without a sheepsfoot roller working the area of placement prior to the placement of the next lift.

The sheepsfoot roller shall be a self-propelled, fully ballasted standard sheepsfoot design developing 6,000 lbs. in weight per linear foot of width at rest on level ground, or equivalent as approved by the Engineer. The sheepsfoot roller shall be equipped with an hour meter to indicate actual roller operating time.

Following compaction with a sheepsfoot roller, the finish grade surface shall be bladed smooth and the proof-rolled with a smooth drum compactor until the surface is relatively smooth, firm and free from projections.

4.6.3 Special Compactors

Special compactors shall be used to compact materials that, in the opinion of the Engineer, cannot be compacted properly by the specified roller because of location or accessibility.

Special compaction measures shall be adopted such as hand-held vibratory compactors or other methods approved by the Engineer to compact fill in trenches, around structures and in other confined areas that are not accessible to the larger vibratory roller or tamping foot roller. Such compaction shall be to the specified density.

4.7 Compaction and Moisture Content

All material, after placing, spreading and leveling to the appropriate layer thickness shall be uniformly compacted in accordance with the requirements for each type of fill as indicated in the following table:

Table 3.1 - Compaction Requirements

Material	Compaction Specification	Moisture Content
Prepared Subgrade	92% of Maximum Dry Density by ASTM D1557	+/- 3% of Optimum
Random Fill	92% of Maximum Dry Density by ASTM D1557	+/- 3% of Optimum
Soil Liner	92% of Maximum Dry Density by ASTM D1557	0 to +5% of Optimum

Section 5.0 - Earthwork Preparation and Placement

5.1 Subgrade Preparation

After grubbing and stripping, the exposed surface shall be inspected and approved by the Engineer prior to subgrade preparation. Subgrade preparation methods will depend on the location and the materials that will be placed over the subgrade.

5.1.1 Areas to Receive Random Fill

Areas to be covered with random fill shall be scarified to a depth of 0.5 feet, moisture conditioned (if necessary) and recompacted to a minimum of 92 percent of maximum dry density as determined by the modified Proctor test (ASTM D1557).

5.1.2 Prepared Subgrade

The prepared subgrade areas shall be prepared in the same manner as subgrade under random fill as described in Section 5.1.1.

All areas to receive geomembrane shall be prepared to the satisfaction of the Engineer. The exposed surface shall be moistened and proof rolled to ensure that the surface is firm and smooth. Proof rolling should be done using a smooth drum roller or another piece of equipment as approved by the Engineer. Areas to be lined with geosynthetics shall have no sudden, sharp or abrupt changes in grade. The surface shall be prepared such that it is smooth, compacted, and free of protruding rocks, vegetation or any other materials or objects deemed unsuitable by the Engineer. In areas were rocks larger than 3/8 inches are protruding, the rocks shall be removed and replaced with sand or other fine-grained material. Sanding may also be used in other areas to produce a relative smooth surface suitable for installation of High Density Polyethylene (HDPE) liner. Any areas not acceptable to the Engineer shall be repaired to his satisfaction at the expense of the Contractor.

5.2 Fill Placement

The intent of these Specifications is to promote the use of "on-site" materials to construct the facility, and to minimize the importation of offsite materials. It is anticipated that most of the embankment construction material, as well as the soil liner material, will be obtained form the material excavated from the ponds. It may however be necessary to develop borrow areas to source specific kinds of materials. The origin of any material in no way guarantees it's suitability as fill material. Designation and approval of a stockpile or borrow area does not guarantee that all material from that source is suitable for construction. Unsuitable materials shall be stockpiled in areas designated by the Engineer. The Engineer will conduct testing to establish suitability of all fill materials used on the project.

The Contractor shall not place any fill material in an area until the Engineer has inspected and approved the foundation or in-place lift.

All fill materials shall be placed to the lines and grades shown on the Drawings and in accordance with Section 4.0 of the Technical Specifications.

5.2.1 Random Fill

Random fill shall consist of inorganic soil and rock materials obtained by excavating the ponds or from borrow areas approved by the Engineer. Random fill material may have a wide range of Unified Soil Classifications, and may have significant variation in index and compaction properties. There are no gradation limitations on the random fill, other than the maximum particle size, which shall not exceed 2/3 of the specified lift thickness. However, the contractor shall take necessary care when placing to coarse rock to ensure that boulders do not become nested to the point that large voids can result. Coarse fill shall be placed in such a manner that boulders are surrounded by finer grained material.

Materials with less than 30 percent (by weight) rock materials larger than 3/4 inches and 8 inches maximum rock size shall be conditioned to within 2 percent of optimum moisture content, placed in lifts not exceeding 1.0 feet and compacted to 92 percent of maximum dry density as determined by ASTM D1557 (modified Proctor).

Random fill containing more than 30 percent rock materials larger than 3/4 inches (rock fill) shall be conditioned, placed and compacted using procedures based on the results of a test fill. The type of compaction equipment, number of passes and maximum rock size and loose lift thickness will be approved by the Engineer in writing based on the acceptable test fill performance. The Contractor shall outline his proposed procedures for moisture conditioning and fill placement and submit them to the Engineer for review and approval.

For rock fills, the Contractor shall construct a test fill to verify the adequacy of the compaction equipment for achieving the required density. The test fill may be located so that it is incorporated within the limits of the compacted fill area. The test fill shall be constructed and monitored as per U.S. Army Corps of Engineer's guidelines for test fill construction (USACE EM 1110-2-2301).

The data to be collected during construction of the test fill shall include the following:

- Lift thickness of 1.0, 2.0, and 4.0 feet (three test fills to establish optimum lift thickness).
- Amount of settlement after every 2 passes of compactor, to a maximum of 25 passes.
- Gradation and moisture content of in-place material.
- In-place fill density at completion of the test by nuclear gauge or other methods approved by the Engineer.

A curve showing change in settlement versus number of passes shall be produced from the data. The minimum number of passes to achieve acceptable compaction will be the number required to achieve 80 percent of the total settlement obtained after no fewer than 10 complete passes of the compaction equipment. The lift thickness and minimum number of passes with compaction equipment shall be approved by the Engineer after review of test fill data. A compaction of 92 percent of maximum dry density as determined by ASTM D1557 (modified Proctor) must be achieved.

Random fill is to have a minimum effective angle of friction of 27 degrees. Maximum rock size for rock fills shall be two-thirds of the compacted lift thickness, unless otherwise approved by the Engineer. Oversized materials shall be removed from the fill. No additional payment will be made to remove oversized materials.

5.2.2 Clay Liner

Clay liner shall consist of inorganic fine grained silt and clay or sandy and gravelly silt and clay obtained from the pond excavations, or approved borrow areas. The clay liner shall be placed in lifts not exceeding 6-inches, moisture conditioned to between 0 and +7 percent of optimum and compacted to 92 percent of maximum dry density, as determined by ASTM D1557. The clay liner is to conform to the following specifications:

- Maximum particle size: 3 inches
- Minimum passing No. 200 sieve: 50%
- Minimum plasticity index: 20

- Maximum coefficient of permeability at 92% of Modified Proctor Density (ASTM D1557): $1x10^{-7}$ cm/sec

The Contractor shall provide the equipment and labor necessary to load the soil liner material, haul, place and spread the material within the pond limits, moisture condition and compact it, and prepare the soil liner surface for the placement of the HDPE liner.

Material placed too wet for adequate compaction shall be left to dry or shall be aerated and dried by a means that has been approved by the Engineer until the moisture content is uniform throughout the lift and within the specified limits, or has been approved by the Engineer. Material placed too dry shall be moisture conditioned with water. The lift shall then be mixed until the moisture content is uniform throughout the lift and within the specified limits, or approved by the Engineer. At his discretion, the Engineer may allow the use of material that has a moisture content above the specified limits, provided that the required compaction can be achieved, and that the permeability of the material meets the specified requirements.

Moisture conditioning shall be completed using equipment properly equipped with pressure spray bars and valves to give a uniform application of water.

Areas to receive a geomembrane liner are to be prepared as detailed in Section 5.1.2.

5.3 Backfilling of Anchor Trenches

The Contractor shall backfill all anchor trenches following the installation of the geomembrane liners after the Engineer has given his approval. The backfill shall consist of random fill material excavated from the trenches, and which has had all sharp rocks and rocks larger than 3-inches in diameter removed. Where the material excavated from the trenches is not suitable for backfill of the trenches, the Contractor may remove the excavated material to a stockpile that has been designated by the Engineer, and backfill the trenches with suitable material from a source that has been approved by the Engineer.

The moisture content and compaction of the anchor trench backfill shall meet the requirements of random fill material.

No backfill shall be placed in water, and it shall be the Contractor's responsibility to remove any water from the trench prior to placement of backfill material.

Any damage to the geosynthetics caused by the Contractor's excavation or backfill operation shall be repaired at the Contractor's expense, including any costs that may be incurred for retesting the geosynthetic liner.

5.4 Filter Sand

Filter sand shall consist of a medium sand with few fines meeting the size graduation given below:

Table 4.1 – Filter Sand – Particle Size Distribution

Sieve No.	Percent Passing	
	Minimum	Maximum
No. 4	95	100
No. 8	70	100
No. 16	40	90
No. 30	25	75
No. 50	2	25
No. 100	0	4
No. 200	0	2

5.5 Riprap

Riprap will be used for lining a number of the stormwater diversion channels, as shown on the Drawings. Stone used for riprap shall be hard, durable, angular in shape, resistant to weathering and to water action and free of shale and organic material and generally conform to the recommended gradation guidelines. Generally riprap should be well graded with the D_{100} twice the size of the D_{50}, and the D50 twice the size of the D_{20}. The riprap gradations shall be in accordance with the following tables:

Table 4.2 – Riprap Particle Size Distribution – D_{50} = 12"

Particle Size (inch)	Percent Passing	
	Minimum	Maximum
24	100	100
12	30	70
6	10	40

Table 4.3 – Riprap Particle Size Distribution – D_{50} = 9"

Particle Size (inch)	Percent Passing	
	Minimum	Maximum
18	100	100
9	30	70
5	10	40

Table 4.4 – Riprap Particle Size Distribution – D_{50} = 6"

Particle Size (inch)	Percent Passing	
	Minimum	Maximum
18	100	100
9	30	70
5	10	40

Stone for riprap shall be placed on the prepared surface in a manned that will produce a reasonably well-graded mass of stone with the minimum practicable percentage of voids. The entire mass of stone shall be placed so as to be in reasonable conformance with the lines and grades shown on the Drawings or required by the Engineer. The thickness of the riprap layer shall be a minimum of twice the specified D_{50} or the equal of the largest particle, whichever is greater. In no circumstance shall the layer be thinner than as indicated on the drawings. Riprap shall be placed to its full course thickness in one operation and in such a manner as to avoid damaging or displacing the underlying material.

The larger stones shall be well distributed and the material shall be placed and distributed such that there will be no large accumulations of either the large or smaller sizes of stone. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to achieve the specified results.

5.6 Pipe Bedding Material

Pipe bedding material shall consist of natural sand, a mixture of sand with gravel, crushed gravel or stone, or other broken of fragmented material. In addition, the material shall have a plasticity index of 5 or less. The pipe bedding material shall meet the following grading requirements:

Table 4.5 – Pipe Bedding Material – Particle Size Distribution

Sieve No.	Percent Passing	
	Minimum	Maximum
1 inch	100	100
⅜ inch	65	100
No. 4	35	100
No. 200	0	15

Section 6.0 - Quality Control Construction Tolerances

The Contractor shall construct the various zones to the lines and grades shown on the Drawings, or as required by the Engineer, within the following tolerances:

1. All drainage zones shall be constructed such that the dimensions at any location within the zone shall not be less than those shown.
2. Finished grades shall slope uniformly between given spot and contour elevations. All grades shall provide for natural runoff of water without low spots or pockets.
3. Excavations shall not exceed a vertical tolerance of plus or minus 0.1 feet, and a horizontal tolerance of 0.5 feet. Should over-excavation occur resulting in the vertical tolerance of 0.1 feet being exceeded, the excavation is to be backfilled using random fill and compacted to obtain a tolerance of 0.1 feet.
4. Fill and backfill shall be placed within a vertical tolerance of plus or minus 0.1 feet, and a horizontal tolerance of 0.5 feet, unless otherwise approved by the Engineer.

Section 7.0 - Quality Assurance/Quality Control (QA/QC)

The Engineer will be responsible for testing construction materials to assess whether materials and methods comply with the Specifications. All testing performed by the Engineer will be performed in accordance with procedures outlined in the Specifications, and will be conducted on samples collected from the field as well as test performed on the compacted fill. The results of the tests carried out by the Engineer will be final and conclusive in determining compliance with the Technical Specifications.

Each lift of fill will require approval by the Engineer prior to placement of next lift. Sufficient time shall be allowed by the Contractor for the Engineer to carry out the required test work and interpretation of the test results in order to decide upon the acceptability of each lift. Cooperation shall be given by the Contractor, to the Owner and the Engineer, for taking samples or making tests, and such assistance shall be rendered as is necessary to enable sampling and testing to be carried out expeditiously. The making of such tests or the time taken to interpret their results shall not constitute grounds for a claim by the Contractor for additional compensation or extension of time.

Tests carried out by the Engineer will be performed in accordance with the latest principles and methods prescribed by the American Society for Testing and Materials (ASTM) and other such recognized authorities.

The Engineer's staff will consist of a Field Engineer who will be assisted by Laboratory or Field Technicians as required. The Field Engineer will have overall responsibility for the site work and will report directly to the Owner's representative. The Field Engineer will be responsible for all inspection and testing, and interpretation of the results.

7.1 Earthworks Quality Control

Inspection of earthworks will involve testing and on-the-spot examination of all materials being used for construction to establish compliance with the material requirements, moisture conditioning, spreading procedures, layer thicknesses, and compaction requirements.

7.2 Testing Requirements

The ensure that satisfactory quality control is maintained and that the design objectives are achieved, specific testing requirements will be implemented for all materials placed within the Work area. Tests to be carried out will be divided into two categories:

- Control tests
- Record tests

Control tests will be used to verify whether the materials comply with the Specifications prior to placement. During placement and after completion of the Work, record tests will be carried out to assess whether the work and materials meet the requirements of the Specifications.

7.2.1 Control Tests

The following control tests will be performed before material has been compacted:

- Particle size distribution for fill materials, soil liner, filter sand and riprap. Samples for these tests will be obtained from the material source, and also from material that has been placed and spread, but not yet compacted.

- Moisture content of fill materials and the soil liner. Samples for these tests will be obtained from the material source, and also from material that has been placed and spread, but not yet compacted.
- Modified Proctor compaction tests (ASTM D1557) of fill materials and the soil liner. Samples for these tests will be obtained from the material source, and also from material that has been placed and spread, but not yet compacted.
- Atterberg limits of fill materials and the soil liner. Samples for these tests will be obtained from the material source, and also from material that has been placed and spread, but not yet compacted.
- Other tests, where applicable, will be made by the Engineer on samples of fill materials taken from borrow areas and on the fill, at frequencies sufficient to assess whether the fill material is in compliance with the Technical Specifications.

7.2.2 Record Tests

The following record tests will be performed on material that has been placed and compacted:

- Particle size distribution for fill materials, soil liner and filter sand.
- Field density test on fill materials and the soil liner.
- Moisture content of the fill materials and soil liner.
- Laboratory compaction and particle size distribution of materials recovered from select field density test locations.
- In-situ laboratory permeability tests on fill materials and the soil liner.
- Atterberg limit tests on fill materials and the soil liner.
- Other tests on the fill compacted in place, and on samples of the compacted fill for related laboratory testing at such frequency as the Engineer considers necessary to assess whether the compacted fill is in full compliance with the Technical Specifications.

7.3 Testing Frequencies

The Engineer will carry out geotechnical tests to establish compliance of the Work with the Technical Specifications. Standard procedures will be used for all activities and in general these will be adopted by recognized organizations, such as the American Society of Testing and Materials (ASTM). The following tables outline the minimum testing requirements for the project.

Table 6.1 - Test Methods

Test Designation	Type of Test	Test Method (ASTM)
C1, R1	Atterberg Limits	D4318
R2a C2, R2b	Nuclear Method Moisture Content Laboratory Moisture Content	D6938 D2216
C3, R3	Particle Size Distribution	D422[3]
C4, R4	Laboratory Compaction	D1557
R5a R5b R5c	Nuclear Method Field Density Sand Cone Field Density Water Replacement Field Density	D6938 D1556 D5030
C6, R6	Laboratory Permeability Test	D5084
C7, R7	Riprap Particle Size Distribution	Pebble Count

Notes:
1. C – Denotes Control Tests
2. R – Denotes Record Tests

3. Hydrometer tests down to the 2-micron size will be carried out as directed by the Engineer but will generally not be required. All samples are to be wash graded over a #200 sieve.

Table 6.2 - Test Frequency - Prepared Subgrade

Test Designation	Type of Test	Frequency (1 per)
R1	Atterberg Limits	2,000 yd^2
C2, R2a, R2b	Moisture Content	1,000 yd^2
C3, R3	Particle Size Distribution	2,000 yd^2
C4, R4	Laboratory Compaction	2,000 yd^2
R5a	Nuclear Density	1,00 yd^2
R5b	Sand Cone Field Density	5,000 yd^2

Table 6.3 - Test Frequency - Random Fill

Test Designation	Type of Test	Frequency (1 per)
R1	Atterberg Limits	5,000 yd^3
C2, R2a, R2b	Moisture Content	2,500 yd^3
C3, R3	Particle Size Distribution	5,000 yd^3
C4, R4	Laboratory Compaction (Modified Proctor)	5,000 yd^3
R5a	Nuclear Density	1,000 yd^3
R5b	Sand Cone Field Density	10,000 yd^3
C6, R6	Laboratory Permeability Test	5,000 yd^3

Table 6.4 - Test Frequency – Soil Liner

Test Designation	Type of Test	Frequency (1 per)
R1	Atterberg Limits	1,000 yd^3
C2, R2a, R2b	Moisture Content	500 yd^3
C3, R3	Particle Size Distribution	1,000 yd^3
C4a, R4a	Laboratory Compaction (Modified Proctor)	1,000 yd^3
R5a	Nuclear Density	1,000 yd^3
R5b	Sand Cone Field Density	2,500 yd^3
C6, R6	Laboratory Permeability Test	1,000 yd^3

Table 6.5 - Test Frequency – Filter Sand

Test Designation	Type of Test	Frequency (1 per)
C3, R3	Particle Size Distribution	250 yd^3

Table 6.5 - Test Frequency – Riprap

Test Designation	Type of Test	Frequency (1 per)
C7, R7	Riprap Particle Size Distribution	1,000 yd^3

7.4 Reporting

The Engineer will prepare daily progress reports throughout the period of construction. The reports will summarize pertinent construction activities, the results of testing completed over that period, and highlight any difficulties that were encountered.

7.5 Test Records

The Engineer will maintain a record of all tests. The tests will be recorded on a form applicable to the test being performed. The location of all tests will be recorded and accurately described. A plan indicating the location of the tests will be maintained.

7.6 Construction Report

On completion of the Work, the Engineer will prepare a construction report that will include a summary of the results from all tests carried out as part of the quality assurance program. It will also include construction record Drawings.

Section 8.0 - As-Built Requirements

To assist in the production of adequate as-built Drawings and documentation, the Contractor will be required to provide one set of 22 inch by 34 inch red-lined Drawings with construction modifications, as well as the electronic formatted version of the Drawings to the Owner.

Knight Piésold
CONSULTING

Section 9.0 - References

ASTM International, 2007, *ASTM D422 - 63 Standard Test Method for Particle-Size Analysis of Soils*, ASTM International.

ASTM International, 2007, *ASTM D1556 - 07 Standard Test Method for Density and unit Weight of Soil in Place by the Sand-Cone Method*, ASTM International.

ASTM International, 2009, *ASTM D1557 - 09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))*, ASTM International.

ASTM International, 2005, *ASTM D2216 - 05 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*, ASTM International.

ASTM International, 2005, *ASTM D4318 - 05 Standard Test Methods for Liquid Limit, Plastic limit, and Plasticity Index of Soils*, ASTM International.

ASTM International, 2009, *ASTM D5030 - 04 Standard Test Method for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit*, ASTM International.

ASTM D5030 - 04 Standard Test Method for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit

ASTM International, 2003, *ASTM D5084 - 03 Standard Test Methods for Measurements of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter*, ASTM International.

ASTM International, 2008, *ASTM D6938 – 08a Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear methods (Shallow Depth)*, ASTM International.

USACE 1110-2-2301, 1994, Engineering and Design – Test Quarries and Test Fills, United States Army Core of Engineers.

