6/12/01
MB

Given/References:

1) Stability Study dated 4/26/95 by MJG. (Retec)

2) Boring logs for MW-23, MW-24, & MW-25 - borings on the proposed wall alignment

3) Hydrographs for MW-23, MW-24 & MW-25 taken from BOD report. Shows gw readings from 10/90 to 10/00

Procedure:

Refrence 1 - one conclusion is that the Rankine analysis for stability of the levee is more conservative than Coulomb procedure - ie, Rankine results in a higher force than Coulomb. Therefore, the Rankine procedure will be utilized to evaluate parameter changes.

A) Look @ water table level used in Ref. 1 calculations. The earlier calculation utilized a groundwater table 4.5 feet below the ground surface. The attached hydrographs indicate that a conservative gwl would be 6' below the ground surface. This is the highest august level in the last 10 years.

⇒ Change A = lower the groundwater level to 6 ft bgs.

B) Soil Properties:
Review boring logs for MW-23, MW-24, MW-25 & MW-42. There are no legends available for the exact sample type, but I think that ⊠ = Dames & Moore and ■ = SPT.

Blow Counts are ⊠ = 50/3, 29, 50/3, 50/3, 50/5", 16

■ = 32, 15, 2

MW-42 was completed using Air Rotary ⇒ blow counts could be suspect. Unsure of drilling method for GeoEngineers borings

⇒ Use SPT N = 30 as a conservative value. Using Peck, Hanson's Thornburn Fig 19.5, $\phi = 36°$ for N=30. This is between medium dense & dense.

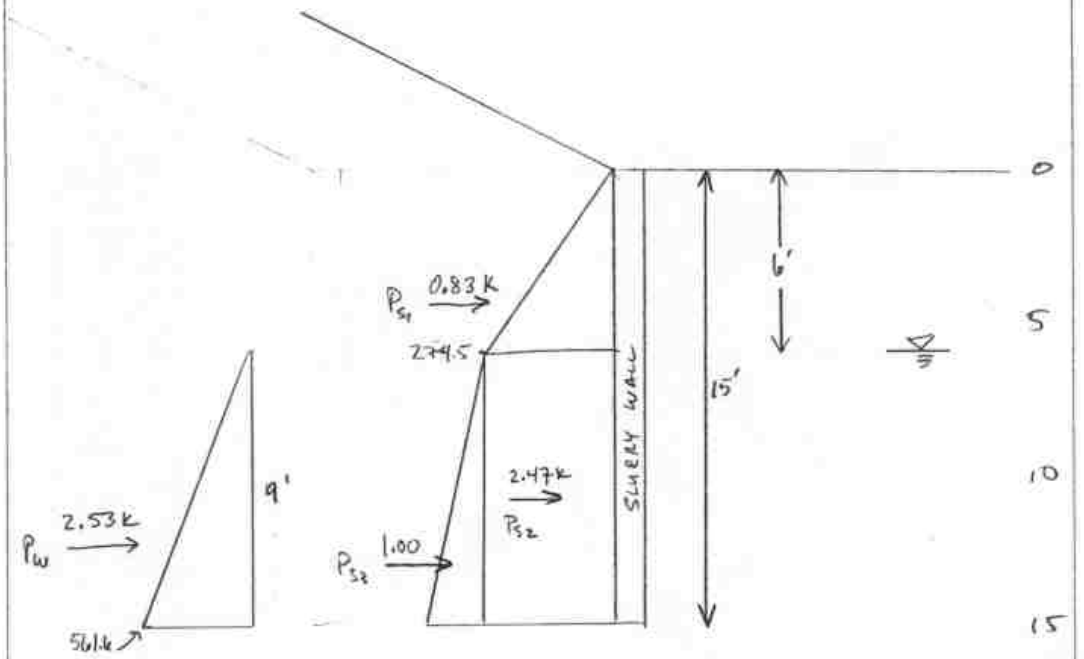
525

CALCULATION.

For a backslope of 26° for levee and $\Phi = 36°$, $K_A = 0.366$

$\gamma_s = 130$ pcf $\quad \gamma_{saturated} = 125$ pcf.

$\gamma_w = 62.4$ $\quad \gamma_b = 130 - 62.4 = 67.6$ pcf.



$P_{total} = 2.53 + 0.83 + 1.00 + 2.47 = 6.83$ K/ft.

20

This value is reduced from refrence 1 calculations due to a lowering of the groundwater table to a reasonable level and increasing the soil of levee strength to 36°. It is reasonable to assume that adjusting these two parameters to realistic values will also lower the Coulomb trial wedge total force to below 6.83 K. => the more conservative analysis remains the Rankine active calculation.

Required slurry density

For a slurry level @ 1' bgs ⇒ 14' from bottom of trench.

$$\gamma_s\left(\frac{H_s^2}{2}\right) = 6830 \text{ lbs.}$$

$$\gamma_s = 6830\left(\frac{2}{14^2}\right)$$

γ_s = 69.7 pct. for a stable condition.

For a slurry level @ 14.5', γ_s = 65 pcf

SPECIFICATION REQUIREMENTS

* Suggest that a slurry density of, 73 pct is required and a max slurry depth of 1' bgs.

- See attached addendum verbage

FAX TRANSMITTAL SHEET

worst case - dozer working along the trench

9 Pond Lane
Concord, MA 01742
(508) 371-1422
FAX (508) 369-9279

Date	5/1/95
Charge No/Project No	3-1161-510
Send to FAX No	
Company Name	RETEC
Attention	AARON
From	Mike G
Number of Pages to Follow	8

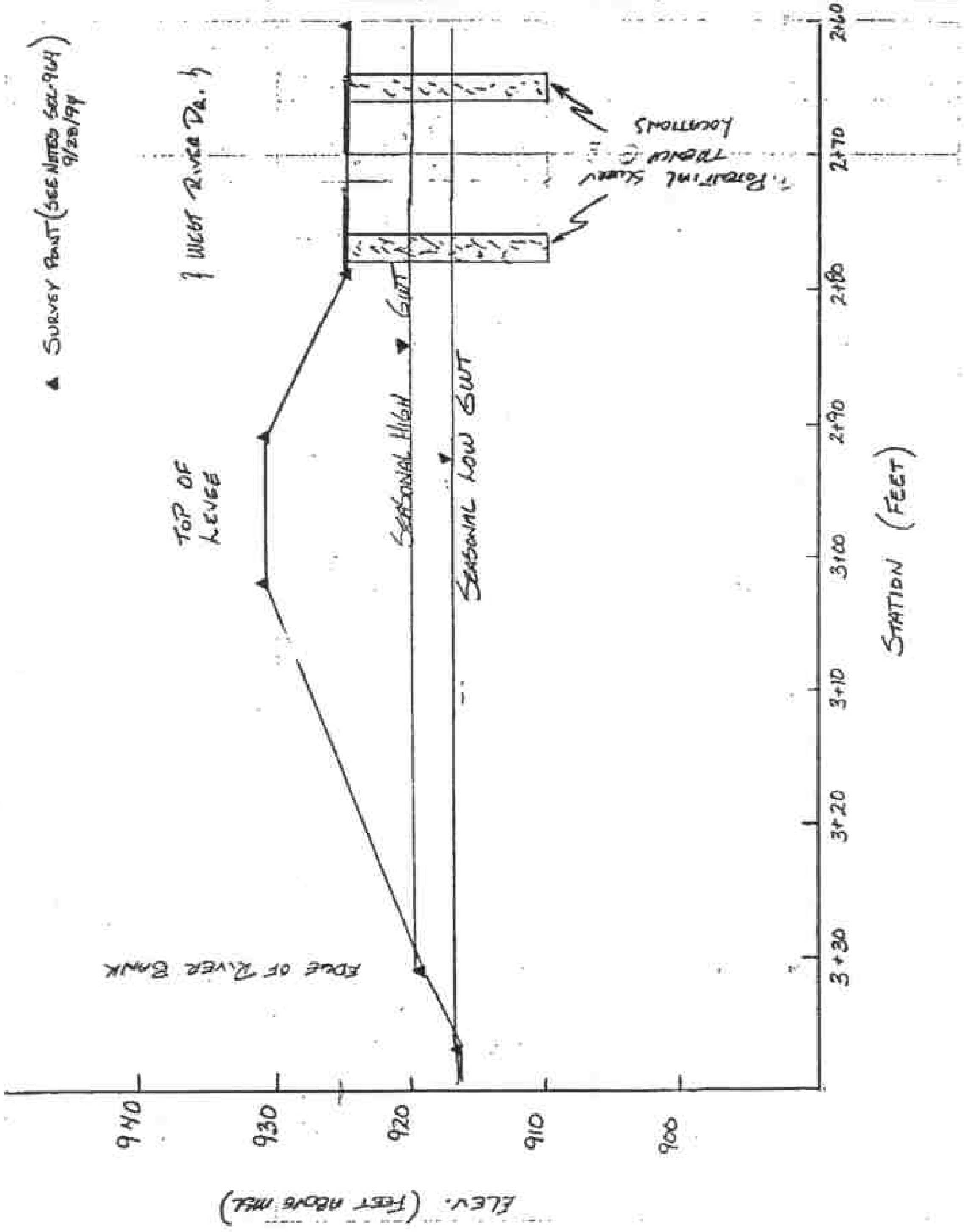
Comments/Special Instructions:

I CAN FAX SOME BACK UP ON SLURRY INFILTRATION the level, If needed -

- if slurry is that permeable, then fence wouldn't work on.

