APPENDIX A

TEST PIT LOGS FOR BUILDINGS 53, 73, 103 AND 154

BROWN AND CALDWELL

TRENCH LOG

CLIENT: USACE

LOCATION: Building 53

PROJECT NAME: B53, B73, B103, B154 Test Pits

JOB NUMBER: 00701

EXCAVATION CONTRACTOR: Nielson Construction

EXCAVATOR TYPE (CIRCLE ONE) OTHER: BACKHOE HAND SHOVEL OTHER: _____

SOIL SAMPLING METHOD (CIRCLE ONE) OTHER: Drive Sampler
SPLIT SPOON GRAB NONE

MONITORING INSTRUMENT (CIRCLE ONE) OTHER: _____
PID FID LEL RAD NONE

SURFACE CONDITIONS (CIRCLE ONE) OTHER: _____
ASPHALT CONCRETE DIRT DRY WET

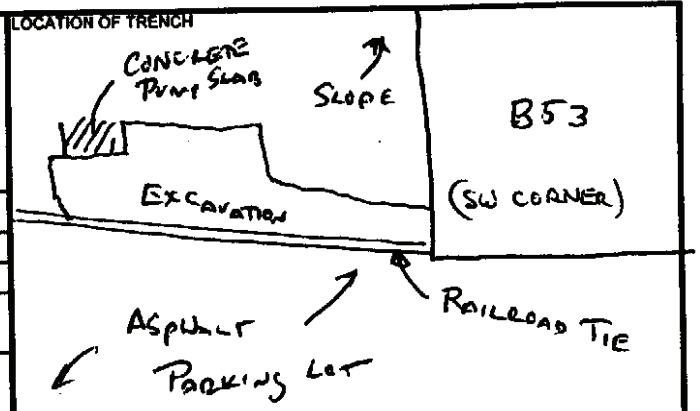
TRENCH NUMBER: 1B053TR001

SHEET 1 OF 1

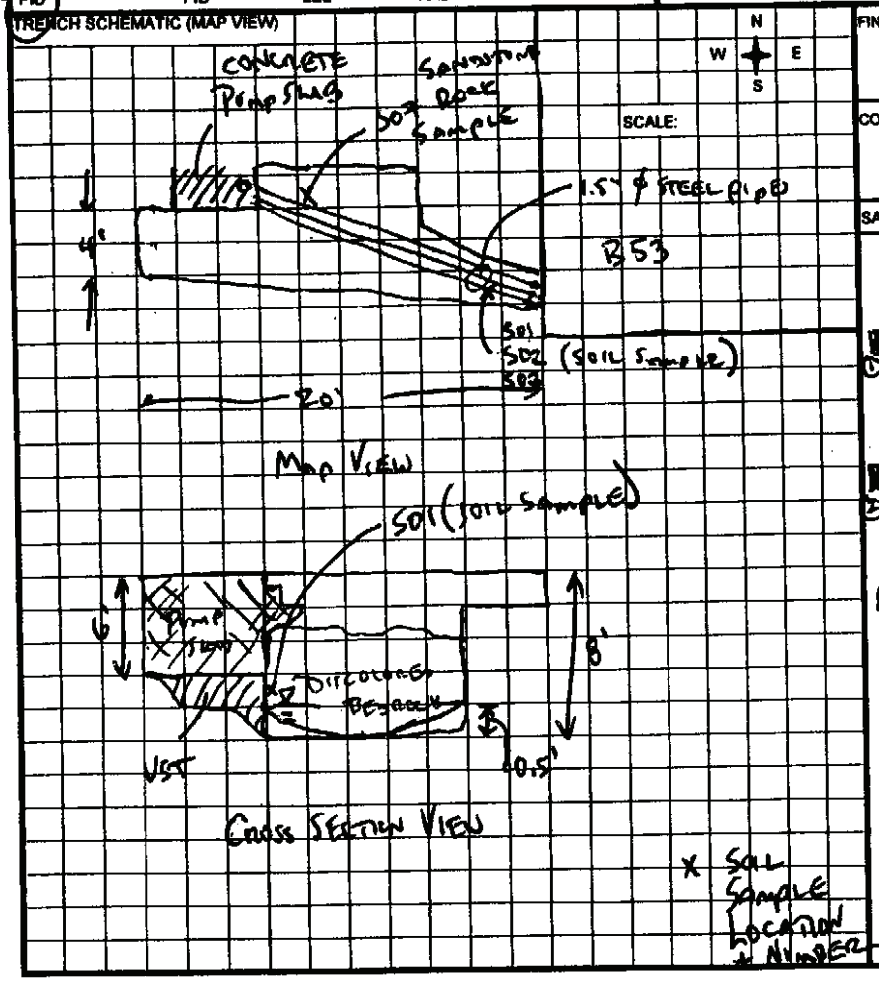
DRILLING

START		FINISH
TIME 1034		TIME 1470
DATE 6/7/99		DATE 6/7/99

LOCATION OF TRENCH



TRENCH SCHEMATIC (MAP VIEW)