Drawings

DEWEY-BURDOCK PROJECT
LAND APPLICATION AND IRRIGATION

JULY 2010

Prepared for
POWERTECH URANIUM CORPORATION
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INDEX OF DRAWINGS

LOCATION MAP

COMMON ABBREVIATIONS

℄	CENTER LINE
DIA	DIAMETER
EL	ELEVATION
NTS	NOT TO SCALE
REQ'D	REQUIRED
SCH	SCHEDULE
SDR	STANDARD DIMENSION RATIO
TOC	TOP OF CONCRETE
TOS	TOP OF STEEL
(TYP)	TYPICAL
FT	FEET

SYMBOLS AND DESCRIPTIONS

3:1	3 (HORIZONTAL) TO 1 (VERTICAL) SLOPE
E 371000	EASTING COORDINATE
N 364500	NORTHING COORDINATE
1 / 100	DETAIL IDENTIFICATION DRAWING REFERENCE NUMBER
A / 100	PROFILE OR CROSS SECTION IDENTIFICATION DRAWING REFERENCE NUMBER
	DIRECTION OF FLOW
	EXISTING GROUND SURFACE OR BOTTOM OF EXCAVATION
6525	EXISTING GROUND SURFACE AND EL, FEET
	SLOPE INDICATOR
	TOP OF ROCK OR ROCK SURFACE
	WATER LEVEL

SYMBOLS AND DESCRIPTIONS

A / 100	SECTION CALLOUT WITH LOCATION REFERENCE
	DETAIL OR DIMENSION BREAK
	FENCE LINE
1 / 2	SLOPE INDICATOR (DETAIL)

REV	DATE	DESCRIPTION	APP'D / CADD
A	09/15/09	ISSUED FOR CLIENT REVIEW	ST / RJB

DISCLAIMER

CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY–BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION INDEX, GENERAL SITE LOCATION MAP AND SYMBOLS

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ACTIVITY CODE	N/A	XREF NUMBER	N/A		

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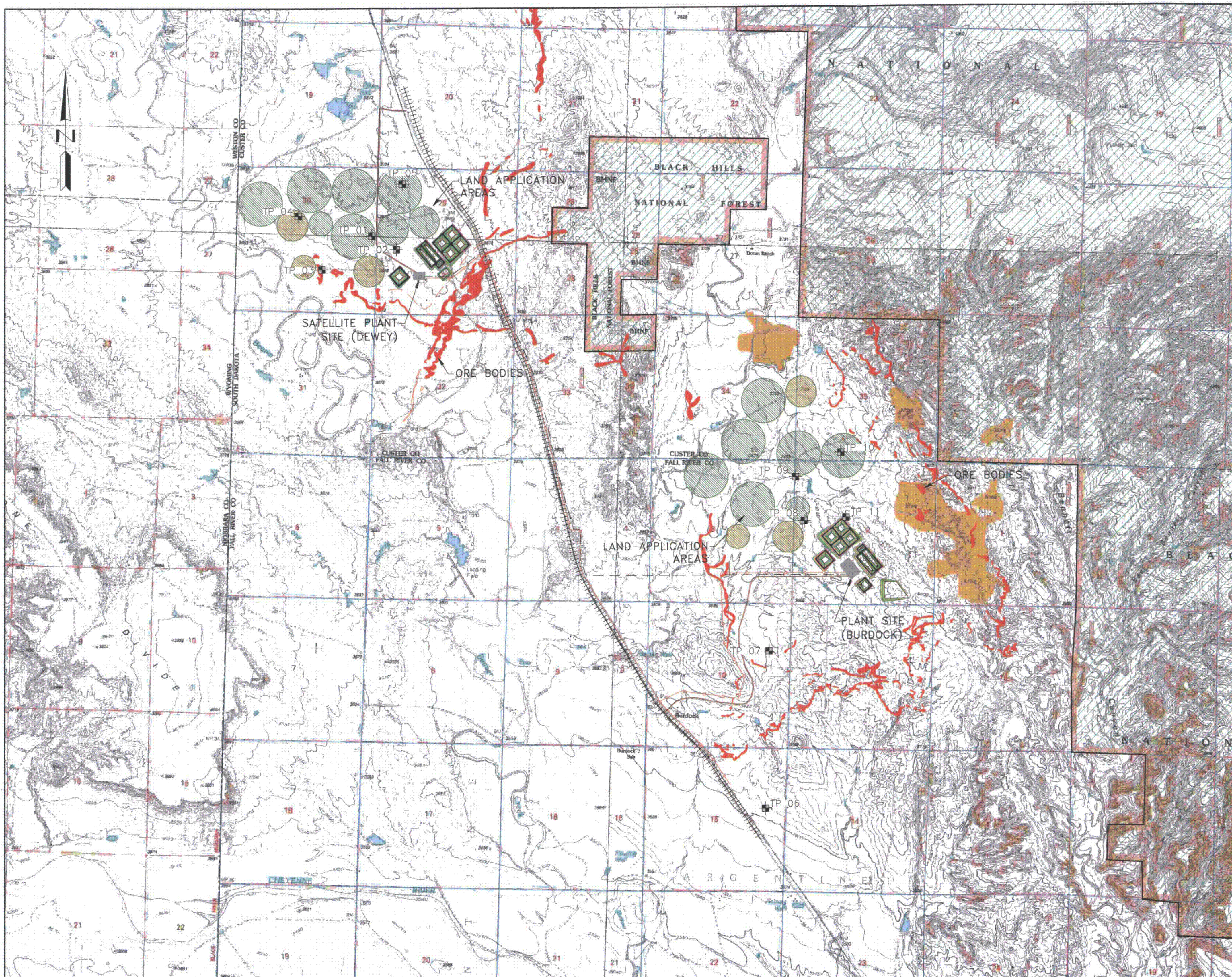

PLAN

2000 0 2000 4000 FEET

1" = 2000' AT FULL SIZE (ANSI D)
1" = 4000' AT HALF SIZE (ANSI B)

LEGEND:

- REGRADED CONTOURS
- NEW ROADS
- RAILROAD
- POWER LINE
- PIPELINE
- ORE BODIES
- LAND APPLICATION AREAS
- NATIONAL FOREST
- BLM AREAS
- TP 05 TEST PIT

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B).

CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY-BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION SITE INVESTIGATION – TEST PIT LOCATIONS

REV	DATE	DESCRIPTION	APP'D
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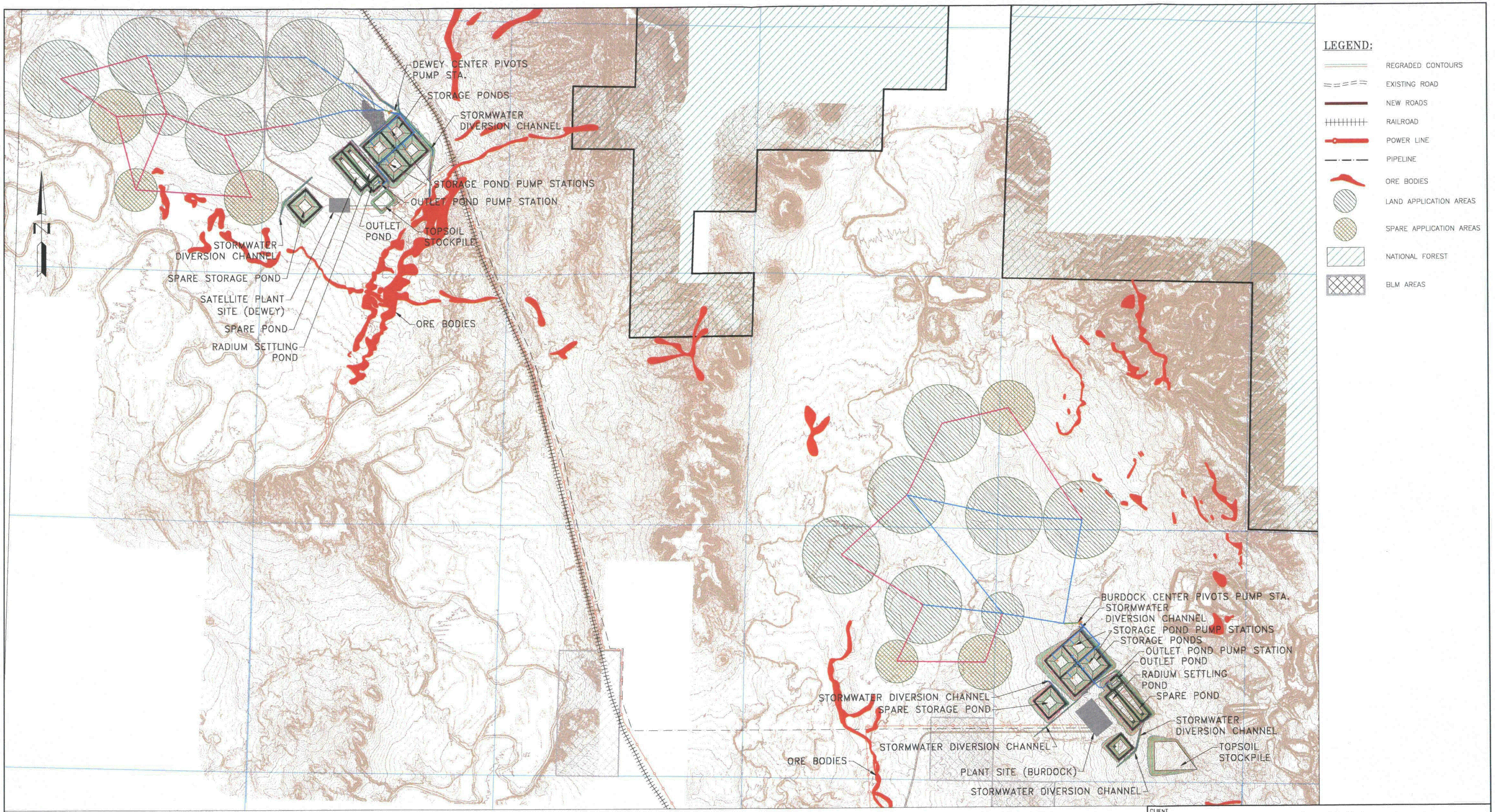

PLAN

1000 0 1000 2000 FEET

1" = 1000' AT FULL SIZE (ANSI D)
1" = 2000' AT HALF SIZE (ANSI B)

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI–D) AND 1.5" ON A HALF SIZE PLOT (ANSI–B).

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PROJECT: DEWEY–BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION SITE PLAN

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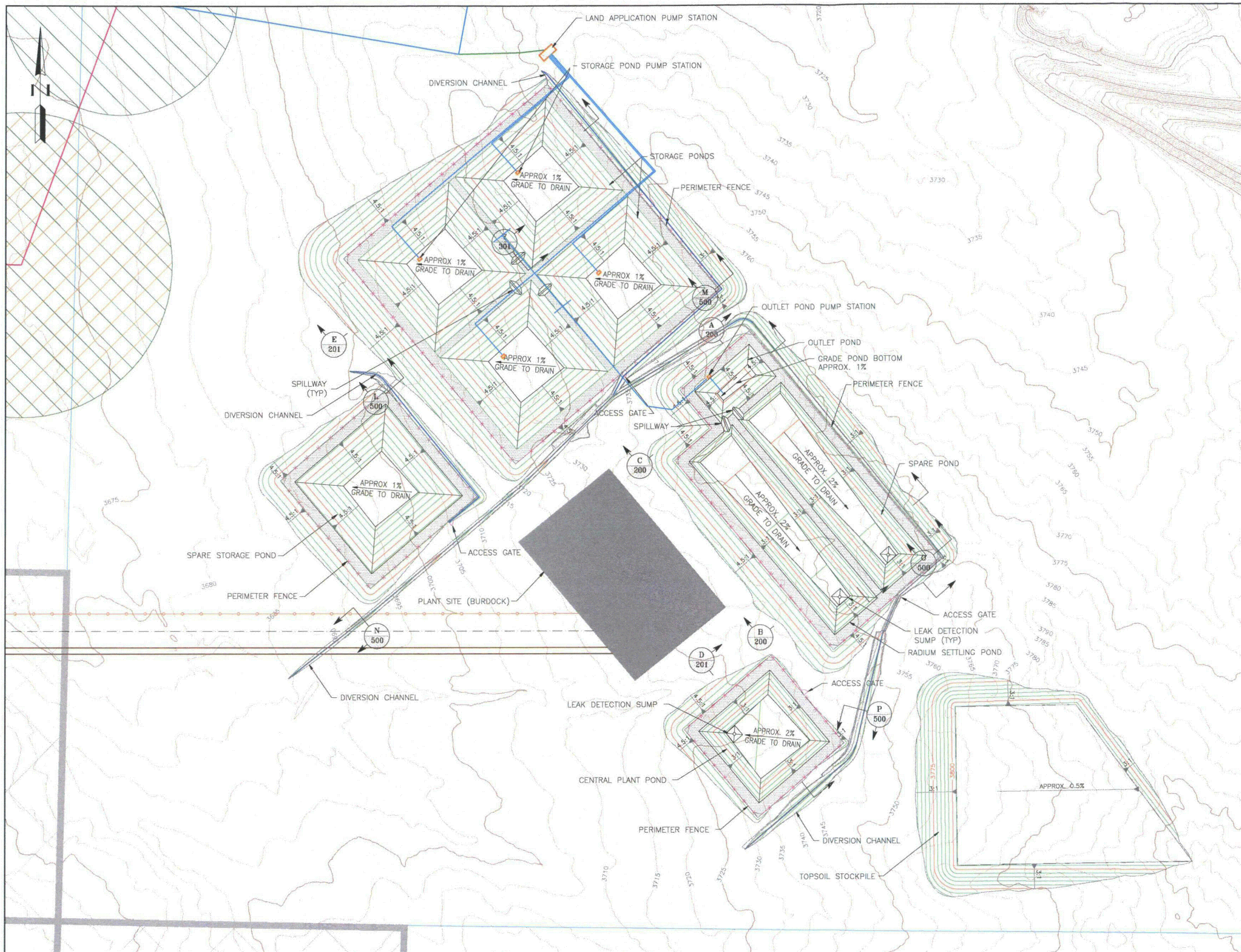

LEGEND:

- EXISTING CONTOURS
- REGRADED CONTOURS
- EMBANKMENT ROAD
- NEW ROADS
- PERIMETER FENCE
- POWER LINE
- PIPELINE
- LAND APPLICATION AREAS
- BLM AREAS

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B).

PLAN – BURDOCK PLANT SITE

200 0 200 400 FEET

1" = 200' AT FULL SIZE (ANSI D)
1" = 400' AT HALF SIZE (ANSI B)

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A	10/30/09	ISSUED FOR CLIENT REVIEW	RJB / CADD

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CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY-BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION BURDOCK PLANT SITE PLAN

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ACTIVITY CODE	N/A	XREF NUMBER	N/A		

PLAN – DEWEY SATELLITE PLANT SITE

200 0 200 400 FEET
1" = 200' AT FULL SIZE (ANSI D)
1" = 400' AT HALF SIZE (ANSI B)

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI–D) AND 1.5" ON A HALF SIZE PLOT (ANSI–B).

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CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY–BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION DEWEY PLANT SITE PLAN

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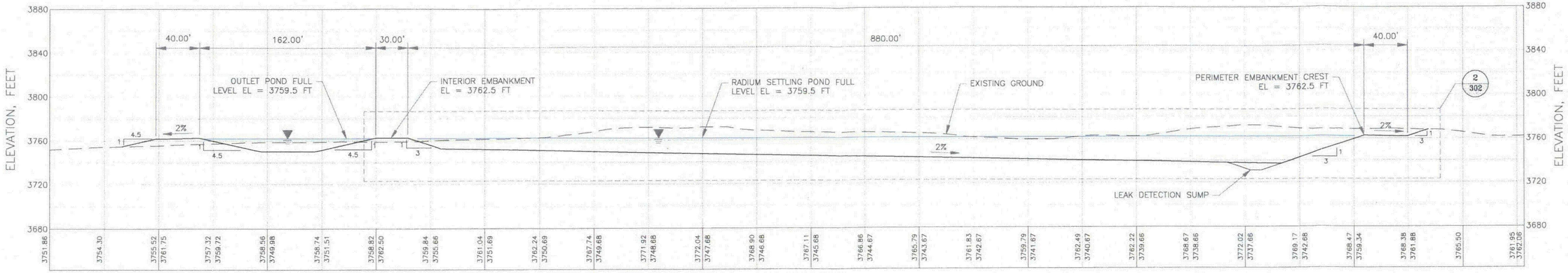
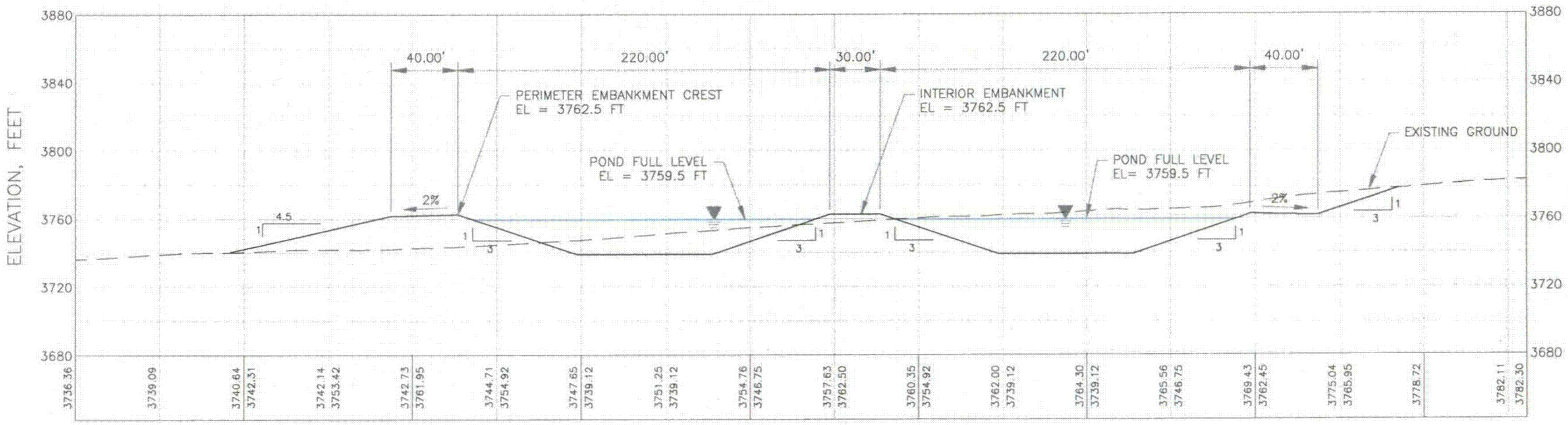


A
101
BURDOCK RADIUM SETTLING AND OUTLET PONDS
SECTION



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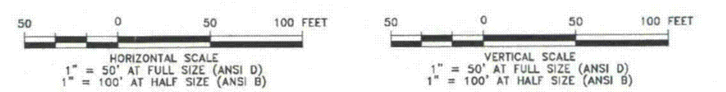
101
BURDOCK RADIUM SETTLING AND SPARE PONDS
SECTION



NOTES:

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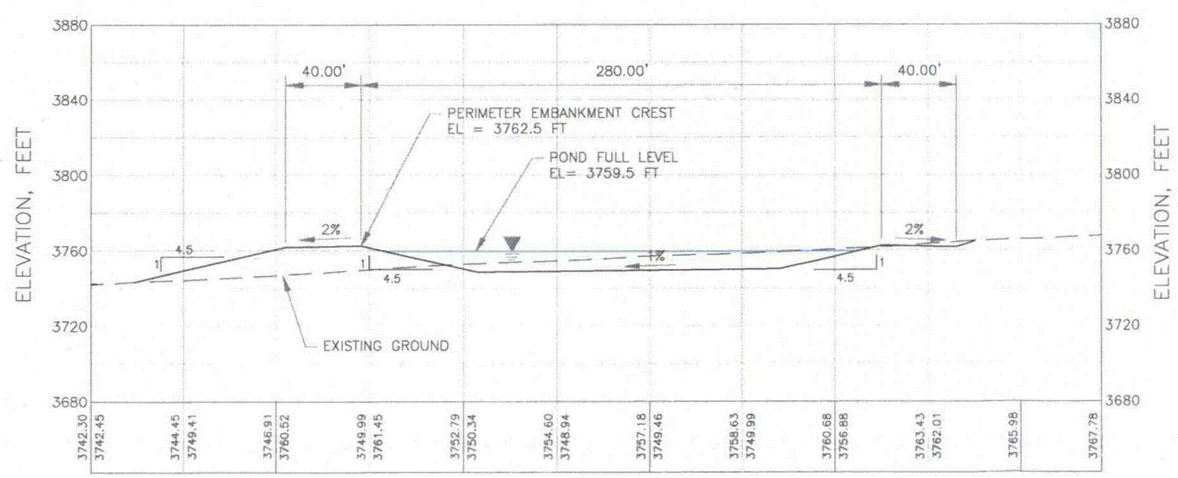

C
101
BURDOCK OUTLET POND
SECTION

REV	DATE	DESCRIPTION	CADD	APP'D
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CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY-BURDOCK PROJECT

TITLE: LAND APPLICAITON AND IRRIGATION
BURDOCK POND SECTIONS
SHEET 1 OF 2

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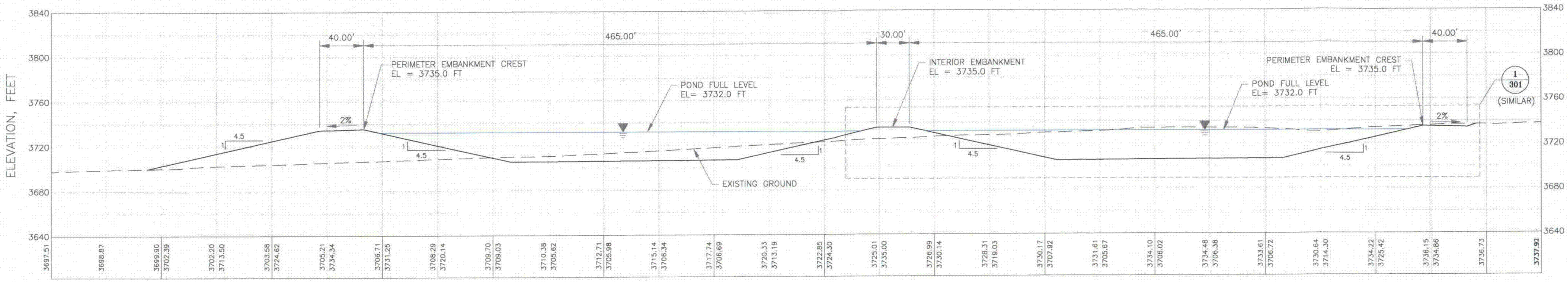
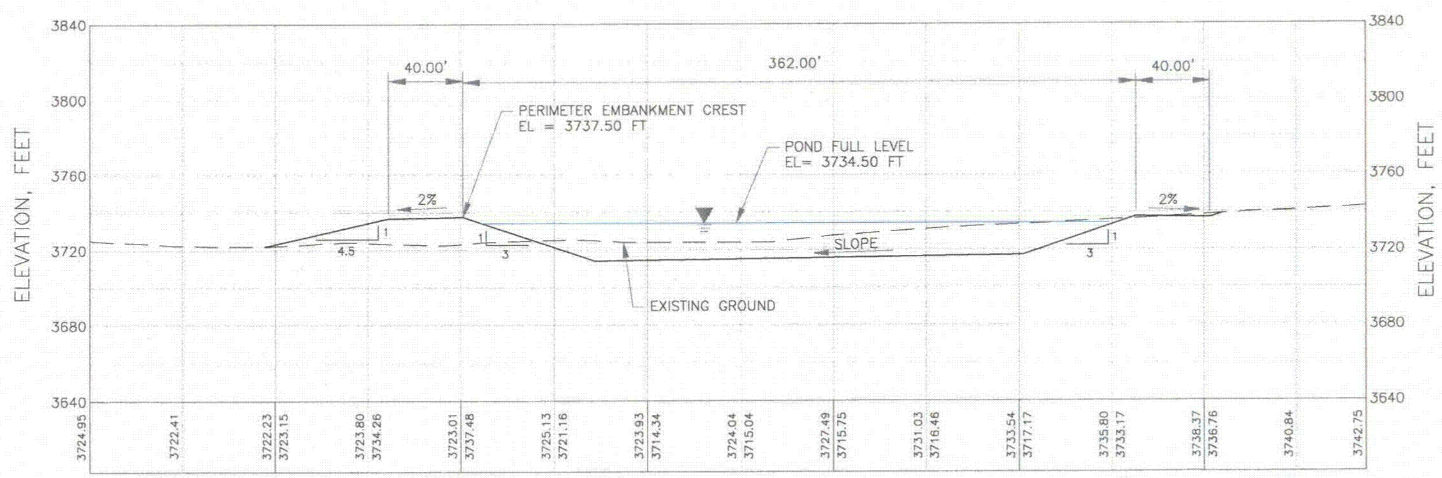
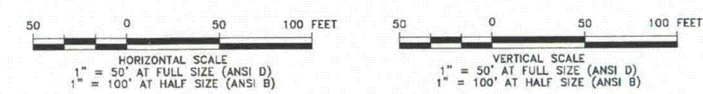


E
101
BURDOCK STORAGE PONDS
SECTION



D
101
CENTRAL PLANT POND
SECTION



NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B).