RETEC

Project No.	3-1161-510	Page	2 of 8
Client	B.N.	Date	4/26/95
Site	SKYKOMISH RIVER	By	MKG
Subject	SLURRY TRENCH STABILITY	App.	



RETEC

Project No. 3-1161-610 Page 2 of 8
Client B.N. Date 4/26/95
Site SKYKOMISH RIVER By MJG
Subject SLURRY TRENCH App.

SOIL PROPERTIES

GRAIN SIZE - SAND, SOME SILT, TRACE CLAY, TRACE GRAVEL (SAY GM)

$N \approx 40 - 100$ (REGIONAL) (FROM NEARBY BORINGS ALONG RIVER DR.)

$\phi \approx 35^\circ$ (CONSERVATIVE ESTIMATE FROM BOWLES TABLE 3-4")

$\gamma_{T(SAT)} = 130$ PCF

$\gamma_{T(UNSAT)} = 110$ PCF

$\gamma_w = 62.4$ PCF

DESIGN ASSUMPTIONS

- 2 MODES OF FAILURE ARE EVALUATED

1.) TRENCH IS LOCATED AT TOE OF LEVEE & FAILURE OCCURES DUE TO WEIGHT OF LEVEE. CONSIDER BOTH COULOMB TRIAL WEDGE AND RANKINE ACTIVE WEDGE

2.) TRENCH FAILURE DUE TO $1/0^K$ EQUIP LOAD OR $100^K/_{LF}$ LINE LOAD DUE TO HOUSE. USE RANKINE ACTIVE WEDGE

- USE SEASONAL HIGH GWT

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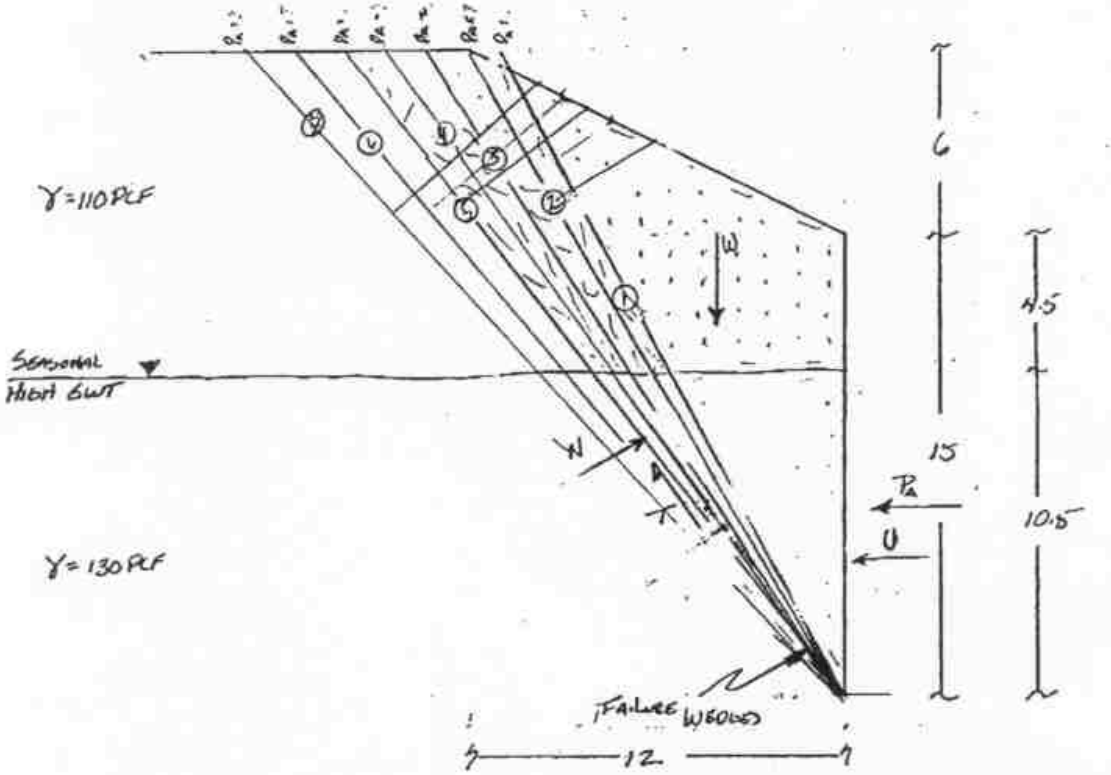
Project No. 3-1161-510 Page 3 of 8
Client B.N. Date 4/28/95
Site SKYKOMISH RIVER By MK
Subject SLURRY TRENCH STABILITY App.

CASE ① SLURRY @ TOE OF LEVEE, FAILURE DUE TO LEVEE SURCHARGE

2 CALCULATE TOTAL ACTIVE THRUST



SCALE 1" = 5.6'

10'

RETEC

Project No. 3-1161-510 Page 4 of 8
Client B.N. Date 4/28/95
Site SKYKOMISH RIVER By MK
Subject SLURRY TRENCH STABILITY App.

TRAIL ①: $\theta = 45^\circ + 35^\circ/2 = 62.5^\circ$

$\Sigma F_H = P_A - N\sin\theta + T\cos\theta$

$W = \left[\frac{1}{2}(10.5')(6.5')(130) + 53 Ft^2(110)\right] = 10.$ K.PS

$N = W\cos\theta = 10^K \cos 62.5 = 4.6$

$T = N\tan\phi = 4.6^K \tan 35^\circ = 3.2^K$

$P_A = 4.6^K \sin 62.4 - 3.2^K \cos 62.4 + \frac{10.5}{2}\frac{(62.4)}{1000}^2 \sim 3.44^K$ (Lone Pressure) $= 6.04$ K.PS

TRAIL ②: $\theta = 60^\circ$

$W = \left[\frac{1}{2}(10.5)(6)(130) + 61 Ft^2(110)\right] = 10.8^{K.PS}$

$N = 10.8^K \cos 60 = 5.4$

$T = 5.4 \tan 35^\circ = 3.78$

$P_A = 5.4 \sin 60 - 3.78\cos 60 + 3.44^K = 6.22$ K.PS

TRAIL ③: $\theta = 57.5^\circ$

$W = \left[\frac{1}{2}(10.5)(6.75)(130) + 71 Ft^2(110)\right] = 12.5$ K.PS

$N = 12.5^K \cos 57.5^\circ = 6.7$

$T = 6.7 \tan 35^\circ = 4.7$

$P_A = 6.7 \sin 57.5 - 4.7\cos 57.5 + 3.44^K = 6.58$ K.PS

RETEC

Project No. 3-1161-610 Page 6 of 8
Client B.N. Date 4/28/95
Site SKYKOMISH RIVER By MYL
Subject SLURRY TRENCH STABILITY App.

TRAIL ④: $\theta = 55^\circ$

$W = \left[\frac{1}{2}(10.5)(7.4)(130) + 78(110)\right] = 13.65^K$

$N = 13.65^K \cos 55^\circ = 7.83$

$T = 7.83 \tan 35^\circ = 5.48$

$P_A = 7.83 \sin 55 - 5.48 \cos 55 + 3.44^K = 6.71^{KIPS}$

TRAIL ⑤: $\theta = 52.5$

$W = \left[\frac{1}{2}(10.5)(8)(130) + 86(110)\right] = 14.90 KIPS$

$N = 14.90 \cos 52.5^\circ = 9.07^K$

$T = 9.07 \tan 35^\circ = 6.35^K$

$P_A = 9.07 \sin 52.5 - 6.35 \cos 52.5 + 3.44^K = 6.77 KIPS$

TRAIL ⑥: $\theta = 50$

$W = \left[\frac{1}{2}(10.5)(9)(130) + 99(110)\right] = 17.03^K$

$N = 17.03 \cos 50 = 10.95^K$

$T = 10.95 \tan 35 = 7.66^K$

$P_A = 10.95(\sin 60^\circ) - 7.66(\cos 60^\circ) + 3.44 = 6.90 KIPS$

TRAIL ⑦ $\theta = 47.5$

$W = \left[\frac{1}{2}(10.5)(9.8)(130) + 113(110)\right] = 19.09 K.PS$

$N = 19.09 \cos 47.5 = 12.89 K$

$T = 12.87 \tan 35 = 9.03$

$P_A = 12.89(\sin 47.5) - 9.03(\cos 47.5) + 3.44^K = 6.85 KIPS$

B4

RETEC

Project No. 3-1161-510 Page 6 of 8
Client BNI Date 4/28/95
Site SKYKOMISH RIVER By MJG
Subject TRENCH STABILITY App.