FINE GRAINED AND ORGANIC SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, SIZE DISTRIBUTION, PLASTICITY, DRY STRENGTH, DILATANCY, TOUGHNESS, MOISTURE, ODOR, STRUCTURE, CONSISTENCY, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, CONTACT DESCRIPTION

COARSE GRAINED SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, GRADATION (g/s/f), SIZE DISTRIBUTION, PLASTICITY, SHAPE, ANGULARITY, MOISTURE, ODOR, STRUCTURE, CEMENTATION, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, MINERALOGY, CONTACT DESCRIPTION

SAMPLE TYPE: INTERVAL: DESCRIPTION

0-2.5 Fill - Silt / Sandy Silt / Silty Sand - (SM) - 10YR 7/2, VF-F, Low Dry Strength, Low Toughness, No Odor, High K, Strong Contact w/ Underlying Bedrock, (0, SO, SD) Dry

2.5-8' Sandstone Bedrock 5Y 5/2 to 10YR 5/4, Discolored to 5Y 5/2 Near UST, Siliceous, VF Grained, No Structure, HC Odor, Stained on Outer Surfaces, Moderately Fractured, No Bedding PID = 500 - 700 ppm

TD = 8 Feet Bgs Water at 7.5 to 8 Feet Bgs

6/8/99 DTW = 54" Bgs.

① B053TR001-SO4, SO5, SO6 } in UST Fill Material
② B053TR001-SO1, SO2, SO3
③ B053TR001 WO1