REV	DATE	DESCRIPTION	ST	APP'D
A	09/15/09	ISSUED FOR CLIENT REVIEW	RJB	CADD

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CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY-BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION
BURDOCK POND SECTIONS
SHEET 2 OF 2

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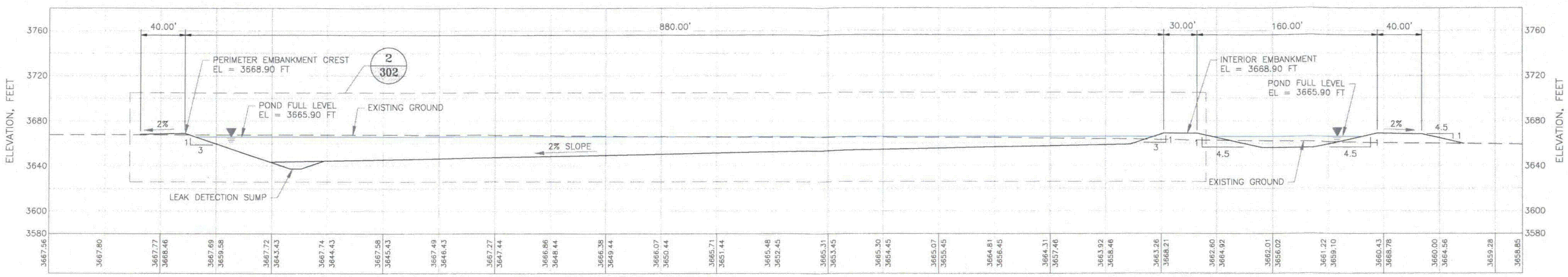
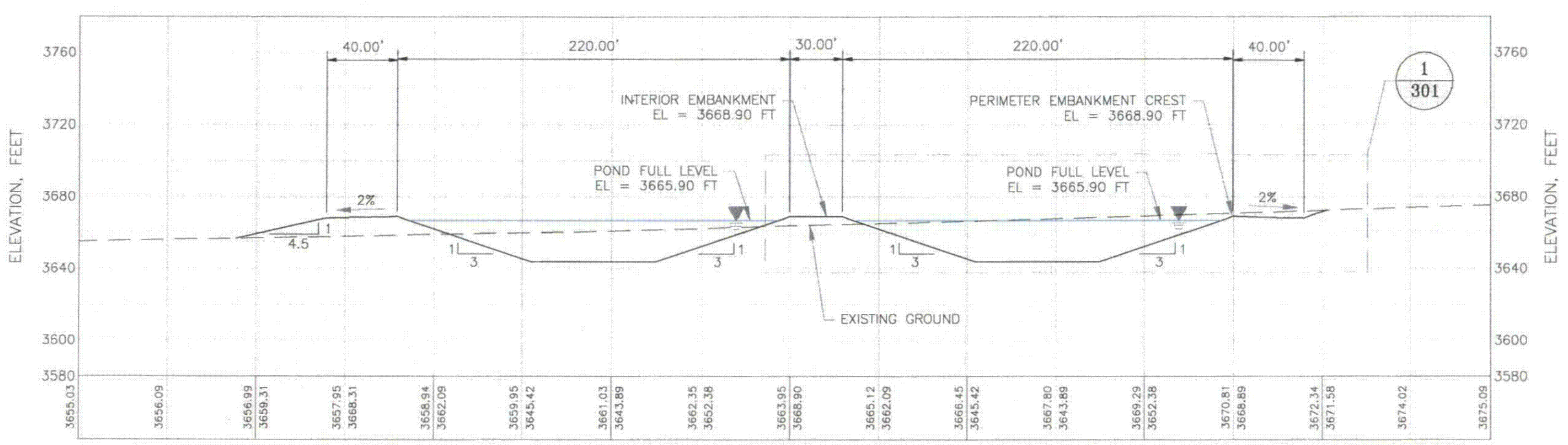


A 102 DEWEY RADIUM SETTLING AND OUTLET PONDS
SECTION



B 102 DEWEY RADIUM SETTLING PONDS
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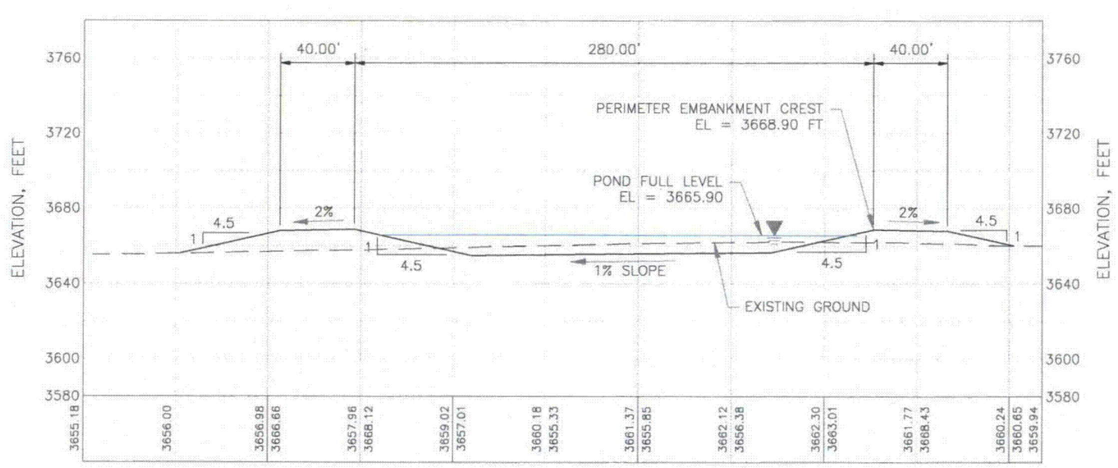

C 102 DEWEY OUTLET POND
SECTION

50 0 50 100 FEET
HORIZONTAL SCALE
1" = 50' AT FULL SIZE (ANSI D)
1" = 100' AT HALF SIZE (ANSI B)

50 0 50 100 FEET
VERTICAL SCALE
1" = 50' AT FULL SIZE (ANSI D)
1" = 100' AT HALF SIZE (ANSI B)

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B).

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CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY-BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION
DEWEY POND SECTIONS
SHEET 1 OF 2

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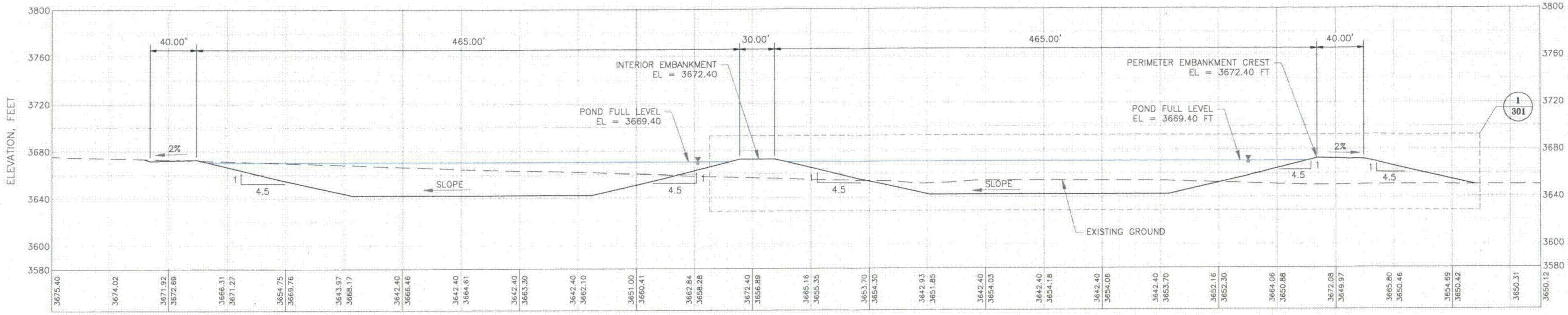
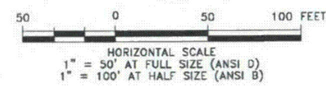
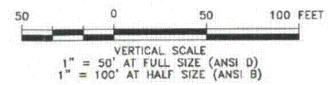


D
102

DEWEY STORAGE PONDS
SECTION





NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B).

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PROJECT: DEWEY-BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION
DEWEY POND SECTIONS
SHEET 2 OF 2

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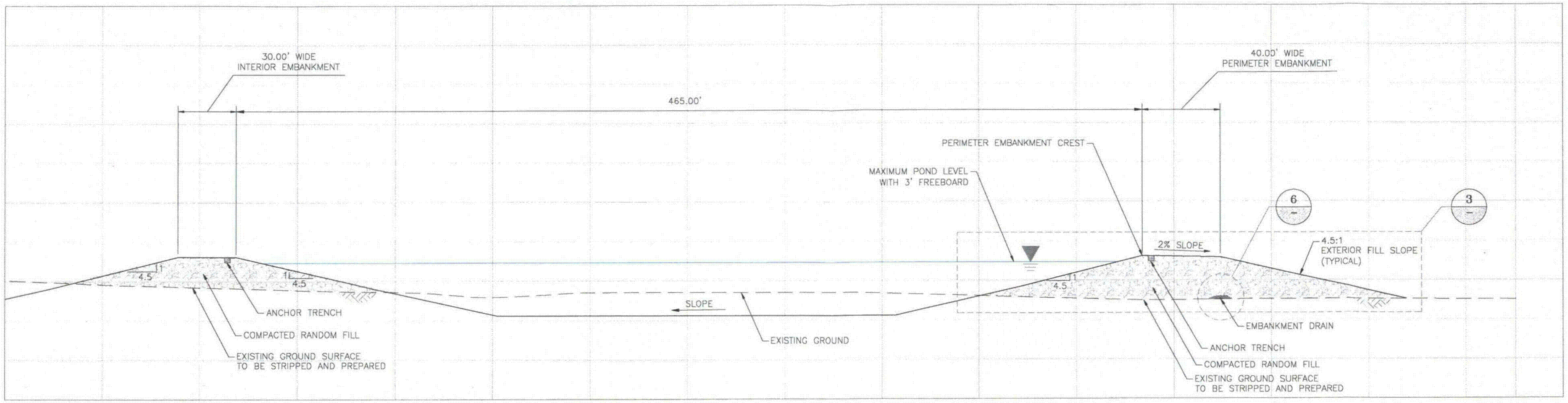
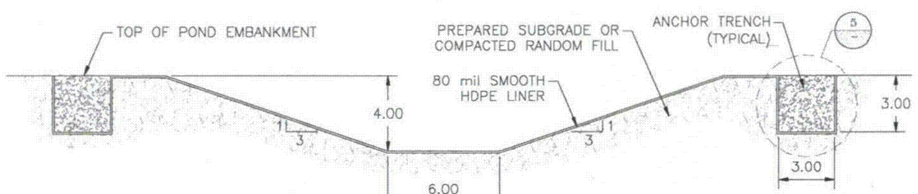


1 / 201 1 / 203 STORAGE POND DETAIL
TYPICAL OF SINGLE LINED PONDS

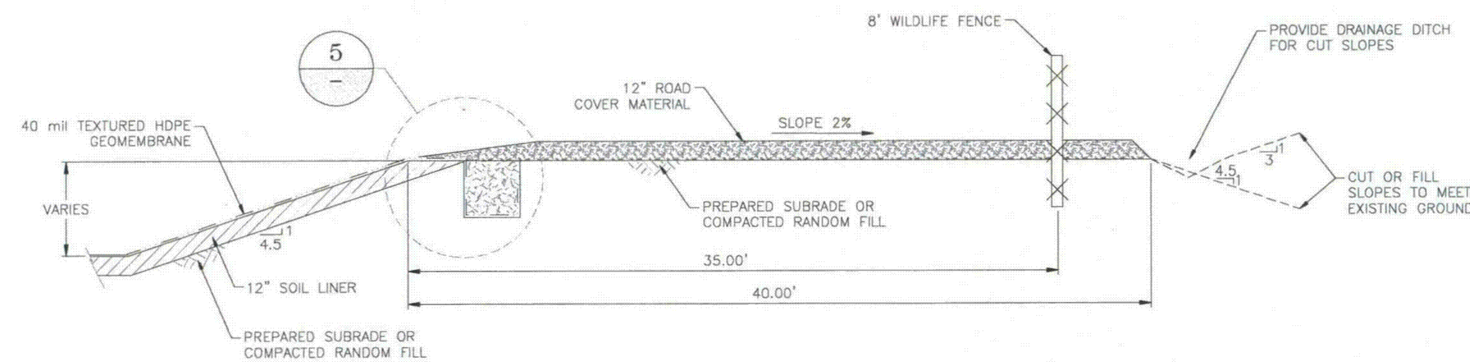
30 0 30 60 FEET
HORIZONTAL SCALE
1" = 30' AT FULL SIZE (ANSI D)
1" = 60' AT HALF SIZE (ANSI B)

30 0 30 60 FEET
VERTICAL SCALE
1" = 30' AT FULL SIZE (ANSI D)
1" = 60' AT HALF SIZE (ANSI B)



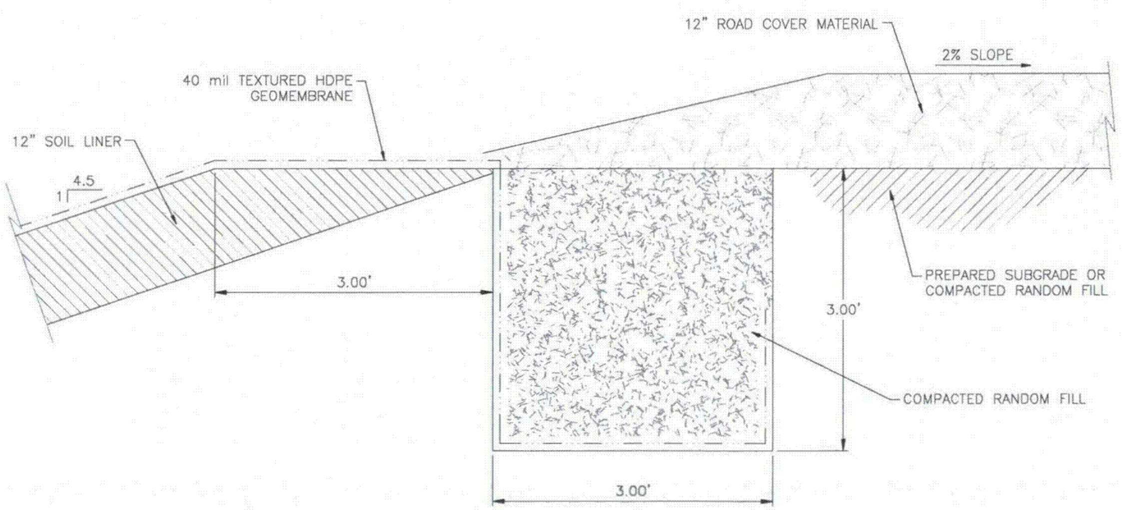
7 / 101 7 / 102 SPILLWAY DETAIL

5 0 5 10 FEET
1" = 5' AT FULL SIZE (ANSI D)
1" = 10' AT HALF SIZE (ANSI B)



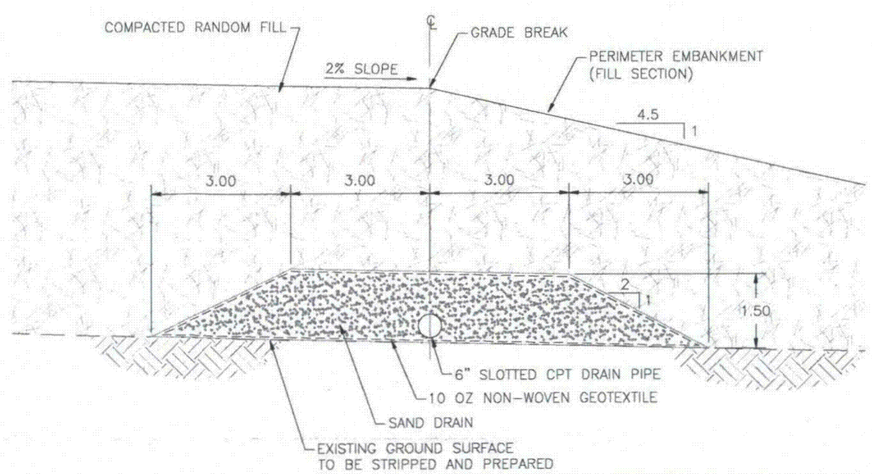
3 POND EMBANKMENT DETAIL
FOR SINGLE LINED PONDS

5 0 5 10 FEET
1" = 5' AT FULL SIZE (ANSI D)
1" = 10' AT HALF SIZE (ANSI B)



5 LINER ANCHOR TRENCH DETAIL
FOR SINGLE LINED PONDS

1 0 1 2 FEET
1" = 1' AT FULL SIZE (ANSI D)
1" = 2' AT HALF SIZE (ANSI B)



6 EMBANKMENT DRAIN DETAIL

2 0 2 4 FEET
1" = 2' AT FULL SIZE (ANSI D)
1" = 4' AT HALF SIZE (ANSI B)

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B).
2. EMBANKMENT DRAINS TO BE CONSTRUCTED BENEATH ALL FILL EMBANKMENTS.

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CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY-BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION
TYPICAL POND SECTIONS AND DETAILS
SHEET 1 OF 2

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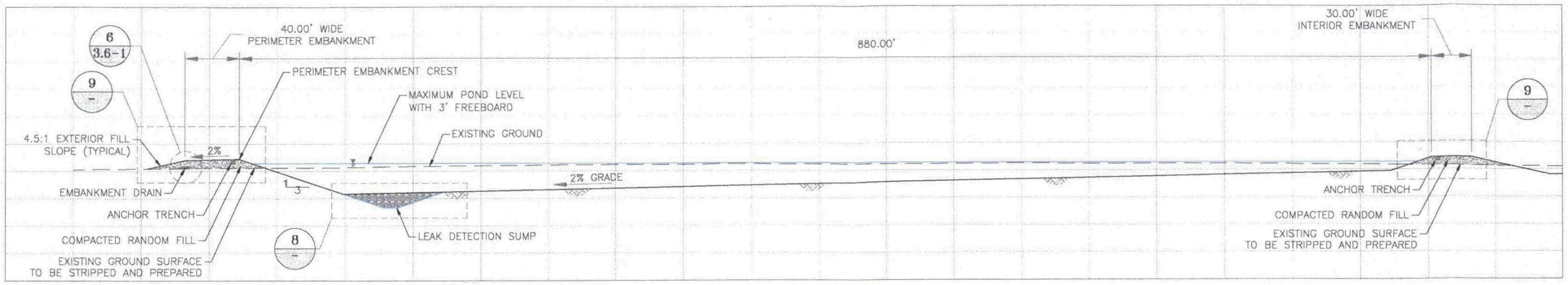
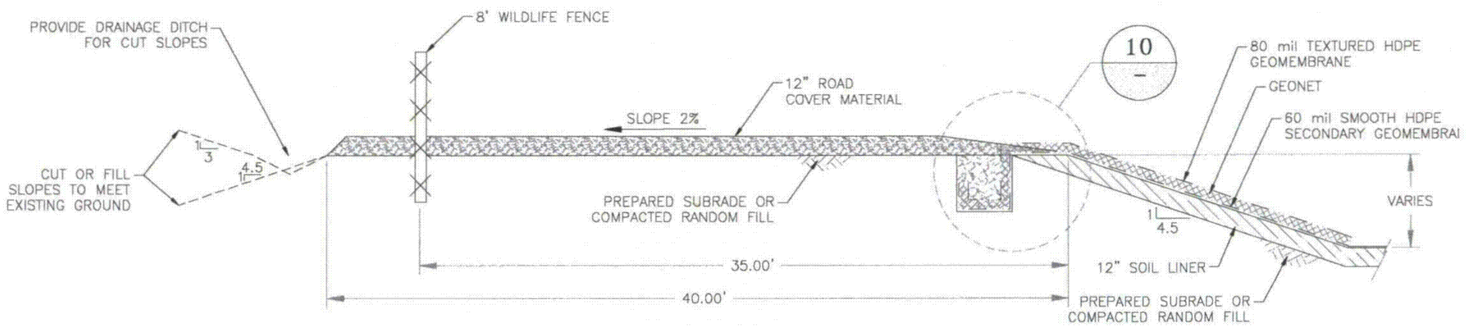
ACTIVITY CODE	N/A	XREF NUMBER	N/A		



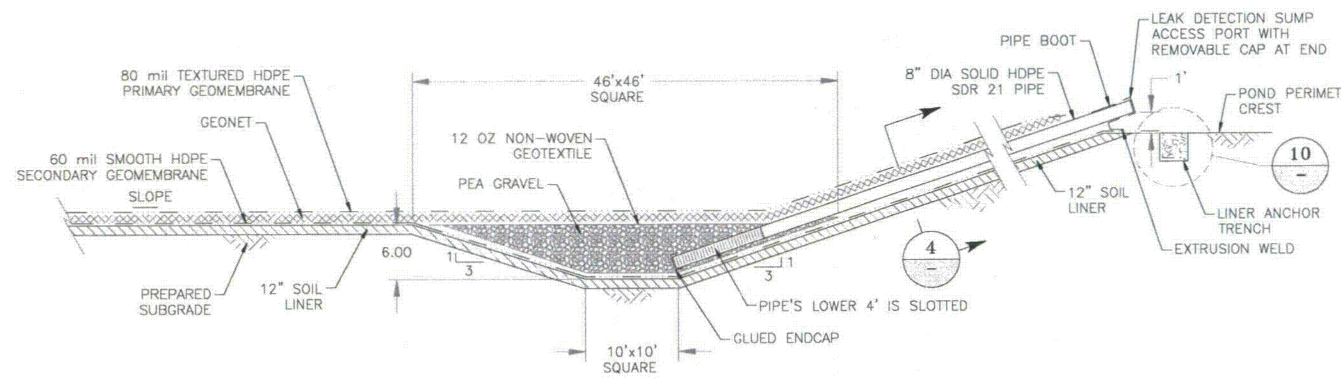
2 / 200 — 2 / 202 RADIUM SETTLING POND DETAIL
TYPICAL OF DOUBLE LINED PONDS

50 0 50 100 FEET
1" = 50' AT FULL SIZE (ANSI D)
1" = 100' AT HALF SIZE (ANSI B)