- THE CRITICAL FAILURE SURFACE OCCURS @ AN ANGLE OF 50° PRODUCING A RESULTANT ACTIVE FORCE OF 3.46 KIPS

w/o water @ 3.44

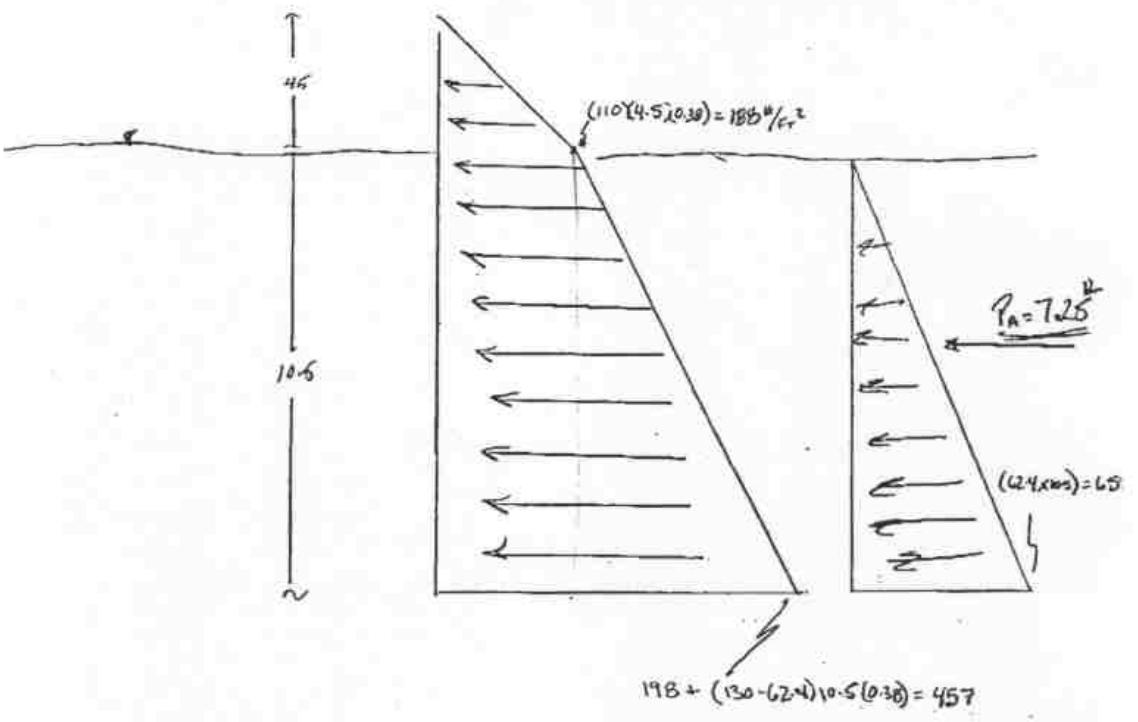
- CHECK: CHECK WITH RANKINE SOLUTION

OBTAIN K_A:

$i = 2°$ (SLOPE OF BACKFILL), $\phi = 35°$

USE $K_A = 0.38$ (DM 7.02, FIG 3, PG 7.2-64)

$P_A = 7.25$ K.IPS (HIGH WATER)

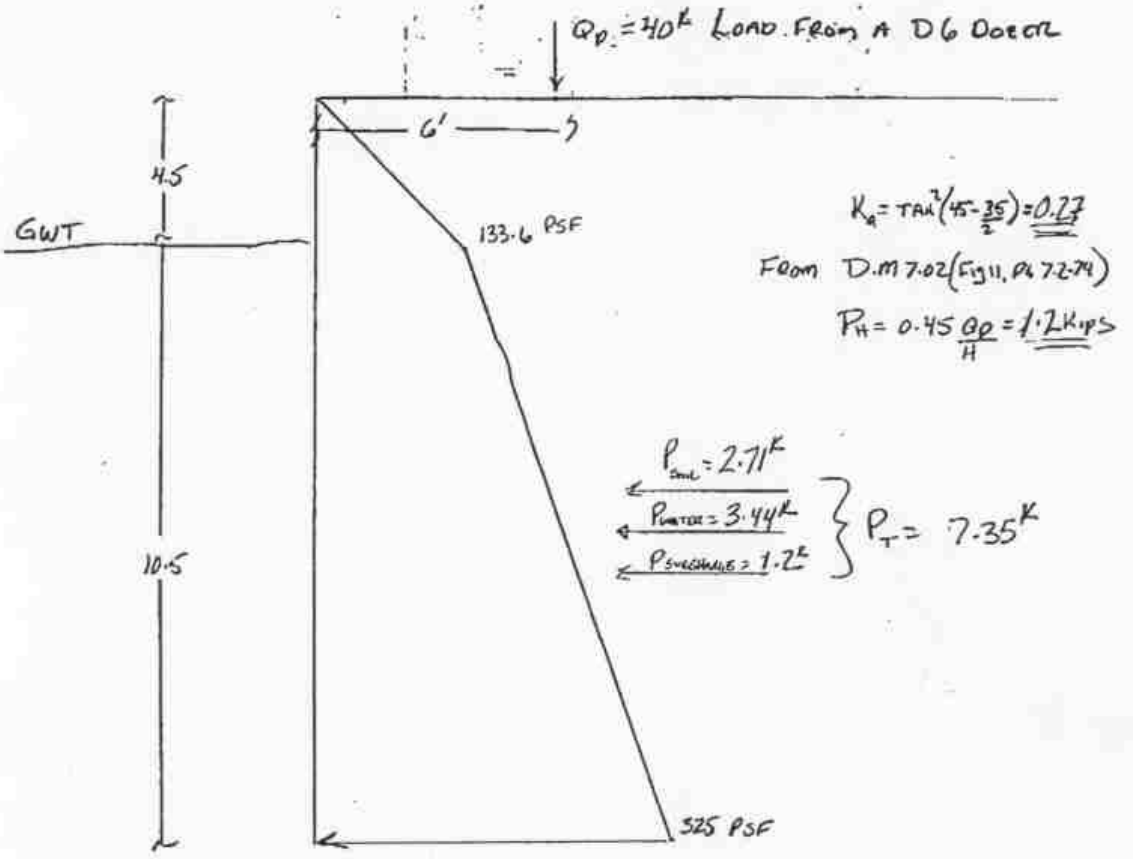


RETEC

Project No.	3-1161-610	Page	7 of 8
Client	B.N.	Date	5/1/95
Site	SKYKOMISH RIVER	By	MTG
Subject	SLURRY TRENCH	App.	

CASE ② FAILURE FROM 40^{K} DOZER WORKING ALONG TRENCH

USE RANKING ACTIVE FOR HORZ. BACKFILL



IF THE TRENCH WAS LOCATED ALONG SOUTH SIDE OF RIVER DRIVE WITH 6'OF 1 STORY W/F HOUSE. THE HOUSE WOULD PRODUCE A LINE LOAD OF 1000 LB/FT ALONG THE TRENCH THIS WOULD RESULT IN A RESULTANT HORZ. FORCE OF 0.5 KIPS & A TOTAL HORZ FORCE OF 2.71 (P_{soil}) + 3.44 (P_{water}) + 0.5 (House surcharge) = 6.65 KIPS

RETEC

Project No.	3-1161-510	Page	8 of 8
Client	B.N.	Date	5/1/95
Site	SKYKOMISH RIVER	By	MSG
Subject	SLURRY TRENCH STABILITY	App.	

MAX ACTIVE FORCE WILL BE 7.35 K, ← Soil (Fluid) water + Surcharge -

REQUIRED SLURRY DENSITY (USE DEPTH

Slurry level @

$\gamma_S - \gamma_S = 65.3$ pcf

@14', $\gamma_S = 75$ pcf

$\gamma_S \left(\frac{14.5^2}{2}\right) = 7350$ LBS

$\gamma_S \cong 70\ ^{LB}/_{FT^3}$

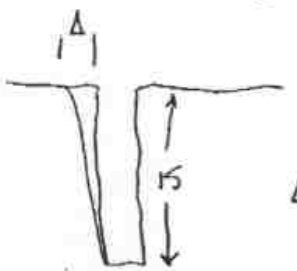
- IF TRENCH WAS IN THE middle OF ... .