BROWN AND CALDWELL

TRENCH LOG

CLIENT: USACE

LOCATION: Building 53

PROJECT NAME: B53 FSIP / TEST PITS

JOB NUMBER: 60701

EXCAVATION CONTRACTOR: Nielson Construction

EXCAVATOR TYPE (CIRCLE ONE): OTHER _____ OTHER _____
BACKHOE HAND SHOVEL

SOIL SAMPLING METHOD (CIRCLE ONE): OTHER Drive Sampler
SPLIT SPOON GRAB NONE

MONITORING INSTRUMENT (CIRCLE ONE): OTHER _____
PID FID LEL RAD NONE

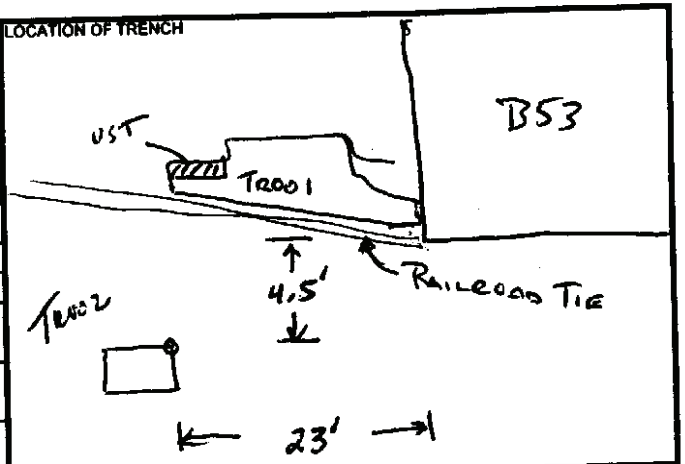
TRENCH NUMBER: 1B053TR002

SHEET 1 OF 1

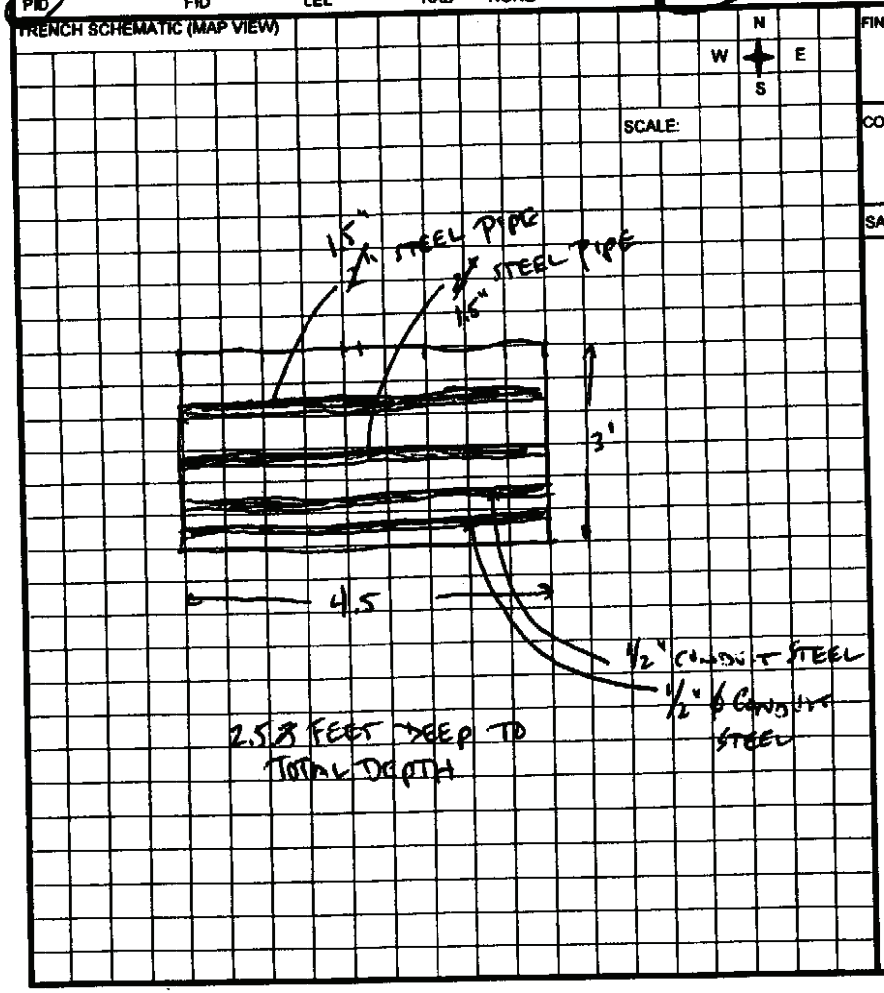
DRILLING	START		FINISH
TIME	1330		1415
DATE	6/7/97		6/7/97

SURFACE CONDITIONS (CIRCLE ONE): OTHER _____
ASPHALT CONCRETE DIRT DRY WET

LOCATION OF TRENCH



TRENCH SCHEMATIC (MAP VIEW)



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SAMPLE TYPE: INTERVAL: DESCRIPTION

0

0-2.5' Fill - 10YR5/4, Sandy Silty Silt, 10YR5/3, Brown, VF grained, Low Dry Strength, Low Toughness, Dry, No odor, Uncons. Dated, High permeability, Blocks & Sandstone (< 6" in size) (0, 70, 70)
PID = 0
TD = 2.5'