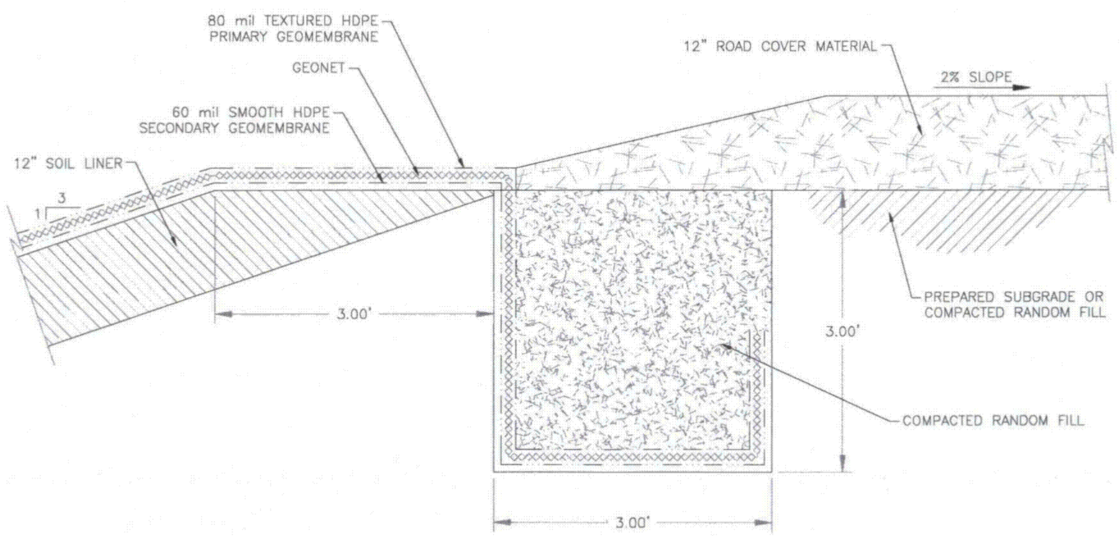
9 — POND EMBANKMENT DETAIL
FOR DOUBLE LINED PONDS

5 0 5 10 FEET
1" = 5' AT FULL SIZE (ANSI D)
1" = 10' AT HALF SIZE (ANSI B)



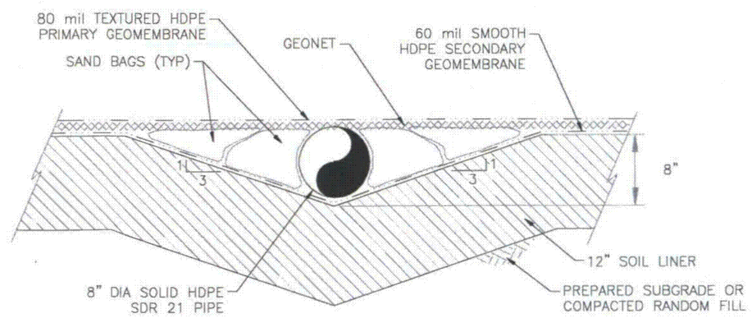
8 — LEAK DETECTION SUMP AND ACCESS PORT DETAIL

10 0 10 20 FEET
1" = 10' AT FULL SIZE (ANSI D)
1" = 20' AT HALF SIZE (ANSI B)



10 — ANCHOR TRENCH AND LINER DETAIL
FOR DOUBLE LINED PONDS

1 0 1 2 FEET
1" = 1' AT FULL SIZE (ANSI D)
1" = 2' AT HALF SIZE (ANSI B)



4 — LEAK DETECTION SUMP ACCESS PORT DETAIL

1 0 1 2 FEET
1" = 1' AT FULL SIZE (ANSI D)
1" = 2' AT HALF SIZE (ANSI B)

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B).
2. EMBANKMENT DRAINS TO BE CONSTRUCTED BENEATH ALL FILL EMBANKMENTS.

CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY-BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION TYPICAL SECTIONS AND DETAILS SHEET 2 OF 2

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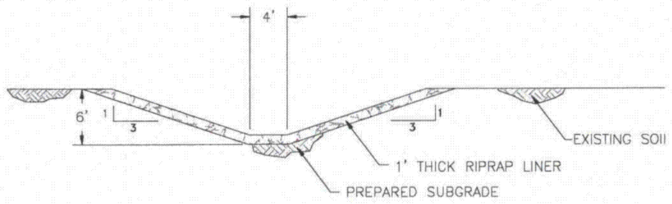
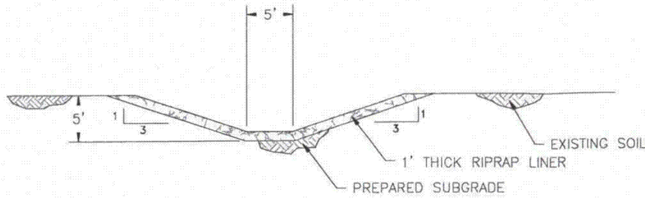


G
102
DEWEY STORMWATER DIVERSION CHANNEL
SECTION



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102
DEWEY STORMWATER DIVERSION CHANNEL
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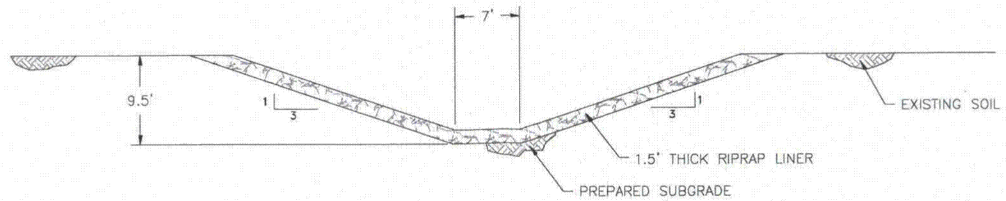

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102
DEWEY STORMWATER DIVERSION CHANNEL
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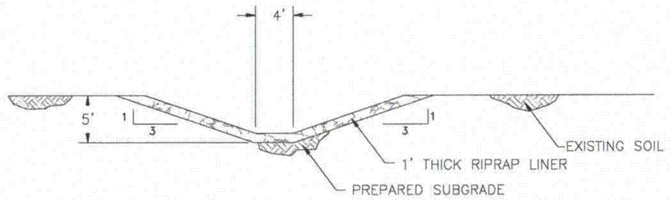

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102
DEWEY STORMWATER DIVERSION CHANNEL
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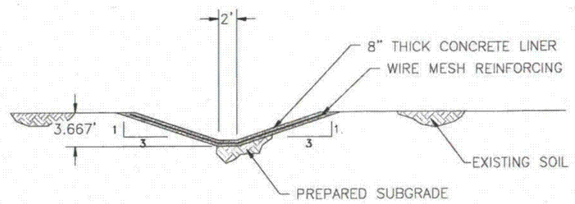

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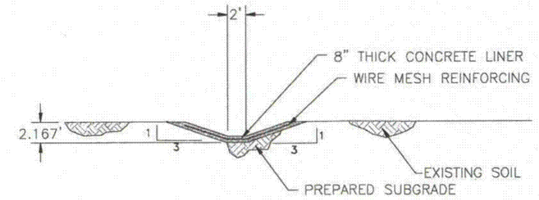
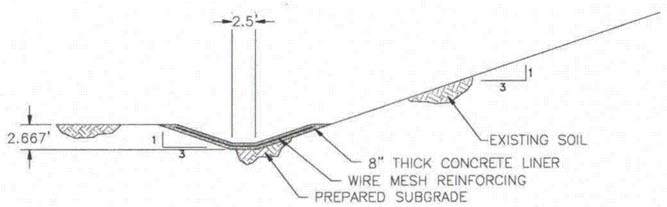
102
DEWEY STORMWATER DIVERSION CHANNEL
SECTION



L
101
BURDOCK STORMWATER DIVERSION CHANNEL
SECTION



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101
BURDOCK STORMWATER DIVERSION CHANNEL
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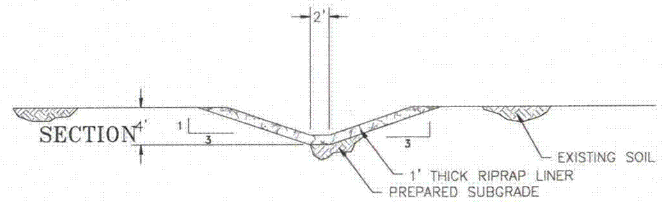

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101
BURDOCK STORMWATER DIVERSION CHANNEL
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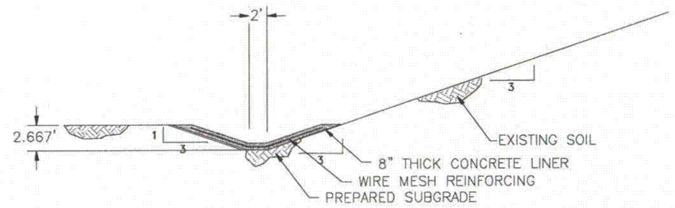
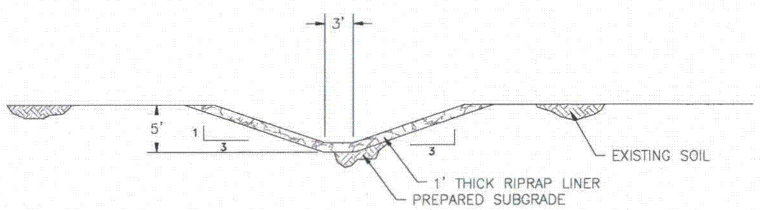


O
101
BURDOCK STORMWATER DIVERSION CHANNEL
SECTION

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B).



P
101
BURDOCK STORMWATER DIVERSION CHANNEL
SECTION

CLIENT
POWERTECH (USA) Inc.

PROJECT
DEWEY-BURDOCK PROJECT

TITLE
LAND APPLICAITON AND IRRIGATION
DIVERSION CHANNEL SECTIONS

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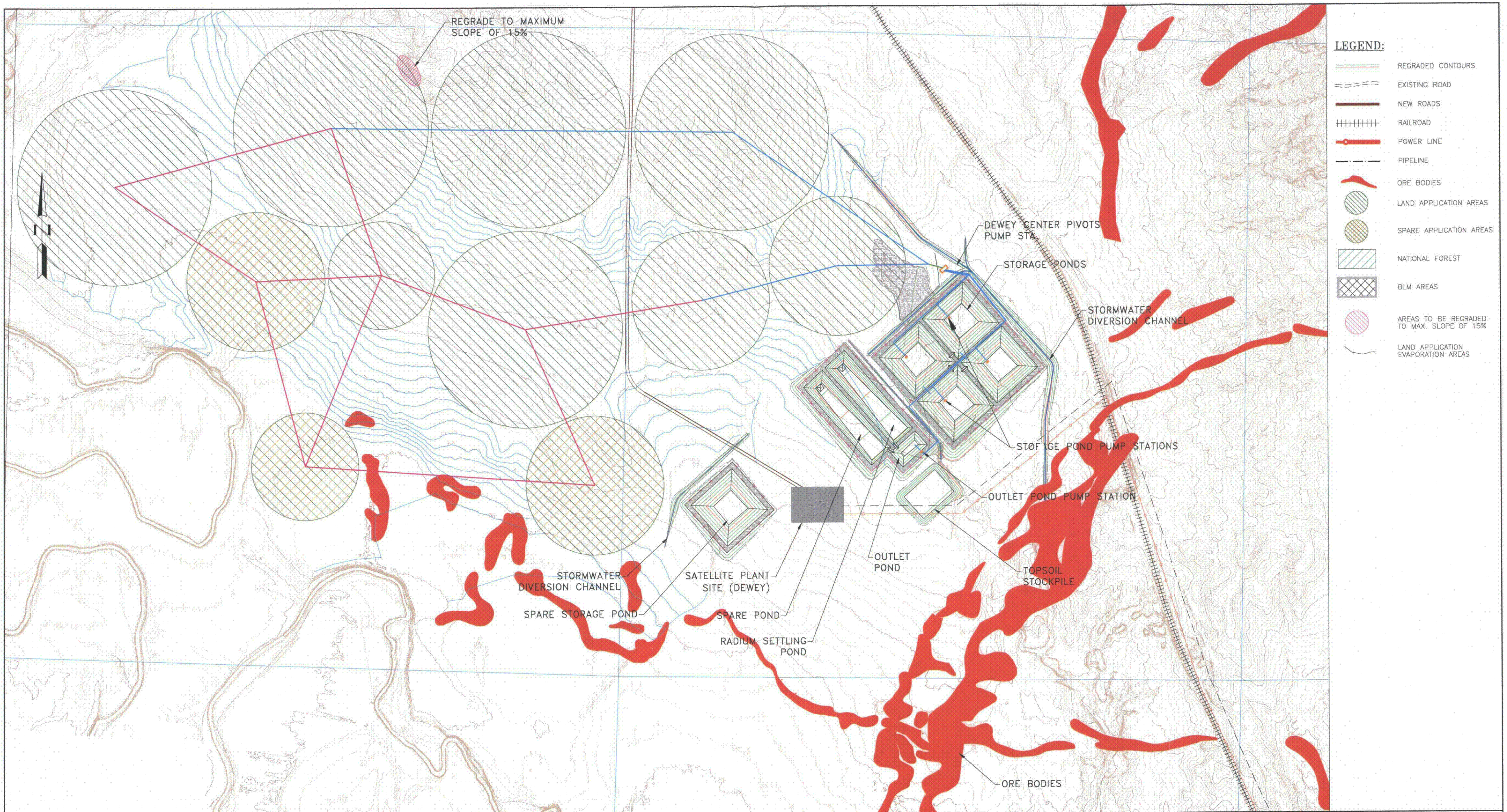

PLAN

400 0 400 800 FEET

1" = 400' AT FULL SIZE (ANSI D)
1" = 800' AT HALF SIZE (ANSI B)

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B).

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CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY-BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION DEWEY EVAPORATION AREAS AND LAND APPLICATION REGRADING

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LEGEND:

- REGRADED CONTOURS
- EXISTING ROAD
- NEW ROADS
- RAILROAD
- POWER LINE
- PIPELINE
- ORE BODIES
- LAND APPLICATION AREAS
- SPARE APPLICATION AREAS
- NATIONAL FOREST
- BLM AREAS
- AREAS TO BE REGRADED TO MAX. SLOPE OF 15%
- LAND APPLICATION EVAPORATION AREAS

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B).

PLAN

400 0 400 800 FEET

1" = 400' AT FULL SIZE (ANSI D)
1" = 800' AT HALF SIZE (ANSI B)

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CLIENT: POWERTECH (USA) Inc.

PROJECT: DEWEY-BURDOCK PROJECT

TITLE: LAND APPLICATION AND IRRIGATION BURDOCK EVAPORATION AREAS AND LAND APPLICATION REGRADING

Knight Piésold CONSULTING

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Powertech (USA) Inc.
Dewey-Burdock Project
Pond and Land Application
Technical Specifications and QA/QC Plan
Part 2 - Geosynthetics

July 2010

prepared for:
Powertech (USA) Inc.
5575 DTC Parkway, Suite 140
Telephone: (303) 790-7528
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KP Project No. DV102.00279.09

Rev. No.	Date	Description	Knight Piésold	Client
0	July 2010		Paul Bergstrom	Powertech (USA) Inc.

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Powertech (USA) Inc.
Dewey-Burdock Project
Pond and Land Application
Technical Specifications and QA/QC Plan
Part 2 - Geosynthetics

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Part 2 - Geosynthetics

Section 1.0 - General

1.1 Introduction

This Specification stipulates materials and installation requirements for geosynthetics related to the construction of the Ponds and Land Application Systems at Powertech's Dewey-Burdock project.

1.2 Limitations and Disclaimer

This Specification titled Dewey-Burdock Project Pond and Land Application Technical Specifications and QA/QC Plan Part 2 - Geosynthetics has been prepared by Knight Piésold and Co. (Knight Piésold) for the exclusive use of Powertech (USA) Inc. (Client). No other party is an intended beneficiary of this Specification or the information, opinions, and conclusions contained herein. Any use by any party other than the Client of any of the information, opinions, or conclusions is the sole responsibility of said party. The use of this Specification shall be at the sole risk of the user regardless of any fault or negligence of the Client or Knight Piésold.

The information contained herein have been completed to a level of detail commensurate with the objectives of the assignment and in light of the information made available to Knight Piésold at the time of preparation. This specification and its supporting documentation have been reviewed and/or checked for conformance with industry-accepted norms and applicable government regulations. To the best of the information and belief of Knight Piésold, the information presented in this Specification is accurate to within the limitations specified herein.

This Specification is Knight Piésold pdf file: Dewey-Burdock Project Pond and Land Application Technical Specifications and QA/QC Plan Part 2 - Geosynthetics Rev 0.pdf. Any reproductions or modifications of this Specification are uncontrolled and may not be the most recent revision.

1.3 Contributors and Approvals

This specification was prepared, reviewed, and approved by the undersigned.

Prepared by:

Steven F. Truby, P. Eng.
Project Engineer

Approved by:

Paul D. Bergstrom, C.E.P.
Sr. Executive Project Manager

Reviewed by:

Jaye Pickarts, P.E.
Sr. Vice President

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Section 2.0 - Scope and General Description of the Work

This Specification stipulates materials and installation requirements for geosynthetics related to the construction of the Ponds and Land Application Systems at Powertech's Dewey-Burdock project. Should the Contractor wish to deviate from these Specifications, he shall notify the Engineer in writing, providing a description of the deviation. The description shall include data indicating the magnitude of the deviation, justification for the deviation, and any possible short or long-term impacts of the deviation on the project. Deviations in materials Specifications shall be subject to the approval of the Engineer and Owner prior to shipment of the materials.

All geosynthetic installation is to be completed in accordance with the Manufacturer's specifications. Prior to starting geosynthetic installation, the Contractor shall provide certification from the Manufacturer that the materials supplied have been produced and tested in accordance with relevant Specifications.

2.1 Definition of Terms

"Owner" is defined as an authorized representative of Powertech.

"Engineer" is defined as representative appointed and authorized by the Owner. The Engineer shall be a Registered Professional Engineer, or a designated site representative under the supervision of a Registered Professional Engineer.

"Contractor" is defined as the party that has executed a contract agreement for the specified Work with the Owner.

"Technical Specifications" is defined as this document, prepared by Knight Piésold and Co. and all supplemental addenda.

"Drawings" is defined as the Drawings, in conjunction with these Technical Specifications, prepared by Knight Piésold and Co. for the ponds and land application system at Powertech's Dewey-Burdock Project.

"Work" is defined as the entire completed construction, or the various separately identifiable parts thereof, as shown on the Drawings, and required to be furnished under the Contract Documents.

"Site" is defined as the project area where the work is to be performed.

"Contract Documents" are defined as the Agreement, Addenda, Contractor's Bid (when attached as an Exhibit to the Agreement), Bonds, General Conditions, Special Conditions, Technical Specifications, Drawings and all modifications issued after execution of the Agreement.

"Modifications" are defined as changes made to the Technical Specifications or the Drawings, that are approved by the Owner and Engineer, in writing, after the Technical Specifications and Drawings have been finalized.

All slopes are defined as horizontal to vertical distances.

2.2 General Technical Requirements

The general technical requirements specified herein shall apply to all activities and operations relating to carrying out the Work or as required by the Engineer or Owner for the earthworks associated with the construction of the ponds and land application system at Powertech's Dewey-Burdock Project, South Dakota.

In the event of an inconsistency in the Technical Specifications and Drawings, the Contractor shall refer all questions to the Engineer for final decision. Work that concerns the inconsistency shall not be performed until the contradiction is remedied or explained by the Engineer. In all events, the decision of the Engineer is final.

2.2.1 General Specifications

The contractor will be required to submit to the Engineer or Owner, at a minimum, the following plans and comply with training requirements associated with their project tasks, as may be applicable:

- Occupational Safety and Health Administration (OSHA)
  - Healthy and Safety Plan in accordance with 29 CFR Part 1910 – Occupational Safety and Health Standards
  - Hazardous Communication Plan in accordance with 29 CFR Part 1910.1200 – Toxic and Hazardous Substances
  - Material Safety Data Sheets (MSDS) for all chemicals in accordance with 29 CFR 1910.1200 (g)
- Spill Prevention, Control and Countermeasure (SPCC) Plan in accordance with 40 CFR Part 112.3 – Requirement to prepare and implement a Spill Prevention, Control, and Countermeasure Plan
- Training
  - Mine Safety and Health Administration – 24-hour class plus 8-hour refresher course in accordance with 30 CFR
  - HAZWOPER – 40-hour class plus 8-hour refresher course in accordance with 29 CFR 1910.120

2.3 Applicable Codes and Regulations

The following publications of the latest issue are a part of this Specification, except where replaced or revised by local codes or ordinances having jurisdiction, in which case the more stringent shall govern.

- National Sanitation Foundation Standard 54
- American Society for Testing Materials (ASTM)
- Mine Safety and Health Administration (MSHA) Code of Federal Regulations - Title 30 (Mineral Resources)
- Army Corps of Engineers Test Methods
- Occupational Safety and Health Administration, General Industry and Health Standards - OSHA 2206 (29 CFR 1910)
- AASHTO - AGC - ARTBA - Task Force 25
- Federal Test Method Standards (FTMS)

Section 3.0 - Mobilization and Demobilization

3.1 Scope

The Work covered by this section consists of the Contractor's mobilization to the Site of all the equipment and temporary facilities required for the successful completion of the Work, and shall include, but not necessarily be limited to, the following:

- Establish the Contractor's maintenance facilities, temporary workshops, temporary office accommodation and sanitary facilities.
- Maintain equipment and temporary facilities for the duration of the Work.
- All items required to be moved onto the Site for execution of the Work.
- On completion of the Work, remove all equipment and temporary facilities from the Site, and clean up the Site to the satisfaction of the Owner and the Engineer.

3.2 Mobilization

The Contractor shall mobilize to the Site sufficient labor, materials, and equipment to allow commencement of the Work. The Contractor shall bring on to the Site, as and when necessary, any additional equipment, labor and materials which may be required to complete the remainder of the Work in the time specified in the General Terms and Conditions.

3.3 Contractor's Workshops, Stores, and Offices

The Contractor shall erect, in the area designated by the Owner and Engineer, adequate workshops, offices and other buildings and structures for the completion of the Work as designated in the Contract Documents. Such workshops, offices and etc., shall be maintained in a neat and tidy condition throughout the duration of the Work to the satisfaction of the Engineer and Owner.

3.4 Sanitation

The Contractor shall provide and maintain adequate sanitary facilities for the personnel at the Site, including the Contractor's offices and Engineer's offices, in compliance with local health regulations and to the satisfaction of the Engineer and Owner.