North side of trench → $P_{(North\ Levee\ side)} < 7.25$ KIPS

South side of Trench → $P_T = 2.71^K(P_{Soil}) + 3.44^K(P_{WATER}) + 1.2^K(P_{Surcharge}) + 0.32(P_{House})$

$P_T = 7670$ LBS

$\gamma_S = 73\ ^{LB}/_{FT^3}$



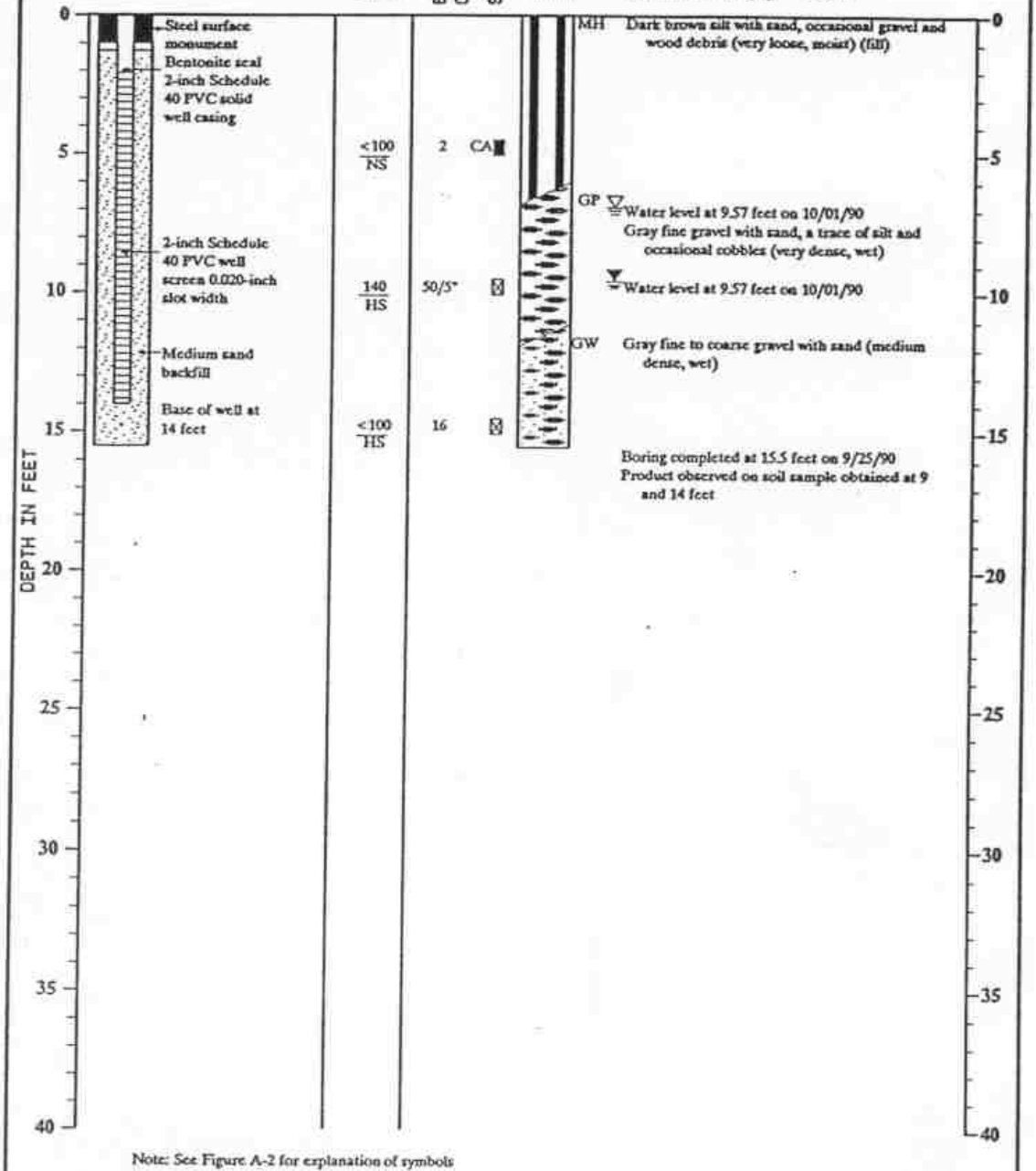
MAX STRAIN TO mobilize ACTIVE STRESSES

$\Delta = 0.001(15\ Ft)\ \frac{12\ in}{FT} = 0.18''$

No Risk TO FOUNDATION

REFRENCE 2

MONITOR WELL NO. MW-25



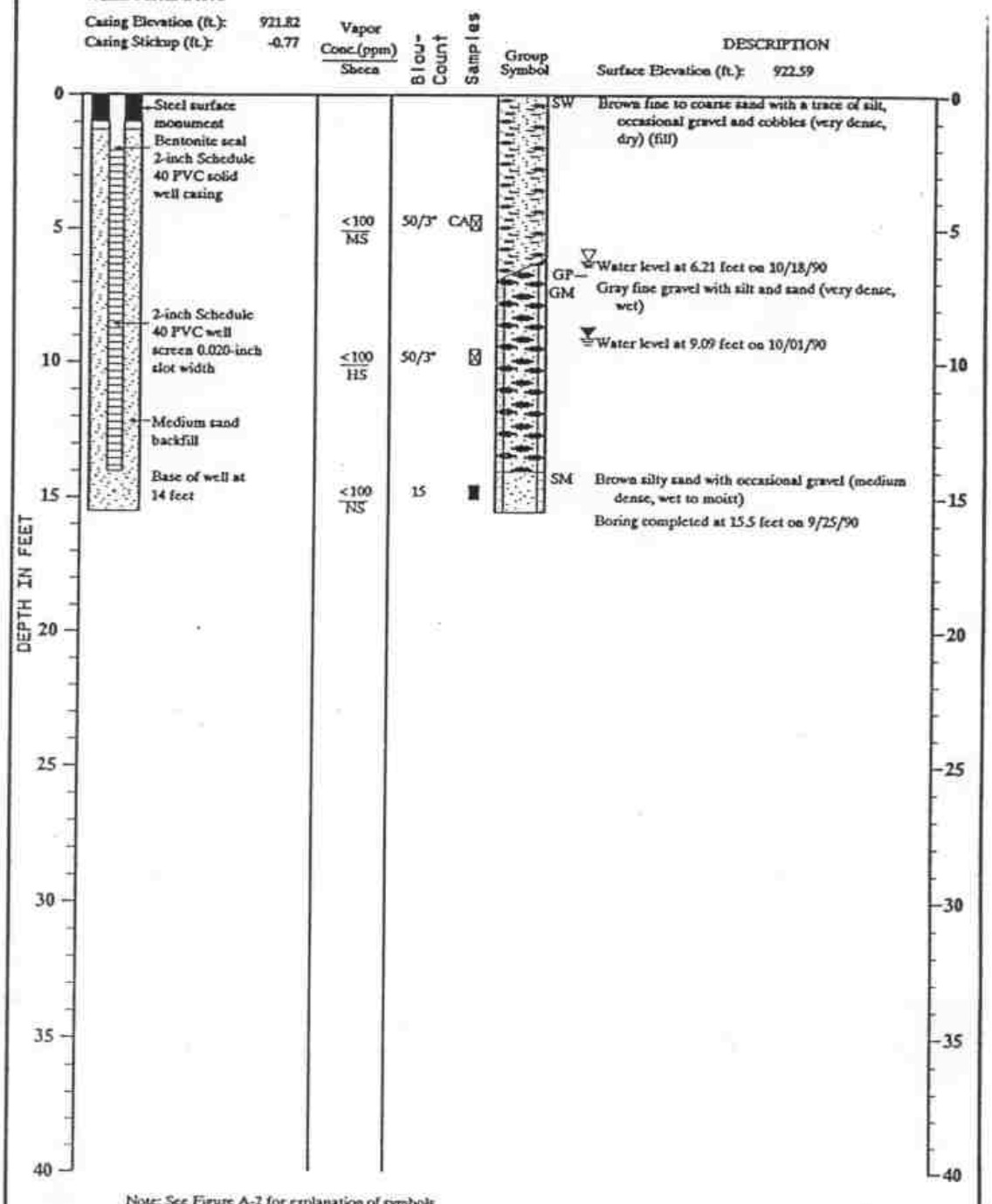
Note: See Figure A-2 for explanation of symbols