3.5 Demobilization

On completion of the Work, the Contractor shall remove all of the Contractor's equipment, temporary facilities and materials from the Site. The Site shall be left in a clean and tidy state, to the satisfaction of the Engineer and Owner. All waste and refuse shall be disposed of in a legal manner acceptable to the Owner.

Section 4.0 - Materials

4.1 Geonet

Geonet used in the Work shall be manufactured by extruding two crossing strands to form a bi-planar drainage net structure. The material provided as geonet shall conform to the following standards:

Table 4.1 - Geonet Specifications - Material Properties

Property	ASTM Test Methods	Minimum Average Value	Unit
Transmissivity	D4716	9.50	gal/min/ft
Thickness	D5199	200	mil
Density	D1505	0.94	g/cm^3
Tensile Strength (MD)	D5035/7179	45	lb/in
Carbon Black Content	D1603[(2)]/D4218	2.0	%

Notes:
1. Gradient of 0.1, normal load of 10,000 psf, water at 70º F, between steel plates for 15 minutes. Contact manufacturer for performance transmissivity value for use in design.
2. Modified

The Contractor shall provide a written material guarantee covering the geonet material for a minimum warranty period of 1 year. The material warranty shall cover the cost of any replacement material required to replace any failed material. A minimum 1-year installation warranty shall also be provided and shall cover the cost of labor and equipment to replace the failed material.

4.2 Geotextile

This Section defines the requirements for nonwoven geotextile material and its installation.

Any alternatives or exceptions to this Specification shall be submitted in writing to the Engineer and shall be approved in writing prior to implementation of the Work.

The materials supplied as nonwoven geotextile shall be of new first-quality needle-punched polypropylene. The material is to be designed and manufactured specifically for the purpose of separation, tensile reinforcement, planar flow, and filtration. Geotextile material shall be produced so that it is free of holes, undispersed raw material, broken needles, or any contamination by foreign matter. Each type of geotextile shall be uniform in color, thickness, size, and texture.

The nonwoven geotextile fabric shall be 10 oz/yd^2 and 12 oz/yd^2, as specified on the Drawings. All geotextile material shall meet the requirements indicated in the table below:

Table 4.2 - Nonwoven Geotextile Specifications - Material Properties

Property	ASTM Test Methods	Unit	Minimum Average Value	
Mass per Unit Area	D5261	oz/yd^2	10	12
Grab Tensile Strength	D4632	lb	260	320
Grab Elongation	D4632	%	50	50
Trapezoidal Tear Strength	D4533	lb	100	125
Puncture Strength	D4833	lb	165	190
Apparent Opening Size (AOS)	D4751	U.S. Sieve Size	100[(2)]	100[(2)]
Permeability (k)	D4491	in/sec	0.12	0.11

Notes:
1. All values reported in weaker principle direction.

2. Value listed is a maximum value.

All rolls of nonwoven geotextile shall be properly identified and tagged by the Manufacturer. A copy of the Manufacturer's specifications is to be submitted to the Engineer by the Contractor prior to ordering materials. A copy of the geotextile certification will be provided to the Engineer prior to deployment.

It is essential that the nonwoven geotextile fabric retain its integrity after UV exposure. The Contractor shall provide a written guarantee covering the fabric against UV degradation for a minimum of 2 years. The guarantee shall cover the cost of the material, labor and equipment required to replace any failed material. With respect to UV degradation the geotextile fabric must meet the following requirements:

1. Retain 70 percent of its tensile strength after 500 hours of exposure to UV rays.
2. Remain intact with no holes evident due to UV degradation for a period of 2 years

4.3 HDPE Geomembrane Liner

The HDPE geomembrane liner shall be 40, 60, or 80 mil thickness, black surfaced, and either smooth or textured, as specified on the Drawings and in Table 4.3. The HDPE liner shall be a high quality formulation containing approximately 98 percent polymer and 2 percent carbon black with antioxidants and heat stabilizers. It shall be resistant to Ultraviolet (UV) rays.

The liner material shall comprise HDPE material manufactured of new, first-quality products designed and manufactured specifically for the purpose of liquid containment in hydraulic structures as applied to the mining industry.

The material shall be produced as to be free of holes, blisters, undispersed raw materials or any sign of contamination by foreign matter. Any such defects shall be repaired using extrusion fusion welding techniques or industry-accepted standard in accordance with the Manufacturer's recommendations.

Liner material samples and Manufacturer's minimum specifications for materials and installation shall be submitted to the Engineer. A copy of the Manufacturer's Quality Control Manual shall be submitted for approval, as required by the Engineer. The material provided as HDPE liner shall conform to the following standards:

Table 4.3 - HDPE Geomembrane Liner Specifications - Material Properties

Property	ASTM Test Methods	Minimum Average Value			Unit
		40 mil Textured	60 mil Smooth	80 mil Textured	
Thickness	D5199 (smooth) D5994 (textured)	40	60	80	mil
Density	D1505	0.94	0.94	0.94	g/cm^3
Tensile @ Break	D6693(1) Type IV	75	243	155	lb/in-width
Tensile @ Yield		90	132	177	lb/in-width
Elongation @ Break		100	700	100	%
Elongation @ Yield		12	13	12	%
Tear Resistance	D1004	32	42	60	lb
Puncture Resistance	D4833	95	125	160	lb
Notched Constant Tensile Load	D5397 Appendix	1,000	1,000	1,000	Hours
Carbon Black Content	D1603(5)/D4218	2.0-3.0	2.0-3.0	2.0-3.0	% (Range)
Carbon Black Dispersion	D5596	Note(3)	Note(3)	Note(3)	n/a

Notes:

1. Machine direction (MD) and cross machine direction (XMD) average values should be the basis of 5 test specimens each direction.
2. Yield elongation is calculated using a gauge length of 1.3 inches. Break elongation is calculated using a gauge length of 2.0 inches.
3. Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
4. Samples may be taken from material delivered to the site and tested for material conformance. Testing frequency to be determined by the Engineer.
5. Modified.

The manufacturer of the liner shall take random samples of the liner material from fabricated rolls during manufacture and test them at a frequency according to the following Table 4.4

Table 4.4 - HDPE Geomembrane Liner – Manufacturer Test Frequencies

Property	ASTM Test Methods	Frequency
Thickness	D5199 (smooth) D5994 (textured)	Per roll
Tensile Properties	D6693(1) Type IV	Every 50,000 square feet
Tear Resistance	D1004	Every 50,000 square feet
Puncture Resistance	D4833	Every 50,000 square feet
Carbon Black Content	D1603[(5)]/4218	Every 50,000 square feet
Carbon Black Dispersion	D5596	Every 50,000 square feet
Density	D1505	Every resin batch
Dimensional Stability (max. ave. %)	D1204	Every resin batch

All welding material shall be of a type recommended and supplied by the liner material manufacturer and shall be delivered in the original sealed containers, each with an indelible label bearing the manufacturer's mark number, and complete directions as to proper usage. The composition of welding wire or pellets shall be identical to the lining material.

The Contractor shall provide a written material guarantee covering the HDPE liner materials, including degradation due to UV light, for a minimum warranty period of 20 years. The material warranty shall cover the cost of replacement material required to replace any failed material. A minimum 1-year installation warranty shall also be provided and shall cover the cost of labor and equipment to replace the failed material.

4.3.1 Conformance Sampling

During liner deployment, the Engineer shall collect conformance samples at a rate of 1 per 120,000 square yards of liner shipped to site. The Contractor shall assist in the collection of these samples. Conformance samples collected shall be tested for thickness, density, tensile properties (yield stress, break stress, yield elongation and break elongation), carbon black content, and carbon black dispersion.

Section 5.0 - Installation

5.1 Geonet

Geonet shall be installed between the primary and secondary geomembrane liners in the areas shown on the Drawings. Geonet shall be installed parallel with the slope, and in the direction of potential flow of fluids. To the extent possible, seams shall be oriented parallel to the slope of the ground. Geonet shall extend to and be anchored in the pond anchor trenches.

Geonet panels shall be butted to each other, and secured with cable ties placed at minimums of every 5 ft along roll length, and placed every 1 foot along roll width. Panels shall be secured with cable ties placed 6 inches on center in the anchor trenches, or at other locations as required by the Engineer.

5.2 Geotextile

The geotextile shall be placed over a prepared surface as shown on the Drawings or as directed by the Engineer. The geotextile shall be placed in such a manner that it will not excessively stretch or tear upon placement of the overlying materials. Care should be taken to place the geotextile in intimate contact with the prepared surface such that no voids exist between the geotextile and the underlying material.

The individual panels of the geotextile shall be sewn, overlapped or fusion-seamed with a heat gun, as site conditions and design dictate and as directed by the Engineer. Joints made by sewing or fusion seaming, shall be overlapped a minimum of 6 inches. Joints not sewn or heat-seamed shall be overlapped a minimum of 36 inches. The installer shall ensure that no foreign material is present within the seams or overlaps. All joints shall be constructed with the upslope sheet placed over the down-slope sheet. Care shall be taken during installation to prevent contamination and/or damage to the geotextile. Torn or punctured material shall be patched when feasible. The patch shall extend a minimum of 36 inches beyond the edge of the tear or damage.

Sewn seams shall be sewn with a Type 401 stitch with 1 or 2 rows of stitching. Each row of stitching shall have between 4 to 7 stitches per 1 inch. The minimum distance between the stitch line and the edge of the geotextile shall be 1.5 inches.

All geotextile panels shall be temporarily secured from the wind until the final covering material is placed. Temporary ballast, such as soil heaps, UV resistant sand bags, or stones, shall be placed on the overlaps and at the perimeter as necessary to secure the geotextile. Where temporary ballasting comparable to the cover material is used and it will not interfere with the placement of the covering material, it may be left in place, subject to the approval of the Engineer.

Methods used for placement of the geotextile shall be selected by the Contractor and are subject to approval by the Engineer. Modifications to construction procedures and techniques may be necessary to prevent undue wastage of the material.

The installed geotextile will be inspected by the Engineer for continuity and defects. Any defects will be repaired at the Contractor's expense.

5.3 HDPE Geomembrane

The HDPE liner shall be installed on the areas shown on the Drawings or as directed by the Engineer. The surface on which the liner is to be installed shall be free of sharp particles, rocks or other debris to the satisfaction of the Engineer. Sharp objects shall be removed by raking, brooming or hand picking as necessary.

The Contractor shall supply the Engineer with panel layouts of the liner. These panel layouts must have been approved by the Engineer prior to the Contractor commencing the Work. It is the Contractor's responsibility to submit timely proposals (allowing a minimum of 2 weeks for approval).

Installation of the HDPE liner shall be performed under the direction of a field Engineer or supervisor who has installed a minimum of 120,000 square yards of flexible lining material.

The liner shall be placed over the prepared surfaces using methods and procedures that assure a minimum of handling. Adequate temporary and permanent anchoring devices and ballasting shall be provided to prevent damage due to winds.

To the extent possible, seams shall be oriented parallel to the slope of the ground. The panels shall be secured temporarily with sandbags or other approved ballasting method to hold them in place until the field seams have been completed and the liner has been permanently anchored.

The Contractor shall take into account that winds may result in delays. The Contractor shall take all necessary measures to ensure that each panel is sufficiently ballasted to prevent damage or movement by wind. Fusion of panels and repairs will only be permitted under weather conditions allowing such work, and within the warranty limits of the liner Manufacturer, as approved by the Owner and Engineer.

The Contractor shall take into account that weather changes could result in delays to the construction of field seams. Fusion of panels and repairs will only be permitted under weather conditions that allow such work, and within the warranty limits of the manufacturer.

Horizontal field seams on slopes shall be kept to a minimum. Horizontal seams on steep slopes shall be avoided where possible by cutting the liner at a 45^{o} angle. Generally, horizontal seams are to be no closer than 5 feet from the toe of the slope. If required, horizontal seams shall be made by lapping the uphill material over the downhill material. Panels shall be shingled in a manner that prevents water from running beneath the liner.

The liner shall be installed in a relaxed condition and shall be free of tension or stress upon completion. The installed liner shall contain sufficient slack material to allow for thermal expansion and contraction. Individual wrinkles should take the form of undulations in the liner but should not be large enough for the material to fold over itself.

During installation, the Contractor shall give each field panel an "identification" code number consistent with the layout plan. The numbering system must have been approved by the Engineer. The Contractor shall upgrade the layout plan as each panel is installed to show the location of each panel. A field panel is defined as the area of liner that is to be seamed in the field (roll or portion of a roll cut in the field).

Individual panels of HDPE material shall be laid out in a pattern that will produce the least number of seams. The material shall be overlapped prior to welding. Extreme care shall be taken by the Contractor in the preparation of the areas to be welded. The joint interface shall be cleaned and prepared according to procedures laid down by the material Manufacturer and approved by the Engineer. Seaming shall not take place unless the panel is dry and clean. All sheeting shall be welded together by thermal methods.

The liner material shall be installed such that foot traffic is minimized. No vehicle traffic or heavy generators are permitted on the liner surface. No open seams or holes shall be allowed in the deployed liner at the end of the shift.

Any liner area showing damage due to excessive scuffing, puncture or distress from any cause shall be replaced or repaired with an additional piece of liner material of the same type. The cost of replacing or repairing the liner shall be borne solely by the Contractor.

The welding equipment used shall be well maintained and in good working condition. It shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the lining material to ensure changes in environmental conditions will not affect the integrity of the weld. The double wedge fusion-welding process shall be used unless the Engineer approves alternate methods. Extrusion welding will be permitted to repair small areas or where test samples have been removed.

No "fish mouths" will be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, overlapped and an overlap extrusion weld shall be applied.

Liner panels must have a finished overlap of 4 inches for double-wedge welding seams and 3 inches for extrusion welding seams. Notwithstanding this provision, sufficient overlap shall be provided to allow peel tests to be performed on any seam.

The temperature of hot air at the nozzle of any welding apparatus shall be controlled at all times such that the liner is not damaged. Upon completion of the Work, all welds shall be tightly bonded.

Handling and storage of HDPE liner material shall be in accordance with the Manufacturer's printed instructions. All persons walking or working on the HDPE liner shall wear soft-sole shoes.

The liner shall extend into the anchor trench as shown on the Drawings. All anchor trenches must have been approved by the Engineer prior to installation of the liner in the trench. The trench must have again been inspected by the Engineer once the liner has been placed in it, and prior to backfilling.

Section 6.0 - Quality Control of HDPE Geomembrane

Written certification shall be provided from the supplier that the material delivered to the project complies with these specifications. A copy of the Manufacturer's printed instruction for installation is also to be provided.

The Manufacturer of the liner shall take random samples of the liner material during manufacture. Samples shall be tested by a qualified laboratory by methods specified within this Section, or applicable ASTM standards, for thickness, strength, tear resistance, low temperature impact, density and dimensional stability. The results shall be supplied to the Engineer.

The Contractor shall be fully responsible for carrying out all quality control tests on HDPE liner and shall do so to the satisfaction of the Engineer and in accordance with this Specification. On-site physical non-destructive and destructive testing shall be completed on all joints to ensure that watertight uniform seams are achieved on a continuous basis as installation proceeds. The Contractor shall provide Technicians experienced in the testing procedures that are to be used. At the time of bid submission, details shall be provided by the Contractor that set forth the method proposed for both destructive and non-destructive testing of seams. The Engineer must have approved these methods prior to the Contractor commencing the Work. Visual inspection alone is unacceptable.

The Contractor shall furnish labor and equipment required to assist in any other sampling and testing that is requested by the Owner or the Engineer.

The welding equipment used shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the material to ensure changes in environmental conditions will not affect the integrity of the weld. Fusion of panels and repairs will only be permitted under weather conditions allowing work that is in conformance to the specifications and within the warranty limits imposed by the manufacturer.

At a minimum, the Contractor's field installation test program shall include periodic visual observations and continuity and strength tests as defined in the following subsections. The amount of geomembrane liner deployed without final quality control and final repairs being completed shall never exceed 300,000 square feet. Upon completion of an area of the liner, the Contractor shall identify the boundaries of the area. At this time, the final inspection by Engineer shall take place to identify any defects in the completed liner. The Contractor shall repair any defects identified to the satisfaction of the Engineer.

6.1 HDPE Geomembrane Testing and Inspection

These tests are to be made routinely on seams from each welding machine regardless of other types of testing required. The procedure for both double wedge fusion and extrusion seams is described as follows (beginning of each day of seaming and upon resumption of work after any stoppage or operator change):

- Run a test seam with each machine to be used. Repair or replace and retest any machine determined to be defective or malfunctioning.
- Visually inspect the seam for squeeze out and melt.
- Record observations.
- Perform a peel and shear seam strength test on each test seam as per Section 6.1.6 (on a continuing basis).
- Visually check field seams for squeeze out, footprint, melt and overlap.
- Check machines for cleanliness, temperature and related items.

6.1.1 Visual Inspections

The Owner, his representatives, and the Engineer shall have unrestricted access and right to inspect all Contractor's work, materials, equipment, tools, and records pertaining to the lining work.

The Contractor shall perform visual inspections of deployed and welded HDPE panels to identify defects, damage, or protrusion of sharp objects that may affect the integrity of the liner. Defective or damaged areas will be marked and repaired according to the Technical Specifications.

The Contractor's QC Technician(s) or Field Engineer shall inspect each panel and all seams, marking his initials and date inspected at the end of each panel. Prior to final inspection of the liner by the Owner and Engineer, the following shall have been completed:

- All trash and debris must have been cleared from the liner.
- All loose gravel around ballast piles or damaged sand bags must have been removed from the liner.
- The area must have been thoroughly inspected by the Contractor's QC personnel.
- All documentation, including destructive test results, air test results and deployment records shall have been completed and submitted to the Engineer.

6.1.2 Continuity Testing

A maximum effort shall be made to install a perfect liner. This implies that all seams completed in the field, patches and extrusions shall be tested and recorded. All failures shall be isolated and repaired as directed by the Engineer. A general testing procedure is included as follows:

- Test all field seams and patches with inter-seam pressure, spark test or other approved methods. Pressure and spark testing are discussed in following subsections.
- Isolate and repair all areas indicating any leakage. Retest the repair.

Testing equipment shall be in good condition and be to the satisfaction of the Engineer. Any equipment that is found to be unacceptable shall be removed from service until it has been repaired, and it has been approved by the Engineer.

6.1.3 Inter-seam Pressure Testing

Test procedure for inter-seam pressure for seams over 65 yards long (for double wedge welding only):

- Seal both ends of the seam to be tested by applying heat to the end of the seam via a heat gun until flow temperature is achieved. Clamp off the ends and let cool.
- Insert a pressure gauge/needle assembly into the end of the seam and seal.
- Apply between 40 and 45 psi air pressure to the void between the 2 seams, for a minimum of 5 minutes.
- The allowable leak down for the seam is 3 psi.
- Enter the results of the leak test on the appropriate document, indicating either a passed or failed seam. The seam is to be repaired if it fails, with the repair work and subsequent testing being recorded on the same document.

6.1.4 Spark Testing

All extrusion welded patches, caps, etc, shall be "spark" tested in accordance with ASTM D6365. All extrusion welds in pipe boots shall be spark tested. The basic concept for spark testing is as follows:

- Just prior to applying the extrusion bead, a small gauge copper wire is placed into the seam. An 18-gauge bare copper wire usually works well. The wire should be grounded at one end and be placed at the edge of the top sheet of the overlap seam. Tucking the wire under the edge of the top sheet will help hold the wire in place during welding, but this should be done prior to grinding to avoid the risk of contamination of the weld area.
- Apply the extrudate bead as normal, and allow the weld to cool.
- Energize the spark tester, and move the electrode wand near a grounding source to determine the maximum length of spark that can be generated. Adjust the output voltage setting until the spark length exceeds the greatest potential leak path distance. This is typically the diagonal distance from the embedded wire to the edge of the weld bead at a "T" joint.
- Once the output voltage has been set, testing may be started. Testing is performed by passing the electrode over the seams with the electrode in contact with the membrane and/or the extruded weld bead. The audible and visual indication of a spark provides the determination of a potential leak path.
- If a potential leak is detected, the area can be repaired by grinding and re-welding. Applying additional weld beads adjacent to the leaking weld is not an acceptable repair technique. This will only lengthen the leak path to the extent that the spark tester may not be capable of generating a spark of sufficient length to breach the lengthened gap.
- After grinding and re-welding, the seam must be retested. If there is still an indication of a potential leak (spark), it may be required to apply a patch over the entire area.

6.1.5 Vacuum Box Testing

Vacuum box testing can be used as a secondary test to check for leaks and holes in addition to spark testing, or in locations where spark testing is not feasible. All vacuum box testing is to be done in accordance with ASTM D5641.

6.1.6 Peel and Shear Strength Testing

The Engineer shall test a minimum of 20 percent of the samples obtained for peel and bonded seam strength. The samples shall be tested either on site, or submitted for testing to an independent laboratory. In all instances, failed coupons determined by the Engineer's testing shall overrule passing test results obtained by the Contractor.

These tests shall be carried out on trial seams comprising a test weld 36 inches long by 12 inches wide for each welding machine at the following times:

- At the beginning of seaming operations
- After every four hours of seaming operation
- A minimum of 1 sample per 500 feet of seam
- After repairs have been made to the seaming equipment
- By each Technician using the seaming equipment
- As required by the Engineer

The test weld shall be marked with date, ambient temperature, and welding machine number. Samples of the weld, 8 inches long by 1 inch wide, shall be cut from the test weld and tested for shear and peel strength requirements. Seams should be stronger than the material. The weld sample shall be kept for subsequent testing on laboratory tensiometer equipment in accordance with the applicable ASTM standards.

Peel and shear seam strength testing shall also be carried out on samples of seams removed from the Work. For these tests, the following procedures shall be followed:

- Coupon sampling of all field seams, including patches and repair areas, shall be taken by cutting perpendicular to the seams a sample approximately 36 inches by 12 inch. This sample shall be cut into three 24 inch by 12 inch samples and labeled with seaming crew names, date, location and individually marked "Owner Sample," "QA/QC Sample" and "Lab QA/QC Sample." The frequency and location shall be determined by the Engineer but shall not be less than one sample per 500 linear feet of field seams. These coupons shall be tested for peel and shear seam strength and thickness. Coupons (5 per series of tests 1 inch by 12 inches) from the destructive sample shall be tested for peel and bonded-seam strength as well as for thickness in accordance with the applicable ASTM standards. All shear and peel test results shall meet or exceed the project requirements. If one or more of the coupons fails, the sample will be considered a failure.
- Heat-welded seams shall be allowed to cool or warm to about 70° F prior to testing. Solvent seams, when used, shall be allowed to cure according to the Manufacturer's recommendations. Additionally, at the Engineer's option, approximately 10 percent of the coupons shall be sent to an independent laboratory for confirmation testing. Should the lab and field tests conflict, installation shall halt until the conflict is resolved to the satisfaction of the Engineer.
- A quality control Technician or field Engineer acting for the Contractor shall inspect each seam, marking his initials and date inspected at the end of each panel. Any area showing a defect shall be marked and repaired in accordance with the applicable repair procedures.

In the case that a destructive seam test fails in either shear or peel, the entire length of seam represented by this test is in question. As a minimum, the procedure for destructive test failures shall be as follows;

- The Contractor shall provide the Engineer with 2 additional destructive test samples at least 150-feet on either side of the failed test. The Engineer and Owner reserve the right to take additional samples as warranted to adequately assess the quality of the work.
- If a failing test occurs at the new destructive test location, an additional test shall be taken at another minimum 50-foot interval from the additional tests. This procedure is repeated until the defective section is fully defined, or the edge of the seam that was originally represented by the original test is reached.
- If passing tests are achieved at the minimum 150-foot distance from the failed destructive test, additional destructive tests may be taken at a closer spacing from the failed test at the discretion of the Contractor. If the tests at the closer interval fail, additional destructive tests shall be taken until the length of the defective seam is fully defined.
- Once the length of defective seam is identified, the Contractor shall either cut out the defective seam and wedge weld a new piece of liner in the seam area; or install a cap-patch strip over the affected seam area. Cap-patches or new sections of liner shall be a minimum of 3-feet in width, and shall be centered over the defective seam. Extrusion welding the exposed flap of liner on wedge welded seams, or additional extrusion welding of extrusion welded seams shall not be allowed.
- In the case that the retest of the repaired area fails, the procedure described above shall be repeated until passing tests are achieved.

In the case that a destructive seam test fails at the beginning or end of a seam, the previous or following seam completed by that same welding machine shall also be tested.

Results of all seam and strength testing completed for a day shall be compiled and submitted to the Engineer by the end of each day. All destructive samples tested by the Contractor shall be tested the same day they are marked.

Destructive samples taken from the liner shall identify the two panels that are joined by that seam.

The Engineer will continuously inspect the installation of the HDPE liner to ensure that the procedures specified in this section are fully adhered to.

Table 6.1 - HDPE Geomembrane Liner Specifications - Field Seaming Requirements

Property (Seam Strengths)[1]	Test Method	Minimum Average Value			Unit
		40 mil Textured	60 mil Smooth	80 mil Textured	
Fusion Peel	ASTM D4437	65	98	130	lb/in
Extrusion Peel[2]		52	78	104	lb/in
Shear Strength		81	121	162	lb/in

Notes:
1. Seam tensile strength testing shall be performed at the same strain rate as the parent material.
2. Seam must exhibit film tear bond (FTB). Trial welds should have no incursion into the weld.

Any material or workmanship that fails to comply with the Specifications shall be corrected or replaced by the Contractor at his expense. The cost of retests and re-inspection shall be the responsibility of the Contractor.

A copy of all tests performed by the Contractor shall be furnished to the Owner and Engineer prior to final acceptance of the HDPE liner. Failure by the Contractor to provide required test and inspection documentation in an acceptable time period may result in the suspension of installation work until the required documentation is submitted.

6.2 Warranty

The Contractor shall provide a written guarantee covering materials, and all workmanship, as well as degradation due to UV light for exposed areas, that the material will not fail for a minimum of 20 years. This guarantee shall cover the cost of material, labor and equipment to replace any failed material.

Section 7.0 - Submittals

The Contractor shall provide the Owner and Engineer with the following material submittals for review prior to the materials being approved for use on the project, or for the Work incorporating the material to be allowed to commence. Data submitted shall include drawings showing essential details of any changes proposed by the Contractor.

Table 7.1 – Submittal Requirements

Section	Subsection	Material	Details
4.0	4.1	Geonet	Material Specifications
4.0	4.2	Geotextile	Material Specifications
4.0	4.3	HDPE Geomembrane Liner	Material Specifications

Section 8.0 - As-Built Requirements

To assist in the production of adequate as-built Drawings and documentation, the Contractor will be required to provide a panel log, seaming log, QC log, repair log, and a 22 inch by 34 inch set of drawings, along with the executable format, showing panel numbers, and locations and types of patches and seams. Locations of all destructive test samples are to be identified on the Drawings. The panel log shall include roll identification numbers.

Section 9.0 - References

ASTM International, 2009, *ASTM A1004 - 09 Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting*, ASTM International.

ASTM International, 2008, *ASTM D1204 - 08 Standard Test Method for Linear Dimensional Changers of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature*, ASTM International.

ASTM International, 2003, *ASTM D1505 - 03 Standard Test Method for Density of Plastics by the Density-Gradient Technique*, ASTM International.

ASTM International, 2006, *ASTM D1603 - 06 Standard Test Method for Carbon Black Content in Olefin Plastics*, ASTM International.

ASTM International, 1996, *ASTM D4218 - 96 Standard Test Method for Determination of Carbon black Content in Polyethylene Compounds by the Muffle-Furnace Technique*, ASTM International.

ASTM International, 1996, *ASTM D4437 - 08 Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes*, ASTM International.

ASTM International, 2004, *ASTM D4491 - 99a(2004)e1 Standard Test Methods for Water Permeability of Geotextiles by Permittivity*, ASTM International.

ASTM International, 2009, *ASTM D4533 - 04(2009) Standard Test Method for Trapezoid Tearing Strength of Geotextiles*, ASTM International.

ASTM International, 2008, *ASTM D4632 - 08 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles*, ASTM International.

ASTM International, 2008, *ASTM D4716 - 08 Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head*, ASTM International.

ASTM International, 2004, *ASTM D4751 - 04 Standard Test Method for Determining Apparent Opening Size of a Geotextile*, ASTM International.

ASTM International, 2007, *ASTM D4833 - 07 Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products*, ASTM International.

ASTM International, 2008, *ASTM D5035 - 06(2008)e1 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)*, ASTM International.

ASTM International, 2006, *ASTM D5199 - 01(2006) Standard Test Method for Measuring the Nominal Thickness of Geosynthetics*, ASTM International.

ASTM International, 2009, *ASTM D5261 - 92(2009) Standard Test Method for Measuring Mass per Unit Area of Geotextiles*, ASTM International.

ASTM International, 2007, *ASTM D5397 - 07 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test*, ASTM International.

ASTM International, 2009, *ASTM D5596 - 03(2009) Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics*, ASTM International.

ASTM International, 2006, *ASTM D5641 - 94(2006) Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber*, ASTM International.

ASTM International, 2003, *ASTM D5994 - 98(2003) Standard Test Method for Measuring Core Thickness of Textured Geomembrane*, ASTM International.

ASTM International, 2006, *ASTM D6365 - 99(2006) Standard Practice for the Nondestructive Testing of Geomembrane Seams using the Spark Test*, ASTM International.

ASTM International, 2008, *ASTM D6693 - 04 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes*, ASTM International.

ASTM International, 2007, *ASTM D7179 - 07e1 Standard Test Method for Determining Geonet Breaking Force*, ASTM International.

Drawings

(see Drawings for Part 1 – Earthworks)

Knight Piésold
CONSULTING

Powertech (USA) Inc.
Dewey-Burdock Project
Pond and Land Application
Technical Specifications and QA/QC Plan
Part 3- Pipeworks and Appurtenances

July 2010

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0	July 2010		Paul Bergstrom	Powertech (USA) Inc.

Powertech (USA) Inc.
Dewey-Burdock Project
Pond and Land Application
Technical Specifications and QA/QC Plan
Part 3- Pipeworks and Appurtenances

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Section 1.0 - General

1.1 Introduction

This Specification stipulates materials and installation requirements for pipework and appurtenances related to the construction of the Ponds and Land Application Systems at Powertech's Dewey-Burdock project.

1.2 Limitations and Disclaimer

This Specification titled Dewey-Burdock Project Pond and Land Application Technical Specifications Part 3 - Pipework and Appurtenances has been prepared by Knight Piésold and Co. (Knight Piésold) for the exclusive use of Powertech (USA) Inc. (Client). No other party is an intended beneficiary of this Specification or the information, opinions, and conclusions contained herein. Any use by any party other than the Client of any of the information, opinions, or conclusions is the sole responsibility of said party. The use of this Specification shall be at the sole risk of the user regardless of any fault or negligence of the Client or Knight Piésold.

The information contained herein have been completed to a level of detail commensurate with the objectives of the assignment and in light of the information made available to Knight Piésold at the time of preparation. This specification and its supporting documentation have been reviewed and/or checked for conformance with industry-accepted norms and applicable government regulations. To the best of the information and belief of Knight Piésold, the information presented in this Specification is accurate to within the limitations specified herein.

This Specification is Knight Piésold pdf file: Dewey-Burdock Pond and Land Application Technical Specifications Part 3 - Pipework and Appurtenances Rev 0.pdf. Any reproductions or modifications of this Specification are uncontrolled and may not be the most recent revision.

1.3 Contributors and Approvals

This specification was prepared, reviewed, and approved by the undersigned.

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Section 2.0 - Codes, Regulations and Definitions

This Specification stipulates materials and installation requirements for pipework and appurtenances related to the construction of the Ponds and Land Application Systems at Powertech's Dewey-Burdock project. Should the Contractor wish to deviate from these Specifications, he shall notify the Engineer in writing, providing a description of the deviation. The description shall include data indicating the magnitude of the deviation, justification for the deviation, and any possible short or long-term impacts of the deviation on the project. Deviations in materials Specifications shall be subject to the approval of the Engineer and Owner prior to shipment of the materials.

All pipe installation is to be completed in accordance with the Manufacturer's specifications. Prior to starting pipe installation, the Contractor shall provide certification from the Manufacturer that the materials supplied have been produced and tested in accordance with relevant Specifications.

2.1 Definition of Terms

"Owner" is defined as an authorized representative of Powertech.

"Engineer" is defined as representative appointed and authorized by the Owner. The Engineer shall be a Registered Professional Engineer, or a designated site representative under the supervision of a Registered Professional Engineer.

"Contractor" is defined as the party that has executed a contract agreement for the specified Work with the Owner.

"Technical Specifications" is defined as this document, prepared by Knight Piésold and Co. and all supplemental addenda.

"Drawings" is defined as the Drawings, in conjunction with these Technical Specifications, prepared by Knight Piésold and Co. for the ponds and land application system at Powertech's Dewey-Burdock Project.

"Work" is defined as the entire completed construction, or the various separately identifiable parts thereof, as shown on the Drawings, and required to be furnished under the Contract Documents.

"Site" is defined as the project area where the work is to be performed.

"Contract Documents" are defined as the Agreement, Addenda, Contractor's Bid (when attached as an Exhibit to the Agreement), Bonds, General Conditions, Special Conditions, Technical Specifications, Drawings and all modifications issued after execution of the Agreement.

"Modifications" are defined as changes made to the Technical Specifications or the Drawings, that are approved by the Owner and Engineer, in writing, after the Technical Specifications and Drawings have been finalized.

All slopes are defined as horizontal to vertical distances.

2.2 General Technical Requirements

The general technical requirements specified herein shall apply to all activities and operations relating to carrying out the Work or as required by the Engineer or Owner for the pipeworks and appurtenances associated with the construction of the ponds and land application system at Powertech's Dewey-Burdock Project, South Dakota.

In the event of an inconsistency in the Technical Specifications and Drawings, the Contractor shall refer all questions to the Engineer for final decision. Work that concerns the inconsistency shall not be performed until the contradiction is remedied or explained by the Engineer. In all events, the decision of the Engineer is final.

2.2.1 General Specifications

The contractor will be required to submit to the Engineer or Owner, at a minimum, the following plans and comply with training requirements associated with their project tasks, as may be applicable:

- Occupational Safety and Health Administration (OSHA)
  - Healthy and Safety Plan in accordance with 29 CFR Part 1910 – Occupational Safety and Health Standards
  - Hazardous Communication Plan in accordance with 29 CFR Part 1910.1200 – Toxic and Hazardous Substances
  - Material Safety Data Sheets (MSDS) for all chemicals in accordance with 29 CFR 1910.1200 (g)
- Spill Prevention, Control and Countermeasure (SPCC) Plan in accordance with 40 CFR Part 112.3 – Requirement to prepare and implement a Spill Prevention, Control, and Countermeasure Plan
- Training
  - Mine Safety and Health Administration – 24-hour class plus 8-hour refresher course in accordance with 30 CFR
  - HAZWOPER – 40-hour class plus 8-hour refresher course in accordance with 29 CFR 1910.120

2.3 Applicable Codes and Regulations

The following publications of the latest issue are a part of this Specification, except where replaced or revised by local codes or ordinances having jurisdiction, in which case the more stringent shall govern.

- American National Standard Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- American Society for Testing and Materials (ASTM)
- American Water Works Association (AWWA)
- American Association of State Highway Transportation Officials (AASHTO)
- Society of Plastics Inc. (SPI)
- American Petroleum Institute (API)
- Plastic Pipes Institute (PPI)

Section 3.0 - Mobilization and Demobilization

3.1 Scope

The Work covered by this section consists of the Contractor's mobilization to the Site of all the equipment and temporary facilities required for the successful completion of the Work, and shall include, but not necessarily be limited to, the following:

- Establish the Contractor's maintenance facilities, temporary workshops, temporary office accommodation and sanitary facilities.
- Maintain equipment and temporary facilities for the duration of the Work.
- All items required to be moved onto the Site for execution of the Work.
- On completion of the Work, remove all equipment and temporary facilities from the Site, and clean up the Site to the satisfaction of the Owner and the Engineer.

3.2 Mobilization

The Contractor shall mobilize to the Site sufficient labor, materials, and equipment to allow commencement of the Work. The Contractor shall bring on to the Site, as and when necessary, any additional equipment, labor and materials which may be required to complete the remainder of the Work in the time specified in the General Terms and Conditions.

3.3 Contractor's Workshops, Stores, and Offices

The Contractor shall erect, in the area designated by the Owner and Engineer, adequate workshops, offices and other buildings and structures for the completion of the Work as designated in the Contract Documents. Such workshops, offices and etc., shall be maintained in a neat and tidy condition throughout the duration of the Work to the satisfaction of the Engineer and Owner.

3.4 Sanitation

The Contractor shall provide and maintain adequate sanitary facilities for the personnel at the Site, including the Contractor's offices and Engineer's offices, in compliance with local health regulations and to the satisfaction of the Engineer and Owner.

3.5 Demobilization

On completion of the Work, the Contractor shall remove all of the Contractor's equipment, temporary facilities and materials from the Site. The Site shall be left in a clean and tidy state, to the satisfaction of the Engineer and Owner. All waste and refuse shall be disposed of in a legal manner acceptable to the Owner.

Section 4.0 - Materials

4.1 General

The Contractor shall perform all material tests in accordance with the Specifications. The Engineer shall have the right to witness all testing conducted by the Contractor provided that the Contractor's schedule is not delayed.

In addition to those tests specifically required, the Engineer may request additional samples of material for testing. The additional samples shall be supplied at no additional cost to the Client.

4.2 High Density Polyethylene (HDPE) Pipe

The type of pipe used shall be as specified on the Drawings, or an equivalent that has been approved by the Engineer, and shall comply with American Water Works Association (AWWA) Specifications C906. It shall have a minimum density of 0.955 grams per cubic centimeter, and a Hydrostatic Design Basis (HDB) of 1,600 psi (ASTM D2837).

HDPE pipe and fittings shall be from a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished.

HDPE pipework and fittings shall be high density, high molecular weight polyethylene pipe such as PLEXCO PE 3408, manufactured by PLEXCO, Inc., or an equivalent that has been approved by the Engineer.

Material used for the manufacture of HDPE pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classification 345434C per ASTM D3350; and meeting Type III, Class C, Category 5, Grade P34 per ASTM D1238.

Should rework compounds be required, only those generated in the Manufacturer's own plant from resin compounds of the same class and type, and from the same raw material supplier shall be used.

Pipe shall be furnished in standard laying lengths not to exceed 50 feet, and to be no shorter than 20 feet.

Dimensions and workmanship shall be as specified by ASTM F714, ASTM D2513 and ASTM D3035.

Stub ends for butt fusion shall be at least the same wall thickness, pressure rating, resin type, and Manufacturer as the pipe to be joined, unless the Engineer has approved otherwise.

Where HDPE and Corrugated Polyethylene Tubing (CPT) pipes are connected, only manufactured fittings shall be used. All other joints shall be flanged joints or as indicated on the Drawings. Backing flanges for HDPE pipe shall be ductile iron unless the Engineer has approved otherwise.

Pipe diameters and thicknesses shall be as specified on the Drawings.

4.2.1 Fittings

All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR rating to which they are made.

The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown in the Drawings or specified herein. No Contractor fabricated fittings shall be used unless approval has been obtained from the Engineer.

HDPE fittings and transitions shall meet ASTM D3261

4.3 Carbon Steel Pipe

All pipes, fittings and flanges shall be carefully examined for cracks and other defects prior to shipment. All defective pipes, fittings and flanges shall be rejected and replaced.

In addition to any other markings specified herein, each length of pipe and each special section shall be legibly marked by paint stenciling, die stamping, or hot roll marking to show the following:

- Manufacturer's name and mark.
- Size and weight of the pipe or special section.
- Type of steel from which the pipe or special section was made.

Carbon steel pipe shall be ERW, bare finish, have beveled ends, and conform to ASTM A-135, Grade B requirements. Pipe schedule shall be Standard unless shown otherwise on the Drawings. All pipes and fittings shall be free from fins and burrs.

4.3.1 Fittings

Butt weld fittings are to be manufactured from carbon steel, to be seamless, conform to ASTM A234 Grade WPB, to be butt welded, and are to be Schedule 40.

Grooved couplings are be Vitaulic Style 77 or an equivalent that has been approved by the Engineer, have Grade "O" Fluoro-elastomer, are to conform to ANSI C606, to be manufactured from ductile iron conforming to ASTM A536, and to have carbon steel heat treated track bolts conforming to ASTM A183. All bolts, nuts and washers shall be made of Type 316 stainless steel.

Pipe Flanges are to be manufactured from Class 150 carbon steel, are to conform to ASTM A105, to be raised face, weldneck, and are to be Schedule 40 bore.

Blind Flanges are to be Class 150 Carbon Steel, are to conform to ASTM A105, and are to be raised face.

Orifice Flanges are to be Class 300 Carbon Steel, are to conform to ASTM A105, be raised face, Weldneck, to have 1/2" screwed taps, and are to be Schedule 40 bore.

4.4 Bolts and Gaskets

4.4.1 Bolts

Flange assembly bolts are to conform to ASTM A307, Grade A Standard. Bolt/stud length shall be such that on completed joints, the ends of the bolts shall protrude the unit by no more than 12mm. Threads shall conform to ASME B1.1. Bolts are to be assembled with an anti-seize compound.

4.4.2 Gaskets

Flange gaskets shall conform to ASME/ANSI B 16.21 and shall be used with all flanged joints unless otherwise specified by the supplier of the valves, fittings or pipework, and approved by the Engineer.

Gaskets are to have a 1/16" minimum thickness for plain finished surfaces, and a 3/32" minimum thickness for serrated surfaces.

4.5 Valves

All valves are to conform to API Specification 6D and API 600. They are to be Class 150, unless otherwise specified. They are to be carefully examined prior to shipment for defects, with any defective valves being rejected and replaced. Valves are to be reexamined when they are offloaded at site, and again when they are installed.

All valves shall be as specified on the Drawings. Valves shall not have any brass, copper, aluminum or zinc parts. Valve specifications, per the valve supplier, shall be submitted to the Engineer for approval prior to bringing such valves on site.

4.6 Pumps

Pumps are to be carefully examined prior to shipment for defects, with any defective pumps being rejected and replaced. Pumps are to be reexamined when they are offloaded at site, and again when they are installed.

All pumps shall be as specified on the Drawings. Pumps shall not have any brass, copper, aluminum or zinc parts. Pump specifications, per the pump manufacturer, shall be submitted to the Engineer for approval prior to bringing such pumps on site.

4.7 Submittals

4.7.1 General

The Contractor shall submit to the Engineer upon request a Manufacturer's certification that all pipe, valves and fittings comply with the applicable portions of the Specification.

The Contractor shall provide a warranty against manufacturing defects of material and workmanship for a period of ten years after final acceptance of the project by the Owner. The Contractor shall replace, at no expense to the Owner, any defective piping/fitting material, including labor, within the warranty period.

4.7.2 HDPE Pipe

Documentation from the resin's manufacturer showing results of the following tests for resin identification is to be provided:

- Melt flow index – ASTM D1238
- Density – ASTM D1505

The HDPE pipe manufacturer shall provide certification that stress regression testing has been performed on the specific polyethylene resin being utilized in the manufacture of the product. This stress regression testing shall be in accordance with ASTM D2837. The manufacturer shall provide a product supplying a minimum Hydrostatic Design Basis (HDB) of 1,600 psi, as determined in accordance with ASTM D2837.

4.7.3 Carbon Steel Pipe

The Contractor is to provide Manufacturer's data on the furnished pipe, indicating compliance with the specifications regarding dimensions, thickness, weights and materials. In addition, he is to provide the manufacturer's "Certificate of Compliance", stating that the materials furnished comply with this Specification.

4.8 Pipe and Valve Delivery, Handling and Storage

All pipe and appurtenances furnished by the Contractor shall be delivered, distributed, and stored at the project site by the Contractor. All items are to be shipped in accordance with the manufacturer's instructions, and stored in a manner that they are not damaged. Care shall be taken in loading, transporting and unloading to prevent damage to the pipe or appurtenances. Pipe, fittings, valves and other appurtenances shall be loaded and unloaded by lifting with hoists or by skidding so as to avoid shock or damage.

- All items shall be handled in such a manner as to avoid damage or hazard.
  - Ropes, fabric or rubber protected slings and straps shall be used when handling pipes.
  - Two slings spread apart shall be used for lifting each length of pipe.
  - Under no circumstances shall pipe or pipe fittings be dropped to the ground or into trenches.
  - Under no circumstances shall chains, cables or hooks inserted into pipe ends be used for lifting the pipe.
- Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. The Contractor shall ensure the safe and proper storage of pipe and fittings. The interior of all pipe shall be kept free from dirt and foreign material at all times.

The Contractor shall be responsible for all materials at all times. The Contractor shall be responsible for all material furnished by him, and shall replace or repair at his own expense, and in a manner that has been approved by the Engineer, all such material found to be defective in manufacture or damaged in handling or during storage after delivery by the Manufacturer. This shall include the furnishing of all materials and labor required for the replacement of installed material discovered to be damaged or defective prior to final acceptance of the work, or during the guaranteed period.

Pipe shall not be stacked higher than the manufacturer's recommendations.

4.8.1 HDPE Pipe

Pipes shall be stored on clean, level ground, preferably turf or sand, and free from sharp objects that could damage the pipe. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width so as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

Stacking of HDPE pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipe under anticipated temperature conditions.