Geo Engineers

Log of Monitor Well

Figure A-27

MONITOR WELL NO. MW-24



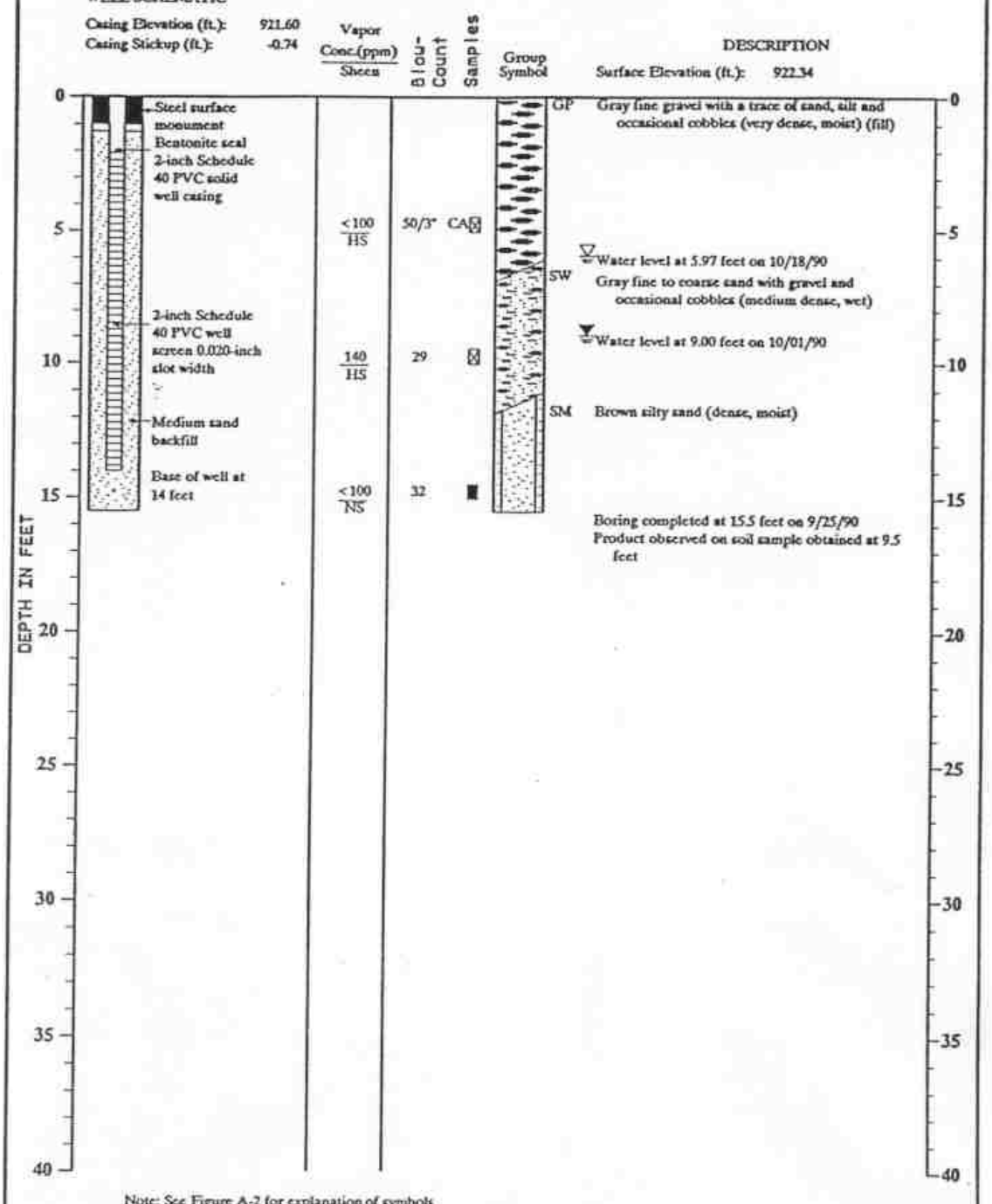
Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-26

MONITOR WELL NO. MW-23



Note: See Figure A-2 for explanation of symbols

Geo Engineers

Log of Monitor Well

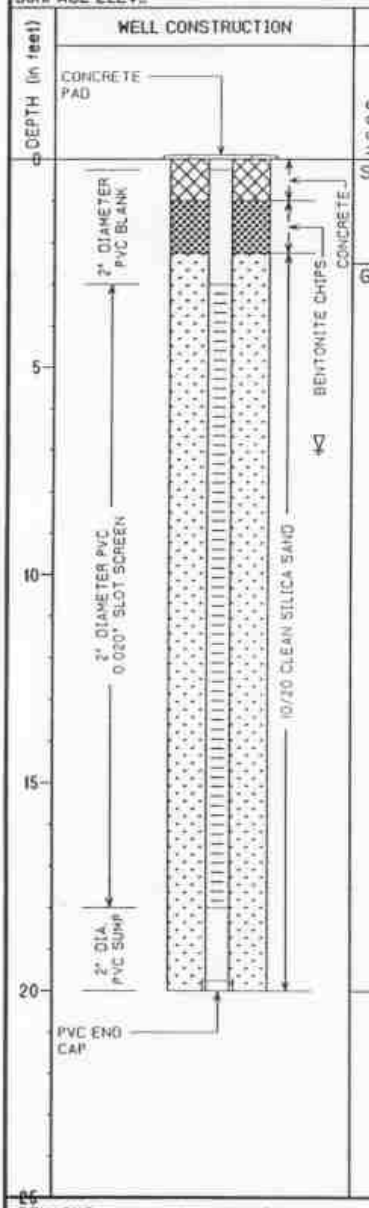
Figure A-25

RETEC

BORING/WELL INSTALLATION LOG
Monitoring Well 42 (Boring SO-3)

1011 S.W. Klickitat Way
Suite #207
Seattle, Washington 98134
(206) 624-9349

PROJECT NO: 3-1181-350 Skykomish RI/FS		CLIENT: Burlington Northern Santa Fe
LOCATION: Skykomish, Washington; Along N. School Yard Fence ~ 80' from N.W. Corner		DRILLING CO.: Cascade Drilling, Inc.
START DATE: 08/28/96 TIME: 09:00	BORING ID: 6 inches	DRILLER: Mike Colbert
COMPLETION DATE: 08/28/96 TIME: 12:30	TOTAL DEPTH: 20.0 feet	RIG TYPE: Ingersoll Rand
WATER LEVEL DURING DRILLING: 7.0' bgs	TOP OF CASING: ~0.25 feet	METHOD: Air Rotary
SURFACE ELEV.:	MP ELEV.: (Ground Surface)	LOGGED BY: Shelly Birch