Pipe shall be handled so that it is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 5 percent of wall thickness. The interior of the pipe is to be free of cuts, scratches or gouges.

4.8.2 Carbon Steel Pipe

All pipes, fittings, flanges and accessories shall be stored at the job site in unit packages provided by the manufacturer, and caution shall be exercised to avoid compression damage or deformation of the piping. Any gaskets shall be stored in a cool, dark place out of the direct rays of the sun, in their original cartons, and are not to come into contact with petroleum products.

Section 5.0 - Installation

5.1 Pipe

All pipe and appurtenances shall be examined before installation, and no piece is to be installed that is found to be defective. Any damage to the pipe shall be replaced or repaired, as directed by the Engineer. If any defective pipe is discovered after it has been installed, it shall be removed and replaced by the Contractor in a satisfactory manner that has been approved by the Engineer, at the Contractor's expense.

All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid.

All pipes and fittings shall be lowered into trenches; under no circumstances shall pipe or appurtenances be dropped into trenches.

All pipe installation is to be completed in accordance with the pipe Manufacturer's specifications. Prior to commencing pipe installation a copy of the Manufacturer's specifications shall be submitted to the Engineer for approval. A copy of the Manufacturer's specifications shall be maintained on site during construction.

The Contractor shall supply and install all piping required to complete the piping installation in accordance with good piping practices, whether such piping is specifically detailed on the Drawings or not. All pipe shown on the Drawings shall be installed to the alignments and grades indicated by the Drawings. Where specific alignments and grades are no indicated on the Drawings, they shall be determined in the field by the Engineer to suit existing conditions and to fulfill the requirements of the project. Where interference is encountered during installation, or relocation of piping is deemed necessary, the Engineer shall be consulted before any changes are made. Care shall be taken in the installation of pipeline runs where drainage is required to ensure that the pipeline has a continuous slope to the point of drainage.

Care should be taken to prevent foreign material from entering the pipe during installation. The open ends of the pipes shall be covered with fabricated end caps or other approved means when installation is not in progress, including lunchtime.

Pipes bent to form curves in any direction shall not exceed the deflections recommended by the Manufacturer and Engineer. The cutting of the pipe for inserting fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.

Backfill materials shall be as indicated on the Drawings and according to Earthworks Specifications. Where compacted earth backfill is indicated, the backfill material shall be placed around and over buried sections in lifts not exceeding 8-inches loose. Compaction is to be achieved by hand operated compactors, or other methods approved by the Engineer. Unless otherwise specified, compaction is to be to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557.

Pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells, joints and couplings. Anchors and supports shall be provided where necessary and where indicated on the drawings for fastening work into place. Fittings shall be independently supported.

Once installation has been completed, thoroughly clean all new pipelines to remove dirt, stones, pieces of wood or other material which may have entered during the construction period by forcing a cleaning swab through all pipes 6" or greater. Flushing velocities shall be a minimum of 2.5 feet per second. All flushing shall be coordinated with the Engineer. Debris removed from the lines shall be removed from the job site and be disposed of in a legal manner that has been approved by the Engineer and Owner.

5.1.1 HDPE Pipe

All HDPE pipe shall be designed, constructed and installed with the best practices and methods, and shall comply with these Specifications. Installation shall be in accordance with the manufacturer's instructions, as show on the Drawings, and as specified herein.

Sections of pipe with cuts, gouges or scratches exceeding 5 percent of the pipe wall thickness, or which is in any other way defective, shall be removed completely and the ends of the pipes rejoined to the Engineer's approval, at the cost of the Contractor.

Joining techniques and operating procedures shall be in accordance with written instructions provided by the pipe Manufacturer and the joining equipment supplier. Joining equipment shall be supplied by, leased from, or otherwise approved by the pipe Manufacturer. Where an inconsistency between pipe Manufacturer and joining equipment supplier exist, the pipe Manufacturer shall overrule once approval has been obtained from the Engineer. A copy of all instructions shall be present at any location that butt fusion is being conducted.

Joining HDPE pipe lengths shall be by thermal butt fusion as outlined in ASTM D2657, and shall conform to the Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe, Technical Report TR-33/2006, published by the Plastic Pipe Institute (PPI), unless otherwise specified on the Drawings.

Pipe segments shall be joined in continuous lengths at the location of installation. Dragging of pipe into place shall be kept to a minimum and will only be permitted when the pipe will not be damaged.

The polyethylene pipe flange adapters at pipe material transitions shall be backed up by stainless steel flanges conforming to ASME/ANSI B16.1 and shaped as necessary to suit the outside dimensions of the pipe. The flange adapter assemblies shall also conform to the following:

- The flange adapter assemblies shall be connected with corrosion resisting bolts and nuts of Type 316 Stainless Steel, as specified in ASTM A726 and ASTM A307.
- All bolts shall be tightened to the manufacturer's specifications; bolts shall be tightened alternatively and evenly.
- After installation, a bitumastic coating is to be applied to the bolts and nuts.

All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

5.1.1.1 Fittings

All fittings shall be installed using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters, and must have been approved by the Engineer. No size-on-size wet taps shall be permitted.

5.1.2 Carbon Steel Pipe

All work on carbon steel pipe shall be done by qualified craftsmen in a workmanlike manner, and shall conform to API 1104 and industry standards. All welders shall be certified in accordance with API 1104. However, other certification may be accepted at the discretion of the Engineer. The Contractor shall submit certifications to the Engineer prior to welding of the pipework.

Before jointing, all joint contact surfaces shall be wire brushed, wiped clean, and kept clean until the jointing is completed. Flange faces shall be wire brushed and cleaned to remove all oil, grease, loose primer, mill scale, or any other foreign matter that could affect the proper seating of the gasket.

All welds shall be full penetration and no backup rings shall be used. Welding shall conform to ASME B31.1.

5.2 Valves

All valves are to be installed as shown on the Drawings, and as specified by the valve manufacturer.

5.3 Pumps

All pumps are to be installed as shown on the Drawings, and as specified by the pump manufacturer.

5.4 Compatibility

The Contractor is responsible for the compatibility between all pipe materials, fittings and appurtenances.

Section 6.0 - Testing

6.1 HDPE Pipe

6.1.1 Bent Strap Tests

On days that butt fusions are to be made, the first fusion shall be a trial fusion in the presence of the Engineer. The following shall apply:

- Heating plates shall be inspected for cuts and scrapes.
- The plate temperature shall be measured at various locations to ensure proper heating/melting per the manufacturer's recommendations.
- Once the trial fusion has been completed, a fusion or test strip shall be cut out of the pipe after cooling completely for inspection.
- The test strip shall be a minimum of 12" or 30 times the wall thickness in length, whichever is greater. The fusion joint shall be located midway along the strip.
- The test strip shall be a minimum of 1" or 1.5 times the wall thickness in width, whichever is greater.
- The joint shall be visually inspected as to continuity of "beads" from the melted material, and for assurance of "cold joint" prevention (a "cold joint" forms when the molten material is squeezed out of the joint, resulting in unmelted sections of the pipe butting up against each other on each side of the joint).
- Joint spacing between the walls of the two ends shall be a minimum of 1/16" to a maximum of 3/16".
- A bent strap test is to be performed on the test strip.
  - These tests require safety measures against inadvertent release, joint failure, and springback during bending. Considerable force may be required to complete the test for pipe having larger wall thicknesses.
  - The Contractor is to ensure that the appropriate safety equipment is provided for the test, and that all participants and witnesses have the appropriate personal protective equipment.
  - During the bent strap test, the test strip is to be bent so that the ends of the strip touch.
  - Any disbondment of the fusion is unacceptable and indicates poor fusion quality.
  - If failure occurs, fusion procedures and/or machine setup should be changed, a new trial fusion must be made, and a new bent strap test specimen prepared and tested.
  - Field fusion shall not proceed until a test joint has passed the bent strap test.

6.1.2 Destructive Laboratory Tests of Butt Fusion Joints

Destructive laboratory tests of tensile specimens prepared from butt fusion joined pipes shall be performed for every 2,500 ft of pipe installed. A minimum of three tests shall be performed for each pipe diameter/SDR combination. These tests shall be performed according to ASTM D638, and shall be compared to specimens without joints, and obtained from the parent pipe.

6.1.3 Pressure Testing

All HDPE pipelines shall be field pressure tested. The Contractor shall supply all labor, equipment, material, gauges, pumps, meters and incidentals required for testing. Each pipeline shall be pressure tested upon completion of pipe laying and backfilling operations, including placement of any required temporary roadway surfacing.

Hydrostatic pressure leak tests of HDPE pipe shall be conducted in accordance with ASTM F2164. The pipes shall be tested using clean water. The following must be complied with during the testing procedure:

- The pipeline must be restrained against movement in the event of catastrophic failure. Joints may be exposed for leakage examination, provided that restraint is maintained.
- The testing equipment capacity and the pipeline test section shall be such that the pipeline can be pressurized and examined for leaks within the test duration time limits. Lower capacity testing and pressurizing equipment may require a shorter test section.
- Test equipment and the pipeline shall be examined before pressure is applied to ensure that connections are tight, necessary restraints are in place and are secure, and that components that should be isolated or disconnected are isolated or disconnected. All low pressure filling lines and other items not subject to the test pressure shall be disconnected and isolated.
- All pipelines shall be tested to 150 percent of the operating design pressure of the pipe at the lowest elevation in the section under test, unless otherwise approved or instructed by the Engineer.
  - If lower pressure rated components cannot be removed or isolated from the test section, the maximum test pressure is the pressure rating of the lowest pressure rated component that cannot be isolated from the test section.
  - Test pressure is temperature dependent, and the pipe manufacturer must be consulted where the pipe is to be tested at elevated temperatures.
- The pressure testing procedure shall be per the Manufacturer's recommendations and as approved by the Engineer, or as follows:
  - Fill the pipeline slowly with water; maintain a flow velocity of less than 2 feet per second.
  - Expel air completely from the line during filling and again before applying the test pressure. Air shall be expelled by means of taps at the points of highest elevation.
  - The test procedure consists of an initial expansion phase, and a test phase.
    - For the initial expansion phase, the test section is pressurized to the test pressure, and make up liquid is added as required to maintain the maximum test pressure for four hours. This allows for the diametric expansion/pipe stretching to stabilize.
    - For the test phase, the pressure is reduced by 10 psi and the pump is turned off. This is the target test pressure. If the pressure remains steady (within 5% of the target test pressure) for an hour, and provided no leaks are observed, the pipe is considered to have passed the test.
  - Upon completion of the test, the pressure shall be bled off form a location other than the point where the pressure was monitored. The pressure drop shall be witnessed by the Engineer at the point where the pressure is being monitored and shall be shown on the recoded pressure readout submitted to the Engineer.
- If any test pipe laid discloses leakage, and/or a significant pressure drop greater than 5% of the target test pressure, the Contractor shall locate and repair the cause of leakage at his own expense, and retest the line.
- All visible leaks shall be repaired regardless of the amount of leakage.
- If leaks are discovered, depressurize the pipeline before repairing leaks. Leakage of a butt fusion joint may indicate imminent catastrophic rupture, and in such circumstances, the pipe must be depressurized immediately. Leaks at fusion joints require that the fusion joint be cut out of the pipeline and redone.
- If the pressure leak test is not completed for any reason, including equipment failure, the test section shall be depressurized and repairs made. The test section is to remain depressurized for at least eight hours before retesting.
- The Contractor must submit his plan for testing to the Engineer for review at least 10 days before starting the test. The Engineer is to be present throughout the entire test procedure.

6.2 Carbon Steel Pipe

6.2.1 Pressure Testing

All carbon steel pipelines shall be hydrostatically pressure tested in accordance with ASME B31.3 - 2008 Process Piping. The Contractor shall supply all labor, equipment, material, gauges, pumps, meters and incidentals required for testing. Each pipeline shall be pressure tested upon completion of pipe laying and backfilling operations, including placement of any required temporary roadway surfacing.

Section 7.0 - As-Built Requirements

To assist in the production of adequate as-built Drawings and documentation, the Contractor will be required to provide one set of 22 inch by 34 inch red-lined Drawings with construction modifications, as well as the electronic formatted version of the Drawings to the Owner.

Section 8.0 - References

American Petroleum Institute (API), October 2005, *API Std 1104 Welding of Pipelines and Related Facilities*, American Petroleum Institute (API).

American Petroleum Institute (API), March 2009, *API Std 600/ISO 10434 Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries*, American Petroleum Institute (API).

American Petroleum Institute (API), March 2008, *API Spec 6D/ISO 14313 Specification for Pipeline Valves*, American Petroleum Institute (API).

ASTM International, 2009, *ASTM A105 / A105M - 09 Standard Specification for Carbon Steel Forgings for Piping Applications*, ASTM International.

ASTM International, 2006, *ASTM A135 / A135M - 06 Standard Specification for Electric-Resistance-Welded Steel Pipe*, ASTM International.

ASTM International, 2009, *ASTM A183 - 03(2009) Standard Specification for Carbon Steel Track Bolts and Nuts*, ASTM International.

ASTM International, 2007, *ASTM A234 / A234M - 07 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service*, ASTM International.

ASTM International, 2007, *ASTM A307 - 07b Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength*, ASTM International.

ASTM International, 2009, *ASTM A536 - 84(2009) Standard Specification for Ductile Iron Castings*, ASTM International.

ASTM International, 2009, *ASTM A726 - 05 Standard Specification for Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types*, ASTM International.

ASTM International, 2004, *ASTM D1238 - 04c Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer*, ASTM International.

ASTM International, 2003, *ASTM D1505 - 03 Standard Test Method for Density of Plastics by the Density-Gradient Technique*, ASTM International.

ASTM International, 2009, *ASTM D1557 - 09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))*, ASTM International.

ASTM International, 2009, *ASTM D2513 - 09 Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings*, ASTM International.

ASTM International, 2007, *ASTM D2657 - 07 Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings*, ASTM International.

ASTM International, 2008, *ASTM D2837 - 08 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products*, ASTM International.

ASTM International, 2008, *ASTM D3035 - 08 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter*, ASTM International.

ASTM International, 2003, *ASTM D3261 - 03 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing*, ASTM International

ASTM International, 2008, *ASTM D3350 - 08 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials*, ASTM International

ASTM International, 2008, *ASTM D638 - 08 Standard Test Method for Tensile Properties of Plastics*, ASTM International

ASTM International, 2007, *ASTM F2164 - 02(2007) Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure*, ASTM International.

ASTM International, 2008, *ASTM F714 - 08 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter*, ASTM International.

American Society of Mechanical Engineers (ASME), 2003, *ASME B1.1-2003 Unified Inch Screw Threads, UN and UNR Thread Form*, American Society of Mechanic Engineers (ASME).

American Society of Mechanical Engineers (ASME), 2005 B16.1 - 2005 Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250, American Society of Mechanic Engineers (ASME).

American Society of Mechanical Engineers, 2005, *ASME B16.21-2005 Nonmetallic Flat Gaskets for Pipe Flanges*, American Society of Mechanic Engineers.

American Society of Mechanical Engineers, 2007, *ASME B31.1-2007 Power Piping*, American Society of Mechanic Engineers.

American Society of Mechanical Engineers, 2007, *ASME B31.3-2008 Process Piping*, American Society of Mechanic Engineers.

American Water Works Association, 2006, *ANSI/AWWA C606-06, AWWA Standard for Grooved and Shouldered Joints*, American Water Works Association.

American Water Works Association, 2007, *AWWA C906 Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission*, American Water Works Association.

Plastic Pipe Institute (PPI), 2009, *Handbook of Polyethylene Pipe, Second Edition*, Plastic Pipe Institute.

Plastic Pipe Institute (PPI), 2006, *Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe, TR-33/2006*, Plastic Pipe Institute

Drawings

(see Drawings for Part 1 – Earthworks)

Meteorology 2.5

TR RAI-2.5-1

Regarding the long-term representativeness of the data collected onsite, please address the following issues.

a. Consistent with Regulatory Guides 3.63, 3.46 and NUREG-1569, Acceptance Criterion 2.5.3(3), explain why the applicant chose the NWS site at Chadron, Nebraska, over other potential NWS sites as a representative location for the purpose of comparing meteorological data.

b. Please clarify what years were used for determining long-term representativeness of meteorological conditions.

c. Consistent with Regulatory Guides 3.63, 3.46 and NUREG1569, Acceptance Criterion 2.5.3(3), demonstrate that the wind direction data obtained onsite are representative of the long-term meteorological conditions in the site vicinity.

Response: TR RAI-2.5-1(a)

See TR_RAI Response Replacement Pages; Section 2.5-1(a). For the justification of the chosen NWS. See also Section 6.0 of the TR Appendix 2.5-D "Meteorological Characterization of the Dewey-Burdock Uranium Project Area" provided in TR_RAI Response Replacement Pages; Section 2.5.2.

TR RAI-2.5-1(b)

For the regional overview, the correct dates are specified in paragraph 1, Section 2.5.2 of the TR (page 2-59). The dates (1978–2007) on page 2-58 were misstated. The sentence in the third paragraph on page 2-58 of Section 2.5.1 of the TR has been corrected. See TR_RAI Response Replacement Pages; Section 2.5-1(b).

Response: TR RAI-2.5-1(c)

See TR_RAI Response Replacement Pages; Section 2.5-1(c) for additional information in TR Section 2.5.3.2.

TR RAI-2.5-2

Demonstrate that wind direction, wind speed, and atmospheric stability data are consistent with the recommendations in Regulatory Guide 3.63 or provide justification for an alternate methodology.

Response: TR RAI-2.5-2

See TR_RAI Response Replacement Pages; Section 2.5-2 for information in TR Section 2.5.3.2.1 and Table 2.5-8

TR RAI-2.5-3

Provide meteorological data consistent with Reg. Guide 3.63 regarding joint frequency and joint relative frequency form for representative release heights, or justify an alternate method.

Response: TR RAI-2.5-3

See TR_RAI Response Replacement Pages; Section 2.5-3 for additional information in TR Section 2.5.3.2.2 and Table 2.5-10.

TR RAI-2.5-4
Consistent with Regulatory Guide 3.63, please provide an annual wind rose summary for the 16 compass directions for the project site.

Response: TR RAI-2.5-4
The annual wind rose summary data is provided in TR Appendix 2.5-D Section C "Site-Specific Wind Analysis" on page C-3.

TR RAI-2.5-5
a. Please make units of wind speed consistent.
b. Please provide data to confirm the applicant's statements for wind data.

Response: TR RAI-2.5-5a
See TR_RAI Response Replacement Pages; Section 2.5-5a and b

Response: TR RAI-2.5-5b
See TR_RAI Response Replacement Pages; Section 2.5-5a and b
All site specific data has been provided within TR Appendix 2.5-D ; "Site-Specific Wind Analysis".
See pages C-12-13 for May data and pages C-26-27 for the December data.

TR RAI-2.5-6
Please specify the location and months included in each seasonal wind rose on the legend and/or titles of the figures.

Response: TR RAI-2.5-6
See Response: TR_RAI-2.5-2 for months included into each season; also, refer to Figures 4-6 and 4-7 in TR Appendix 2.5-D page 30.

TR RAI-2.5-7
Please explain the method by which the applicant obtained the atmospheric stability.

Response: TR RAI-2.5-7
See TR_RAI Response Replacement Pages; Section 2.5-7 for information now included into Section 2.5.3.2.1 and Table 2.5-9.

TR RAI-2.5-8
Provide a discussion of wind stability class and average inversion height in the description of the local meteorological conditions.

Response: TR RAI-2.5-8
See TR_RAI Response Replacement Pages; Section 2.5-8 for additional information in TR Section 2.5.3.2.3.

TR RAI-2.5-9
Consistent with Regulatory Guide 3.63, please provide threshold values for the meteorological instruments measuring wind direction and wind speed.

Response: TR_RAI-2.5-9
Refer to Table 4-1 "Specifications for Weather Instruments Installed to Perform Dewey-Burdock Site-Specific Analysis" in TR Appendix 2.5-D; page 24.

TR RAI-2.5-10
Please demonstrate that the applicant's system maintenance and servicing schedule during the onsite data collection period is consistent with Regulatory Guide 3.63 or provide justification for an alternate methodology.

Response: TR_RAI-2.5-10
See TR_RAI Response Replacement Pages; Section 2.5-10 for insertion into TR Section 2.5.1.

TR RAI-2.5-11
Demonstrate that our calibration program during on site data collection period is consistent with Reg. Guide 3.63 or provide justification for alternate method.

Response: TR_RAI-2.5-11
See TR_RAI Response Replacement Pages; Section 2.5-10 for insertion into TR Section 2.5.1.

REFERENCES

Oswald, J. K., 2008. Meteorological Characterization of the Dewey-Burdock Uranium Project Area Fall River and Custer Counties, South Dakota, RSI-2008, prepared by RESPEC, Rapid City, SD, for Powertech (USA) Inc., Edgemont, SD.

South Dakota State University, 2008. *South Dakota Climate and Weather*, retrieved August 18, 2008, from The World Wide Web at http://www.climate.sdstate.edu/climate_site/ climate_page.htm

2.5 Meteorology

2.5.1 Introduction

The proposed project is located in an area in southwestern South Dakota that can be characterized as a semiarid or steppe climate. It lies adjacent to the southwestern extension of the Black Hills. The area experiences abundant sunshine, low relative humidity, and sustained winds which lead to high evaporative demand. There are also large diurnal and annual variations in temperature.

Precipitation in the PAA is generally light or mild. Migratory storm systems that originate in the Pacific Ocean release a majority of their moisture over the Rocky or Cascade Mountains. Major precipitation events can occur when these systems regain moisture already present in the area or moisture advected from the Gulf of Mexico. Localized summer convective storms, caused by the Black Hills, can produce heavy precipitation events.

To complete the site-specific analysis, a weather station was installed in coordination with the South Dakota State Climatology office located a the SDSU campus in Brookings South Dakota. The station is located at approximately the center of the PAA, in accordance with NUREG-1569, in July 2007. Automatic Weather Data Network (AWDN) data are quality assured/quality controlled (QA/QC) through an internal querying process at SDSU to determine if sensors and the associated data logging equipment function properly. All data collected during the sampling period had over a 90 percent recovery rate. Sites were visually inspected periodically throughout the sampling period to assess any defects in sampling equipment.

The station was part of the SDSU AWDN, therefore the SDSU recalibration schedule was used, which is approximately once per year. The station was calibrated just prior to the sampling period and monitored by the SDSU internal querying process (as explained above), it is assumed that all the weather instruments were functioning properly and calibrated throughout the sampling period.

This site collects temperature, humidity, solar radiation, wind speed/direction, barometric pressure, and precipitation at 1-minute, 5-minute, and hourly time steps. To determine whether this period of data collection (July 18, 2007, to July 17, 2008) was representative of long-term meteorological conditions, weather data from the nearest National Weather Service (NWS) site at Chadron, Nebraska, for the same period was compared to data collected at the site from years 2007 and 2008.