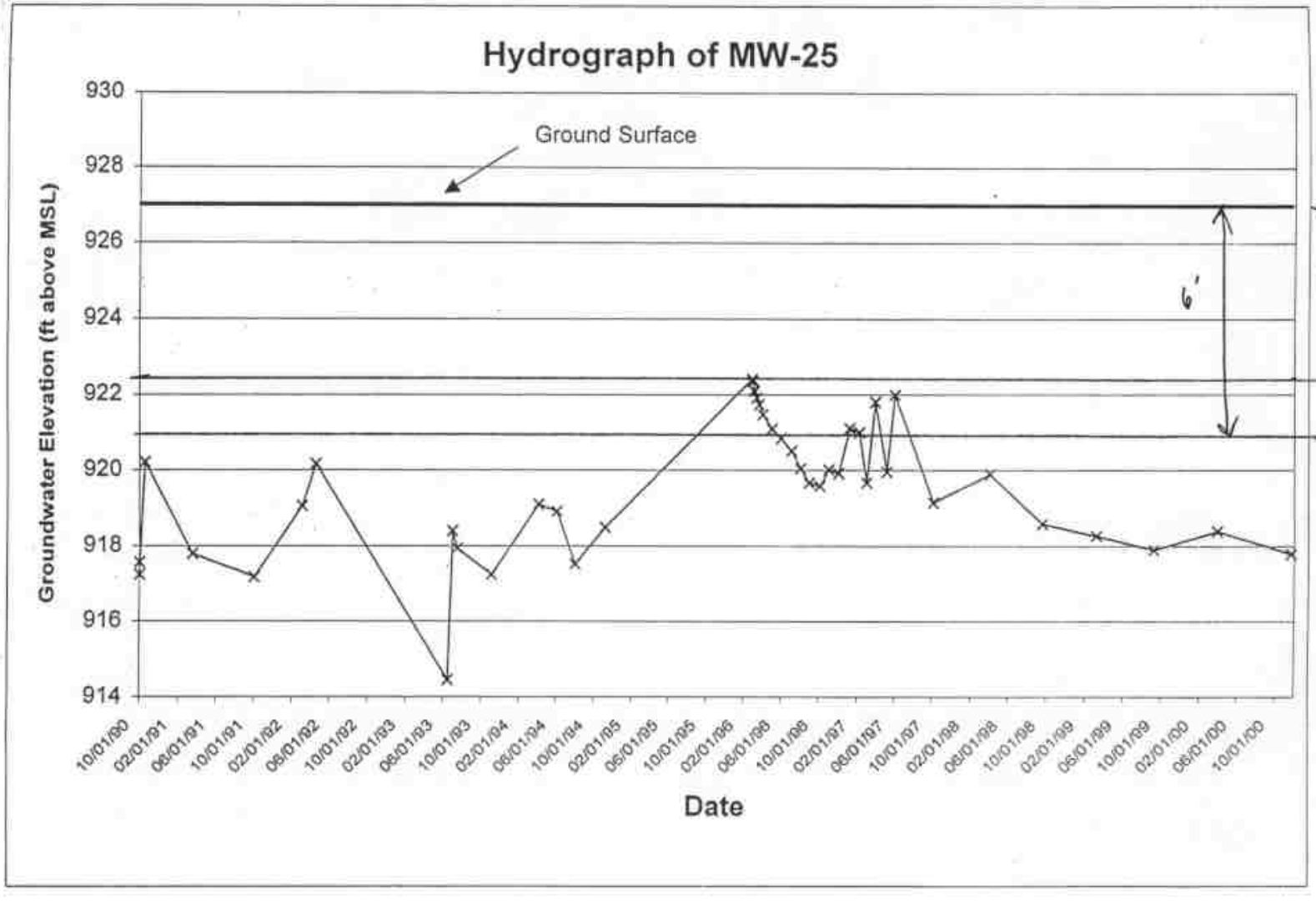


DEPTH (ft)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE DEPTH	BLOWS/ft	%RECOVERY	PID (ppm)
0	SM		SILTY SAND: Moderate yellow-brown; poorly sorted; some small gravels up to ¼".	C				NR
	GW		SANDY GRAVELS: Brown; very fine to coarse, poorly sorted.					
10			12.0' – Same; water table; no evidence of product; no odor.	SS		2 2 3	10	NR
20			18.5' – Same	SS		50/ 6"	30	NR
			Total depth = 20.0 feet bgs.					

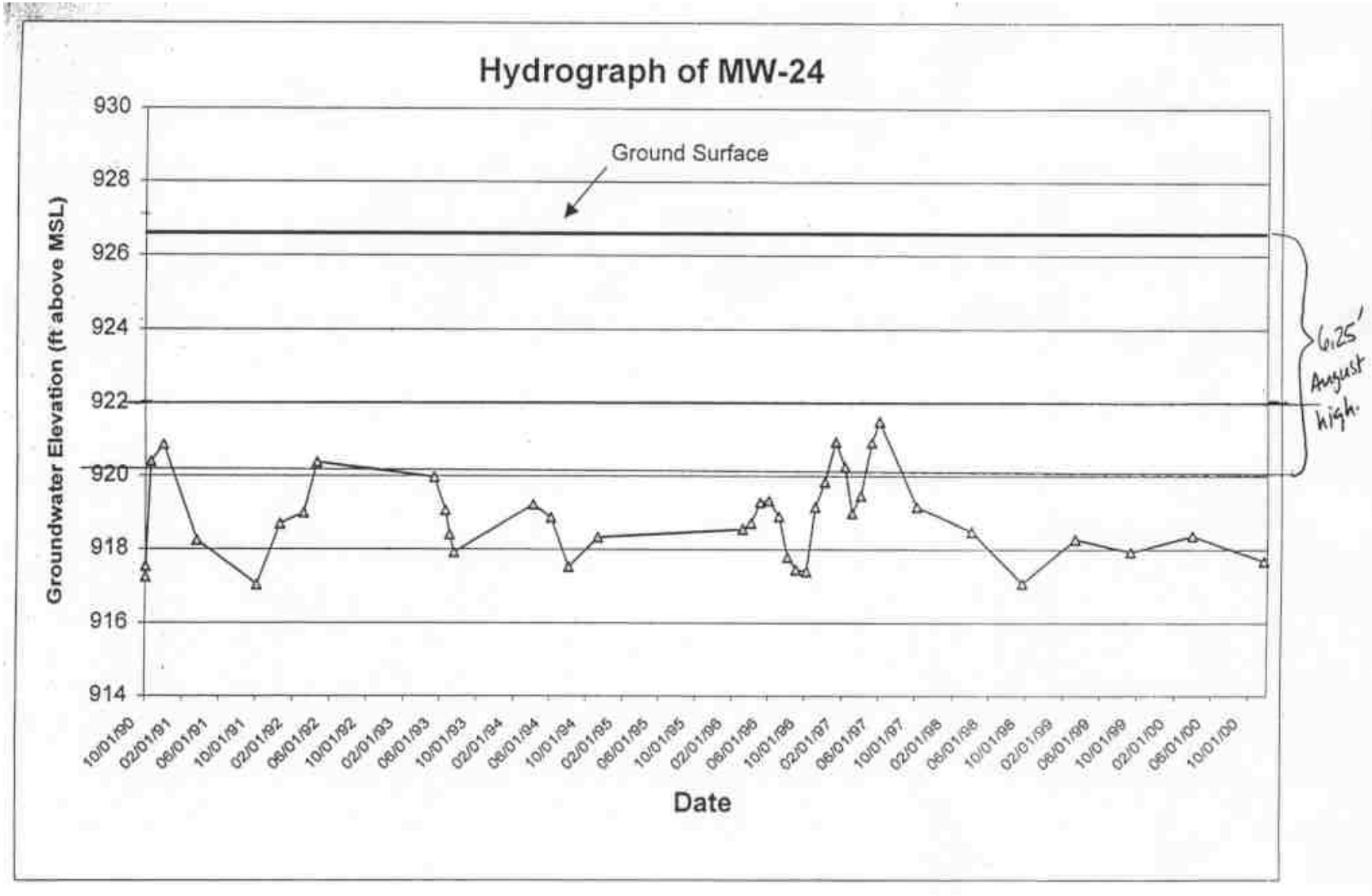
REMARKS:
B – Analytical Sample
C – Cuttings
NR – No reading above background.
SS – Split Spoon

REMEDIATION TECHNOLOGIES, INC.
A Thermo Electron Company

gw level in August every year.



REFERENCE 3


Hydrograph of MW-24
Ground Surface
Groundwater Elevation (ft above MSL)
930
928
926
924
922
920
918
916
914
6.25' August high.
10/01/90
02/01/91
06/01/91
10/01/91
02/01/92
06/01/92
10/01/92
02/01/93
06/01/93
10/01/93
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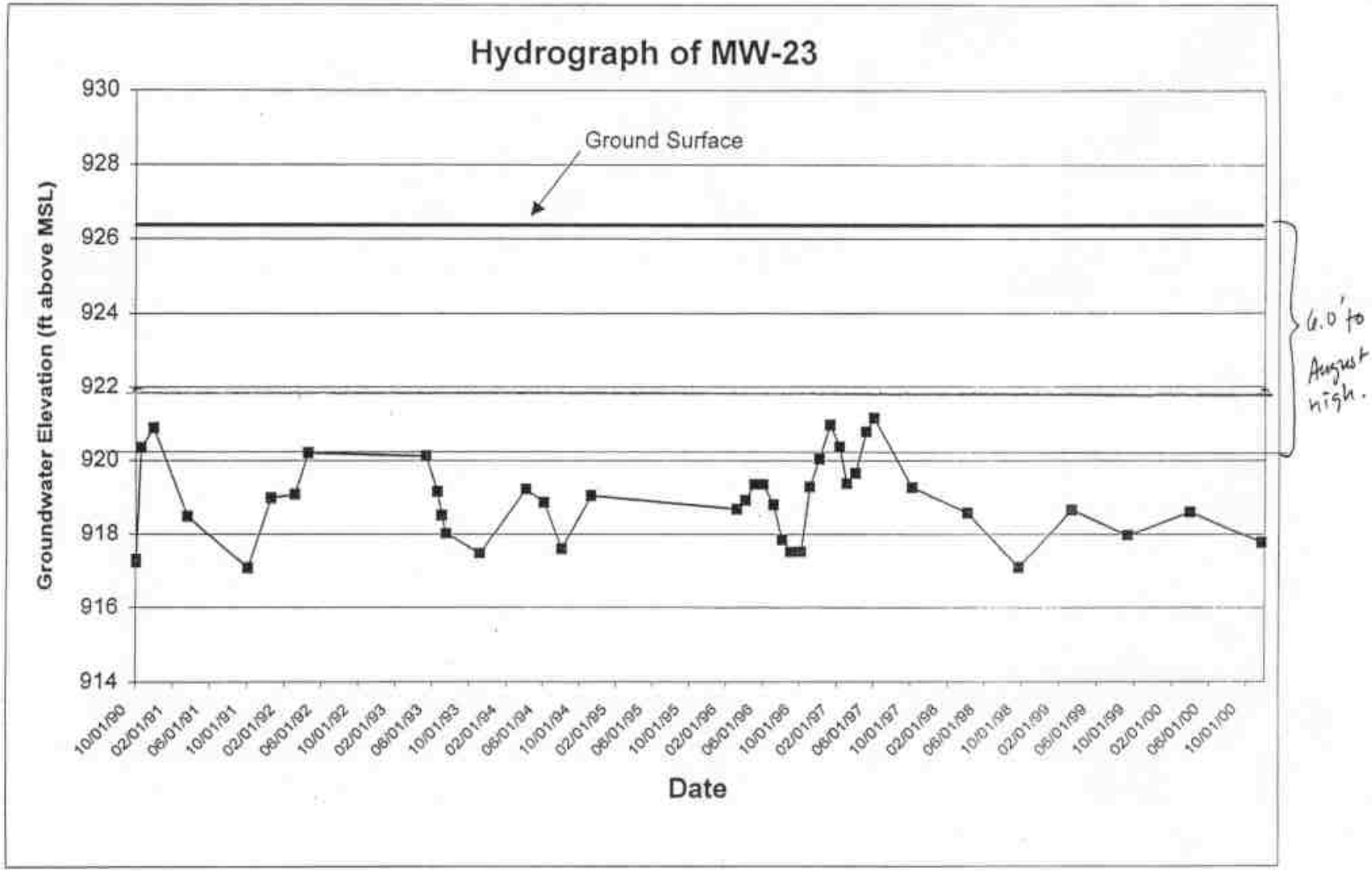
10/01/00
Date


Hydrograph of MW-23
Ground Surface
Groundwater Elevation (ft above MSL)
930
928
926
924
922
920
918
916
914
10/01/90
02/01/91
06/01/91
10/01/91
02/01/92
06/01/92
10/01/92
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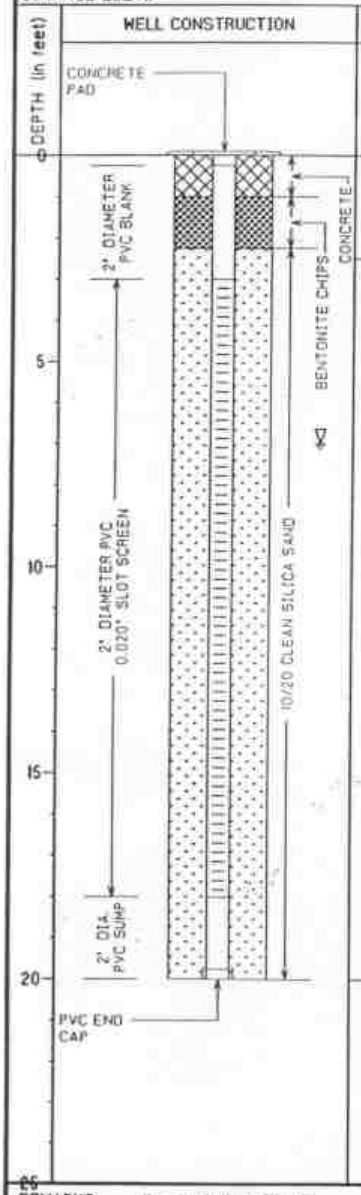
02/01/98
06/01/98
10/01/98
02/01/99
05/01/99
10/01/99
02/01/00
05/01/00
10/01/00
Date
6.0' to August high.

RETEC

BORING/WELL INSTALLATION LOG
Monitoring Well 42 (Boring SO-3)

1011 S.W. Klickitat Way
Suite #207
Seattle, Washington 98134
(206) 624-9349

PROJECT NO: 3-1161-350 Skykomish RI/FS		CLIENT: Burlington Northern Santa Fe
LOCATION: Skykomish, Washington; Along N. School Yard Fence ~ 80' from N.W. Corner		DRILLING CO.: Cascade Drilling, Inc.
START DATE: 08/28/98 TIME: 09:00	BORING ID: 8 inches	DRILLER: Mike Colbert
COMPLETION DATE: 08/28/98 TIME: 12:30	TOTAL DEPTH: 20.0 feet	RIG TYPE: Ingersoll Rand
WATER LEVEL DURING DRILLING: 7.0' bgs	TOP OF CASING: ~0.25 feet	METHOD: Air Rotary
SURFACE ELEV.:	MP ELEV.: (Ground Surface)	LOGGED BY: Shelly Birch



DEPTH (in feet)	WELL CONSTRUCTION	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	SAMPLE DATA: TYPE	DEPTH	BLOWS/ft	%RECOVERY	PID (ppm)
0	CONCRETE PAD	SM		SILTY SAND: Moderate yellow-brown; poorly sorted; some small gravels up to ¼".					
		GW		SANDY GRAVELS: Brown; very fine to coarse, poorly sorted.	C				NR
10				12.0' – Same; water table; no evidence of product; no odor.	SS		2 2 3	10	NR
20				18.5' – Same	SS		50/ 6"	30	NR
				Total depth = 20.0 feet bgs.					

REMARKS:
B – Analytical Sample
C – Cuttings
NR – No reading above background
SS – Split Spoon

REMEDIATION TECHNOLOGIES, INC.
A Thermo Electron Company

ThermoRetec Corporation
1011 S.W. Klickitat Way, Suite 207
Seattle, WA 98134-1162

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(206) 624-2839 Fax
www.retec.com

June 15, 2001

Dominic Parmantier
Project Manager
Hayward Baker Inc.
11004 E. Marginal Way South
Tukwila, WA 98168

RE: Addendum No. 1
Request for Proposal for Construction Services
LNAPL Containment Barrier Wall
BNSF – Skykomish, Washington

Dear Dominic:

On behalf of the Burlington Northern and Santa Fe Railway Company (BNSF), ThermoRetec Consulting Corporation is providing Addendum No. 1 to the Request for Proposal (RFP) for Construction Services for the above referenced project. The RFP was issued on June 8, 2001. Information in this addendum was developed in response to public, County and agency comments to the Basis of Design report which were not entirely available at the time of the RFP, and as clarification to issues identified internally.

Addenda items include the following:

A-1-1: Bid Date. Given the information contained in this addendum, the bid date has been extended to 5:00pm Pacific Standard Time on Thursday, June 21, 2001. Bids will be accepted at the ThermoRetec office in Seattle, Washington until that time.

A-1-2: Trench stability for cement bentonite slurry wall excavation. If a slurry wall is the chosen alternative, the contractor shall maintain stability of the trench walls at all times for its full depth. It should be noted that the flood control levee is very close to the slurry wall corridor, a fact that should be considered when evaluating stability of the trench walls. The level of slurry shall not be permitted to drop more than one (1) foot below the surfaces of the surrounding ground. The Contractor shall have personnel, equipment, and materials ready to raise the slurry level at any time. To this end, the Contractor shall have personnel on call to raise the slurry level (if required), weekends and/or holidays included. Additionally, the unit weight of the cement bentonite slurry shall not be allowed to drop below 73 pounds per cubic foot. This density is an in-place density, and as such, will be measured on slurry that is in the trench.

Modifications to the requirements set forth in this addenda item will be considered if the proposed modifications are presented with sufficient time for review, and with complete

stability calculations for the trench sealed by a Professional Engineer registered in the state of Washington. If a modification is requested, it should be indicated in the bidder's proposal with supporting information submitted along with the project work plan.

A-1-3: Water Quality Data. The attached data is supplied so that the Contractor can develop a mix design that is compatible with groundwater contaminants on the site. These data specifically should be used as the basis for compatibility testing/evaluations of the proposed mix design. The attached Table 2 and Figure 2 indicate extent of dissolved TPH constituents monitored on groundwater beneath the LNAPL plume. LNAPL thicknesses measured in the vicinity of the proposed barrier range from 0.1 to 1.0 feet.

A-1-4: Flood Events. With notice of a potential flood event on the Skykomish River, all trench excavation work (if a cement bentonite slurry wall is the chosen option) will be halted, or modified as specified herein. If the flood is eminent, the trench section that contains fresh slurry will be filled to the extent possible to maintain a stable trench in light of the rising flood waters and groundwater. If suitable time is available, all trench excavation will be halted at least 12 hours prior to flooding and the cement bentonite slurry in the trench will be allowed to remain in the trench with no additional backfilling. Standby time as defined in the RFP will be evaluated by the Engineer if requested by the Contractor during times when the project is halted by the Engineer for flooding.

A-1-5: This is an environmental project with specific health and safety training requirements associated with working on a site impacted with Bunker C and diesel LNAPL. As such, spoils associated with barrier wall construction work are impacted with TPH constituents and will ultimately be disposed of at a Subtitle D landfill facility. The Contractor shall consider spoils as contaminated soil and include special handling requirements typically associated with contaminated soil. This includes at a minimum management, stockpiling and containment in lined holding areas with appropriate run-on and run-off controls.

A-1-6: The chosen Contractor's proposal will need to be approved by Department of Ecology prior to awarding the work. ThermoRetec intends to issue an "Intent to Award" recommendation to the Department of Ecology once the bids are received and evaluated. The Department of Ecology will either concur with the recommendation or provide comments to the letter. All comments need to be addressed, and a concurrence from the Department of Ecology is required before BNSF can award the project.