The data compiled from several sites (listed in Table 2.5-1 and shown in Plate 2.5-1) surrounding the PAA from the High Plains Regional Climate Center (HPRCC) and South Dakota State University (SDSU) was used to represent the long-term meteorological conditions of the project region. All the sites were used to characterize regional trends of temperature and precipitation along with growing, heating, and cooling degree days. Only the SDSU sites had sufficient data available to analyze regional patterns of humidity, and only the Oral, South Dakota, site had adequate data to characterize wind speed/direction and evapotranspiration.

Data were analyzed at each site by time of day, month, and season of the year. The seasons for this analysis are defined as: winter (December, January, February), spring (March, April, May), summer (June, July, August), and fall (September, October, November).

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Response: TR RAI-2.5-1

TR_RAI 2.5-1(a) – 2.5-1(c)

Justification and Clarification for Determination of Representative Data and Location of Comparison NWS Station

Table 2.5-1: Meteorological Stations Included in Climatology Analysis

Name	Data Source	*X*	*Y*	*Z* (ft)	Years of Operation
Redbird	NCDC[(a)]	10,417	4,315	3,890	1948–2006
Oral	SDSU[(b)]	10,316	4,324	2,960	1971–2007
Oelrichs	NCDC	10,314	4,311	3,340	1948–2007
Newcastle	NCDC	10,414	4,351	4,380	1918–2006
Edgemont	NCDC	10,349	4,318	3,440	1948–2007
Custer	NCDC	10,336	4,346	5,330	1926–2007
Ardmore	NCDC	10,339	4,304	3,550	1948–2007
Angostura	NCDC	10,326	4,322	3,140	1948–2007
Jewel Cave	SDSU	10,349	4,343	5,298	2004–2008

Source: High Plains Regional Climate Center, 2008; South Dakota State University, 2008

(a) National Climatic Data Center.

(b) South Dakota State University Climate Web site.

2.5.2 Regional Overview

The Chadron, Nebraska, National Weather Site (NWS) site was selected as the most representative due to the proximity to the project site (approximately 62 miles to the southeast) and availability of long-term weather parameters (wind speed, temperature, precipitation). The closest NWS site with the same parameters available is located at Rapid City, South Dakota (approximately 58 miles northeast). This site was not selected because Rapid City is located on the eastern slope of the Black Hills and the project area is located on the western slope. This is important because weather fronts often move from west to east, which could cause significant differences in local climate, especially precipitation.

Meteorological data from the NWS site at Chadron, Nebraska, were collected from the HPRCC and analyzed to determine whether the past year's data (July 18, 2007, to July 17, 2008) was representative of long-term meteorological conditions (January 1, 1978, to July 17, 2008) in the area. The parameters analyzed were average daily temperature, wind speed, and precipitation.

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Response: TR RAI-2.5-2

Demonstration that Wind Speed, Direction and Atmospheric Stability Monitoring Data are Consistent with Regulatory Guide 3.63

POWERTECH (USA) INC.

Response: TR RAI-2.5-7

Additional Information Concerning Atmospheric Stability Method

TR Section 2.5.3.2.1 and Table 2.5-9

2.5.3.2 Wind Patterns

Wind direction data from the NWS Chadron, NE and the Oral, SD stations were determined not to represent site specific wind patterns due to an orographical effect of the Black Hills.

Due to geographic differences and the associated orographic effects, it is believed the Chadron, NE nor the Oral, South Dakota sites represent the long-term conditions at the Dewey-Burdock site located in the southwestern Black Hills.

The data collected on site show that during the collection period (July 18, 2007, to July 17, 2008), the winds prevailed predominantly from the northwest to southeast except during summer months, see TR Figures 2.5-22 and 2.5-23 and Figures 4-6 and 4-7 in TR Appendix 2.5-D. The nearest weather station with long-term wind speed and direction data (Oral, SD) indicate the predominant wind direction is from the southwest and northeast direction, see Figure 3-14 in TR Appendix 2.5-D.

There is no NWS or other meteorological site with available wind speed and direction data that would demonstrate the wind direction data on site are representative of the long-term meteorological conditions in the site vicinity.

2.5.3.2.1 *Methods for Collecting Wind Speed, Direction and Atmospheric Stability*

A weather station was installed in coordination with the South Dakota State Climatology office at approximately the center of the PAA, in accordance with NUREG-1569, in July 2007. Parameters sampled at the site included wind speed and wind direction at three and 10-meter heights (9.8 and 32.8 feet). Data were analyzed at each site by time of day, month, and season of the year. The seasons for this analysis are defined as: winter (December, January, February), spring (March, April, May), summer (June, July, August), and fall (September, October, November).

Wind Speed and Direction

Wind speed and wind direction data were collected throughout the entire collection period (July 17, 2007, to July 16, 2008) once a minute every minute for the entire data collection period. The hourly average is an average of the 60 one-minute data points for that hour. This exceeds recommendations found in paragraph 3, Section C-1 of Reg. Guide 3.63, which recommends at least 15 consecutive minutes of continuous data each hour to represent 1-hour average data. Table 2.5-6 lists the model number and specifications of the sensors that were installed.

Wind speed and direction was measured in the field using Met-One 014A and 024A model sensors. Statistical analysis and visualization of wind data were performed using WRPLOT View Version 5.3 distributed by Lakes Environmental. All data analysis outputs are included in Appendix 2.5-C. The average wind speed over the period of record was approximately 5 mph, while calm winds occurred only 1.8 percent of the time.

As shown in Table 2.5-7, a majority of the winds (51 percent) come from the southeast and approximately 55 percent of all winds were less than 4.0 knots. December had the least amount of wind with 7.66 percent of the total winds being classified as calm and having an average wind speed of 2.43 knots. In contrast, May was the windiest month with only 0.41 percent of calm winds and an average wind speed of 6.0 knots. Southeasterly winds were prevalent in the winter months (38 percent of total shown in Figure 2.5-22) as well as the summer months (56 percent of total shown in Figure 2.5-23).

Table 2.5-7: Normalized Frequency Distribution of Wind at the Project Meteorological Site

Frequency Distribution (Normalized)							
Wind Direction	Knots						
	1–4	4–7	7–11	11–17	17–21	≥ 22	Total
348.75–11.25	0.000345	0.000115	0.000000	0.000000	0.000000	0.000000	0.000459
11.25–33.75	0.002526	0.000804	0.000459	0.000115	0.000000	0.000000	0.003904
33.75–56.25	0.012517	0.003790	0.003790	0.000804	0.000230	0.000230	0.021360
56.25– 78.75	0.028250	0.016996	0.021475	0.003330	0.000459	0.000000	0.070510
78.75–101.25	0.057074	0.037322	0.018489	0.001263	0.000000	0.000000	0.114148
101.25– 123.75	0.069936	0.025609	0.011713	0.000000	0.000000	0.000000	0.107258
123.75–146.25	0.070740	0.022738	0.007350	0.000115	0.000115	0.000000	0.101056
146.25–168.75	0.071199	0.015618	0.001378	0.000345	0.000000	0.000000	0.088539
168.75–191.25	0.057533	0.004364	0.000459	0.000230	0.000000	0.000000	0.062586
191.25–213.75	0.035829	0.004364	0.000345	0.000115	0.000000	0.000000	0.040652
213.75–236.25	0.035140	0.005397	0.002182	0.001034	0.000000	0.000000	0.043753
236.25– 258.75	0.030202	0.006890	0.004593	0.001493	0.000115	0.000000	0.043294
258.75– 281.25	0.032269	0.014469	0.004364	0.001952	0.000000	0.000000	0.053055
281.25–303.75	0.027905	0.034566	0.019982	0.002986	0.000000	0.000000	0.085439
303.75–326.25	0.017570	0.040652	0.052710	0.015962	0.000230	0.000000	0.127124
326.25–348.75	0.004364	0.006546	0.006775	0.001263	0.000115	0.000000	0.019063
Subtotal	**0.553399**	**0.240239**	**0.156063**	**0.031006**	**0.001263**	**0.00023**	**0.973702**
			Calms				**0.017646**
			Missing/Incomplete				**0.008652**
Source: South Dakota University, 2008			**Total**				**1.000000**

Atmospheric Stability Method

The atmospheric stability was calculated for each hour from July 17, 2007 through July 16, 2008 from hourly averages of measurements of wind speed and solar radiation taken at 1-minute intervals. This is consistent with paragraph 3, Section C-1 of Reg. Guide 3.63. See also -Table: 2.5-8 below; a Compilation of atmospheric stability data collected July 17, 2007 through July 16, 2008 in joint relative frequency form (in percent of total data). Calm winds compose of 2.52% of the data and 0.28% of the data is reported missing due to the criteria of 15 minutes of continuous data per hour interrupted due to maintenance down time.

The atmospheric stability was estimated with the Solar Radiation Delta-T method for estimating Pasquill-Gifford stability categories. The method uses measurements of daytime solar radiation, nighttime vertical temperature gradient, and wind speed to assign Pasquill-Gifford stability categories to time periods (EPA, 1993). Table: 2.5-9 summarizes the method.

Measurements of nighttime temperature gradient were not made. Instead, the more conservative stability class was chosen for each nighttime hour (the stability class for the nighttime temperature gradient ≥ 0).

2.5.3.2.2 *Joint Frequency and Joint Relative Frequency*

Joint relative frequency of the atmospheric stability data collected July 17, 2007 through July 16, 2008 is presented in Table2.5-10. Quarterly joint frequency and joint relative frequency tables were not generated because this information is not used in MILDOS to estimate public dose limits which are annual limits. Quarterly data is not helpful in estimating annual public doses from operations. A joint frequency table of the atmospheric stability data collected July 17, 2007 through July 16, 2008 was not generated because the same information, albeit in a different form, is displayed in Table2.5-10

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	Wind	Table: 2.5-8 Wind Direction																Total
	Speed	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
Class A	0-3	0.026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.026
	4-7	0	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0.026
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.026	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0.052
Class B	0-3	0.393	0.236	0.131	0.105	0.079	0.183	0.157	0.341	0.734	0.734	0.786	0.498	0.865	0.839	0.917	0.708	7.706
	4-7	0.052	0	0	0.026	0	0.026	0	0.052	0.079	0.079	0.052	0.105	0.262	0.079	0.183	0.105	1.1
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0.079	0	0	0.079
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.445	0.236	0.131	0.131	0.079	0.209	0.157	0.393	0.813	0.813	0.838	0.603	1.127	0.997	1.1	0.813	8.885
Class C	0-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4-7	0.052	0	0.026	0	0.026	0.079	0.341	0.236	0.314	0.026	0.105	0.288	0.629	1.101	0.865	0.681	4.769
	8-12	0	0	0	0	0.105	0.026	0.288	0.236	0.026	0	0.026	0.026	0.131	0.839	0.681	0.445	2.829
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.052	0	0.026	0	0.131	0.105	0.629	0.472	0.34	0.026	0.131	0.314	0.76	1.94	1.546	1.126	7.598
Class D	0-3	1.76	0.472	0.183	0.157	0.262	0.21	0.288	0.629	0.812	0.472	0.498	0.655	0.577	0.498	0.943	1.179	9.595
	4-7	1.02	0.15	0.15	0.34	0.83	0.62	0.52	0.62	0.23	0.23	0.02	0.157	0.49	1.389	2.096	1.887	10.821

			7	7	1	9	9	4	9	6	6	6		8				
	8-12	0.314	0.105	0.105	0.603	1.074	0.524	0.55	0.183	0	0	0.131	0.079	0.472	2.463	4.193	1.468	12.264
	13-18	0.026	0	0.026	0.393	0.577	0.105	0.105	0.079	0	0	0.183	0.183	0.314	1.73	4.769	0.812	9.302
	19-24	0	0	0	0.052	0.026	0	0	0	0	0	0	0.079	0.183	0.655	2.516	0.157	3.668
	>24	0	0	0	0	0	0	0	0	0	0	0	0.026	0.026	0.052	0.97	0.026	1.1
	Total	3.12	0.734	0.471	1.546	2.778	1.468	1.467	1.52	1.048	0.708	0.838	1.179	2.07	6.787	15.487	5.529	46.75
Class E	0-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4-7	0.812	0.079	0.131	0.183	0.21	0.157	0.262	0.288	0.026	0	0.026	0	0.052	0.288	0.603	0.865	3.982
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.812	0.079	0.131	0.183	0.21	0.157	0.262	0.288	0.026	0	0.026	0	0.052	0.288	0.603	0.865	3.982
Class F	0-3	5.56	3.354	2.07	1.205	0.865	0.839	0.891	1.205	1.127	0.786	0.524	0.577	0.943	1.494	2.594	5.425	29.459
	4-7	0.76	0.157	0.105	0.105	0.131	0.21	0.079	0.131	0.183	0	0.052	0.026	0.105	0.183	0.288	0.76	3.275
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	6.32	3.511	2.175	1.31	0.996	1.049	0.97	1.336	1.31	0.786	0.576	0.603	1.048	1.677	2.882	6.185	32.734
	Total	10.775	4.56	2.934	3.17	4.194	2.988	3.485	4.009	3.537	2.333	2.409	2.725	5.057	11.689	21.618	14.518	100.001

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Response: TR RAI-2.5-3

TR Section 2.5.3.2.2
Joint Frequency Format of the Atmospheric Stability Monitoring Data
Table 2.5-9

TR_RAI-Table: 2.5-9: ***Solar Radiation Delta-T method for estimating Pasquill-Gifford stability***

Wind Speed (m/s)	**Daytime Solar Radiation**			
	≥925	**675-925**	**175-675**	**<175**
<2	***A***	***A***	***B***	***D***
2-3	***A***	***B***	***C***	***D***
3-5	***B***	***B***	***C***	***D***
5-6	***C***	***C***	***D***	***D***
≥6	***C***	***D***	***D***	***D***

Wind Speed (m/s)	**Nighttime Temperature Gradient**	
	<0	**≥0**
<2	***E***	***F***
2-2.5	***D***	***E***
≥2.5	***D***	***D***

categories (EPA, 1993).

Table 2.5-10: Compilation of atmospheric stability data collected July 17, 2007 through July 16, 2008 in joint relative frequency form (in percent of total data). Calm winds compose of 2.52% of the data and 0.28% of the data is missing.

	Wind Speed (mph)	Wind Direction																Total
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
Class A	0-3	0.026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.026
	4-7	0	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0.026
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.026	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0.052
Class B	0-3	0.393	0.236	0.131	0.105	0.079	0.183	0.157	0.341	0.734	0.734	0.780	0.498	0.305	0.839	0.917	0.705	7.706
	4-7	0.052	0	0	0.026	0	0.026	0	0.052	0.079	0.079	0.052	0.105	0.262	0.079	0.183	0.105	[illegible]
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0.079	0	0	0.079
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.445	0.236	0.131	0.131	0.079	0.209	0.157	0.393	0.813	0.813	0.838	0.603	1.127	0.997	1.1	0.813	8.885
Class C	0-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4-7	0.052	0	0.026	0	0.026	0.079	0.341	0.236	0.314	0.026	0.105	0.288	0.629	1.101	0.865	0.681	4.769
	8-12	0	0	0	0	0.105	0.026	0.288	0.236	0.026	0	0.026	0.026	0.131	0.839	0.681	0.445	2.829
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.052	0	0.026	0	0.131	0.105	0.629	0.472	0.34	0.026	0.131	0.314	0.76	1.94	1.546	1.126	7.598
Class D	0-3	1.76	0.472	0.183	0.157	0.262	0.21	0.288	0.629	0.812	0.472	0.498	0.655	0.577	0.498	0.943	1.179	9.595
	4-7	1.02	0.157	0.157	0.341	0.839	0.629	0.524	0.629	0.236	0.236	0.026	0.157	0.493	1.389	2.096	1.887	10.621
	8-12	0.314	0.105	0.105	0.603	1.074	0.524	0.55	0.183	0	0	0.131	0.079	0.472	2.463	4.193	1.465	12.264
	13-18	0.026	0	0.026	0.393	0.577	0.105	0.105	0.079	0	0	0.183	0.183	0.314	1.73	4.769	0.812	9.302
	19-24	0	0	0	0.052	0.026	0	0	0	0	0	0	0.079	0.183	0.655	2.516	0.157	3.668
	>24	0	0	0	0	0	0	0	0	0	0	0	0.026	0.026	0.052	0.97	0.026	[illegible]
	Total	3.12	0.734	0.471	1.546	2.778	1.463	1.467	1.52	1.048	0.708	0.838	1.179	2.07	6.787	15.187	5.529	46.75
Class E	0-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4-7	0.812	0.079	0.131	0.183	0.21	0.157	0.262	0.288	0.026	0	0.026	0	0.052	0.288	0.603	0.865	3.982
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.812	0.079	0.131	0.183	0.21	0.157	0.262	0.288	0.026	0	0.026	0	0.052	0.288	0.603	0.865	3.982
Class F	0-3	5.56	3.354	2.07	1.205	0.865	0.839	0.891	1.205	1.127	0.786	0.524	0.577	0.943	1.494	2.591	5.425	29.459
	4-7	0.76	0.157	0.105	0.105	0.131	0.21	0.079	0.131	0.183	0	0.052	0.026	0.105	0.183	0.288	0.76	3.275
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	6.32	3.511	2.175	1.31	0.996	1.049	0.97	1.336	1.31	0.786	0.576	0.603	1.048	1.677	2.882	6.185	32.734
Total (All Classes)		10.775	4.56	2.331	3.17	4.194	2.988	3.485	4.009	3.537	2.333	2.409	2.725	5.357	11.689	21.618	14.516	100.001

2.5.3.2.3 ***Wind Stability Class and Inversion Height***

Atmospheric stability was compiled from meteorological data collected July 17, 2007 through July 16, 2008. Table 1 summarizes the atmospheric stability in joint relative frequency form. The atmospheric stability was Class A ~0.1 % of the time, Class B ~8.9 % of the time, Class C ~7.8 % of the time, Class D ~46.8 % of the time, Class E ~4.0 % of the time, and Class F ~32.7 % of the time. The atmospheric stability classes are briefly described in Table 2.5-11.

Table 2.5-11: ***Pasquill's categories of atmospheric stability (Cember, 1996).***

Class	*Stability*
A	*Extremely Unstable Conditions*
B	*Moderately Unstable Conditions*
C	*Slightly Unstable Conditions*
D	*Neutral Conditions*
E	*Slightly Stable Conditions*
F	*Moderately Stable Conditions*

Average mixing heights were derived from the AERMOD calculations used for dispersion modeling and are based on hourly data obtained from the National Weather Service stations in Rapid City (upper air), Custer, and the local Edgemont Station. The AERMOD calculation is based on a combination of mechanically and convectively driven boundary layer processes. As a result, seasonal and monthly mixing height averages are provided in Tables 2.5-12 and 2.5-13, respectively.

TR RAI-Table 2.5-12: ***Seasonal Mixing Height Averages***

	Winter	*Spring*	*Summer*	*Fall*
Average Mixing Height (m)	*936*	*1285*	*1382*	*839*

Table 2.5-13: *Monthly Mixing Height Averages*

Month	*Average Mixing Height (m)*
January	*835*
February	*963*
March	*1189*
April	*1237*
May	*1245*
June	*1217*
July	*1487*
August	*1333*
September	*1297*
October	*1146*
November	*550*
December	*815*

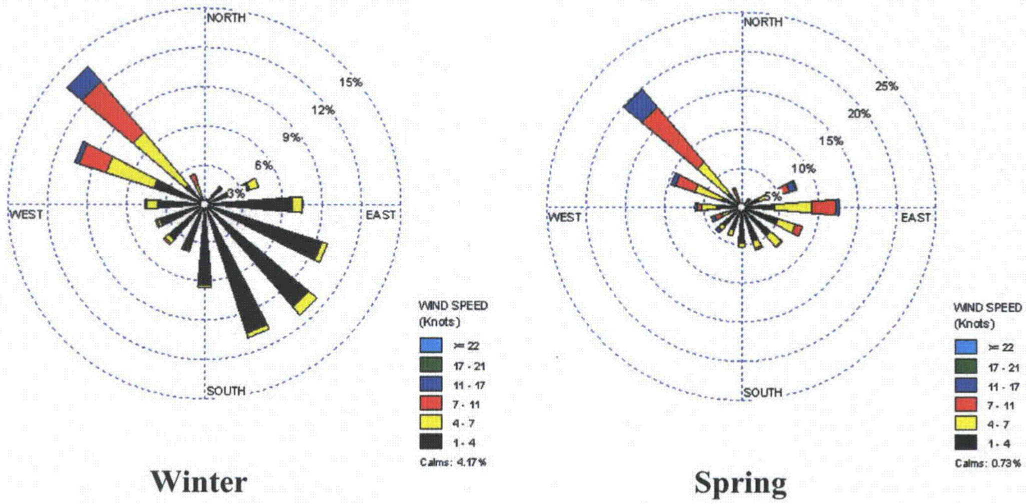

Figure 2.5-22: Winter and Spring Wind Roses

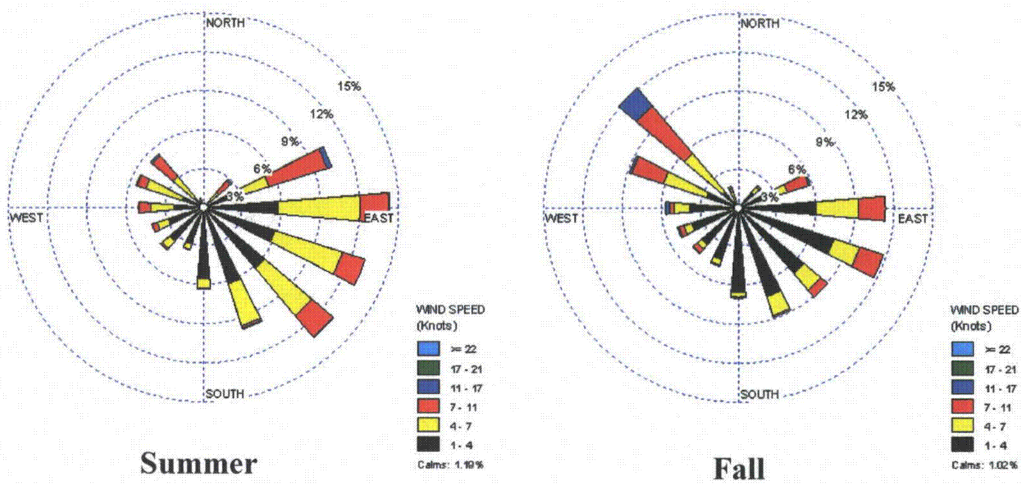

Figure 2.5-23: Summer and Fall Wind Roses