A-1-7: Construction Staging Area. A modification to the construction staging area has been required to remain clear of the school's drain field. The attached modified Plate 1 indicates the new dimensions of the staging area that will be available during construction.

A-1-8: GPR survey. A ground penetrating radar (gpr) study was completed along the alignment in an attempt to locate any potential undiscovered subsurface utilities. The results of the study indicate that there is a high potential for debris within 3 feet of the ground surface. The exact nature of the debris is not known, but it is speculated to be cobbles, wood, old piping, and/or boulders. There were also several locations where potential cobbles/boulders/pipe was identified at depths between 3 and 8 feet below the ground surface. These potential obstructions are not necessarily shown on the boring logs because they were not encountered during drilling. The contractor should consider this information in preparing their bids and in developing their recommended wall system.

Sincerely,

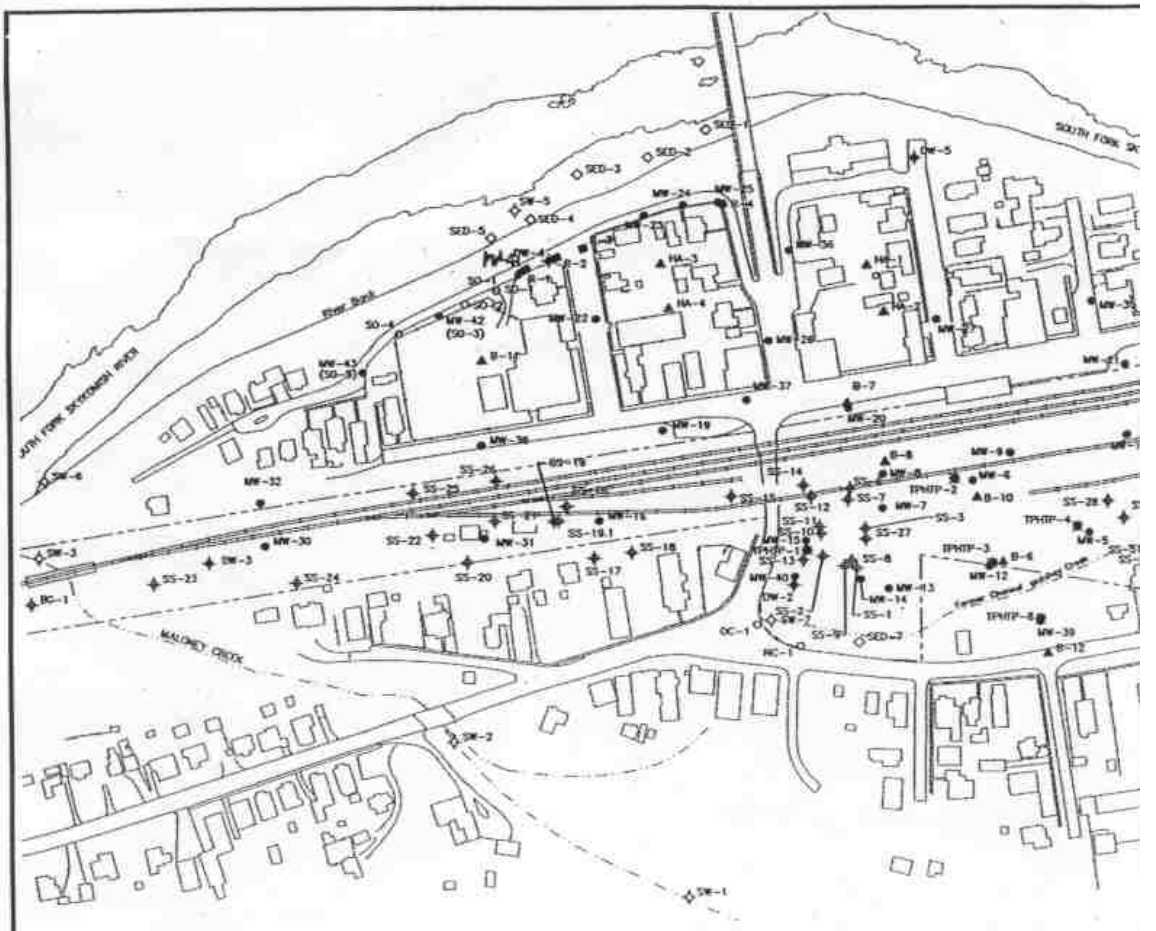
ThermoRetec Consulting Corporation

Bryan Stone

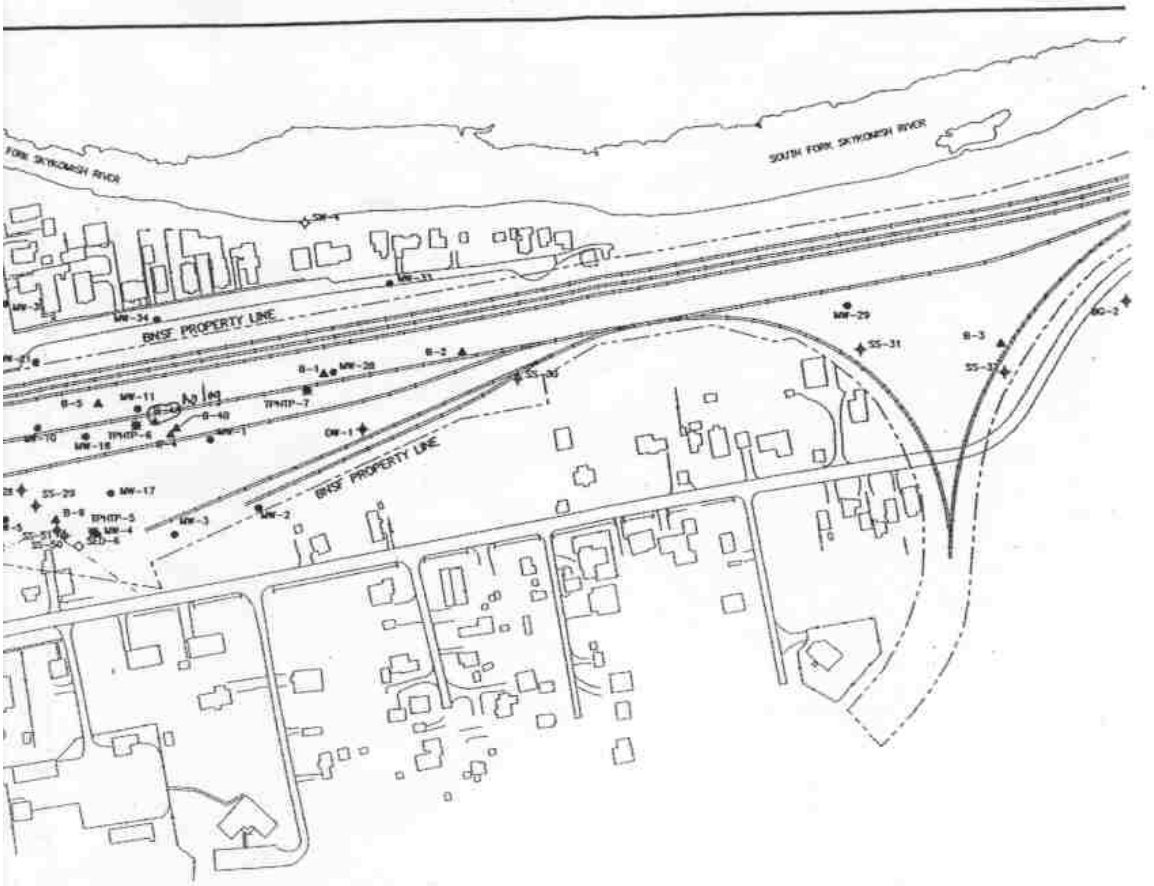
Bryan Stone
Construction Manager

Attachment: Revised Plate 1
Table 2
Figure 2

cc: B. Sheppard – BNSF
R. Truax, H. Voges, M. Byers, W. Chen – ThermoRetec; BN050-04018-560



ThermoRetec



NOTE:

SOIL SAMPLE LOCATIONS SS-50 & SS-51 ARE APPROXIMATE AND NOT BASED ON DATA GATHERED BY AN ENGINEERING SURVEY.

LEGEND

MW-32	MONITORING WELL LOCATION
DW-1	DEEP MONITORING WELL LOCATION
B-11	BORING LOCATION
BG-1	BACKGROUND SAMPLE LOCATION
SS-23	SURFACE SOIL SAMPLE LOCATION
HA-1	HAND AUGER SAMPLE LOCATION
TP-2	TEST PIT LOCATION
SO-1	BORING LOCATION
R-2	RECOVERY WELL LOCATION
SW-1	SURFACE WATER SAMPLE LOCATION
SED-1	SEDIMENT SAMPLE LOCATION

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SKYKOMISH, WASHINGTON
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SAMPLE LOCATIONS

FIGURE 2-3