5

0

5

0

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BROWN AND CALDWELL

TRENCH LOG

CLIENT: USACE

LOCATION: 9th Jackson ST

PROJECT NAME: B073 FSIP

JOB NUMBER: 00701

EXCAVATION CONTRACTOR: Nielson Construction

EXCAVATOR TYPE (CIRCLE ONE) OTHER: BACKHOE ~~BACKHOE~~ HAND SHOVEL OTHER: ____

SOIL SAMPLING METHOD (CIRCLE ONE) OTHER: Drive Sampler

SPLIT SPOON GRAB NONE

MONITORING INSTRUMENT (CIRCLE ONE) OTHER: ____

~~PID~~ FID LEL RAD NONE

TRENCH NUMBER: B073TR001

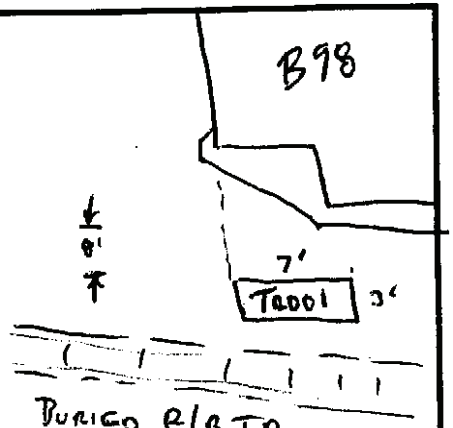
SHEET 1 OF 1

DRILLING	START	FINISH
TIME	1300	1430
DATE	6/10/99	6/10/99

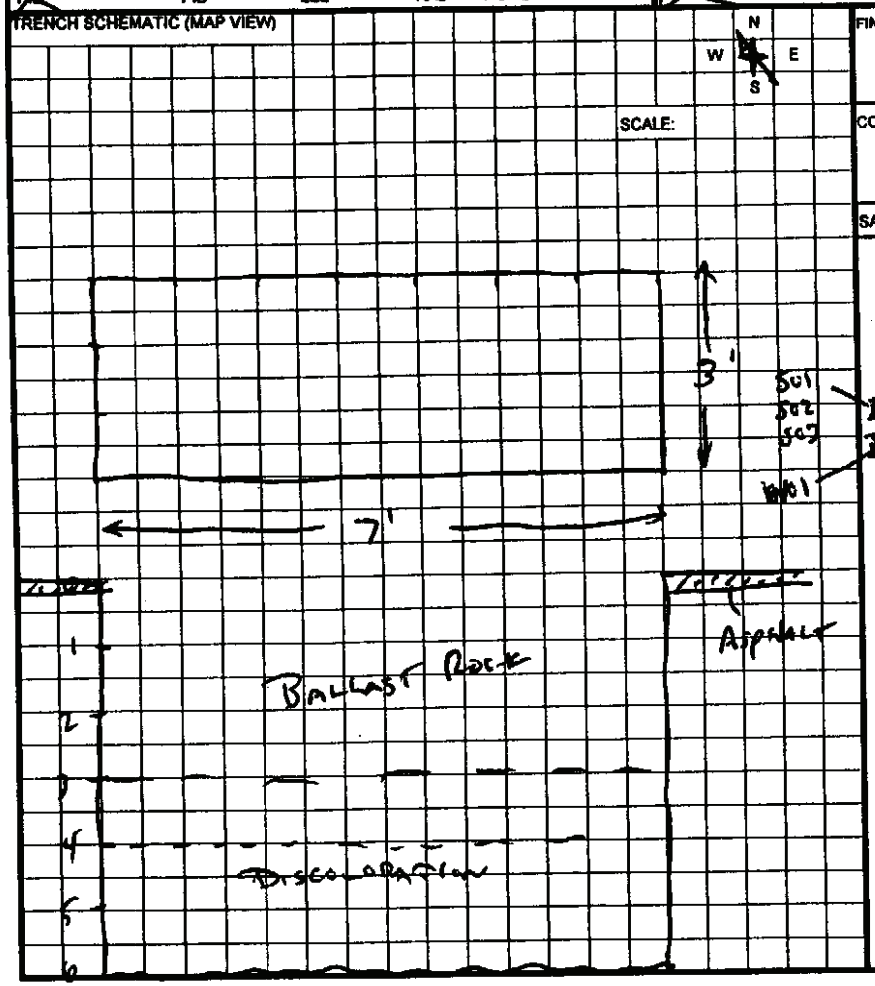
SURFACE CONDITIONS (CIRCLE ONE) OTHER: ____

~~ASPHALT~~ CONCRETE DIRT ~~DRY~~ WET

LOCATION OF TRENCH



TRENCH SCHEMATIC (MAP VIEW)



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COARSE GRAINED SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, GRADATION (g/s/f), SIZE DISTRIBUTION, PLASTICITY, SHAPE, ANGULARITY, MOISTURE, ODOR, STRUCTURE, CEMENTATION, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, MINERALOGY, CONTACT DESCRIPTION 10,20 70

SAMPLE TYPE: INTERVAL: DESCRIPTION

0 – 2" ASPHALT

2" – 3' FILL - BALLAST ROCK FOR RAILROAD TRACKS SILTY GRAVEL (GW) 10yr 5/4, BRN, GAP GRADED, 2" – 1" IN SIZE ANGULAR GRAVEL W/ SILTY MATRIX, DRY, NO ODOR, UNCONSOLIDATED, HIGH K, SHARP LOWER CONTACT (70, 5, 25)

3' – 6' SILTY CLAY W/ GRAVEL (CL) - 10yr 5/4 TO 5GY 5/1 (GRNISH GRAY) BELOW 4 FT BGS (FILL) WOOD FRAGMENTS, LOW - MED PLASTICITY, LOW DRY STRENGTH, SLOW DILATANCY, MOIST TO WET BELOW @ 5 FT BGS, UNCONSOLIDATED, LOW - MED K, LENSES OF SANDIER CLAY AT @ 5 FEET WITHIN, PERCOLATING IN READILY WATER

NOT SURE IF WATER AT 5 FEET IS WATER TABLE OR PERCHED WATER

TD - 6 FEET BGS

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BROWN AND CALDWELL

TRENCH LOG

CLIENT: USACE

LOCATION: 900 Jackson Street

PROJECT NAME: B103

JOB NUMBER: 00701

EXCAVATION CONTRACTOR: Nielson Construction

EXCAVATOR TYPE (CIRCLE ONE): ~~BACKHOE~~ HAND SHOVEL OTHER OTHER

SOIL SAMPLING METHOD (CIRCLE ONE): SPLIT SPOON GRAB ~~NONE~~ OTHER

MONITORING INSTRUMENT (CIRCLE ONE): ~~PID~~ FID LEL RAD NONE OTHER

TRENCH NUMBER: B103TR001

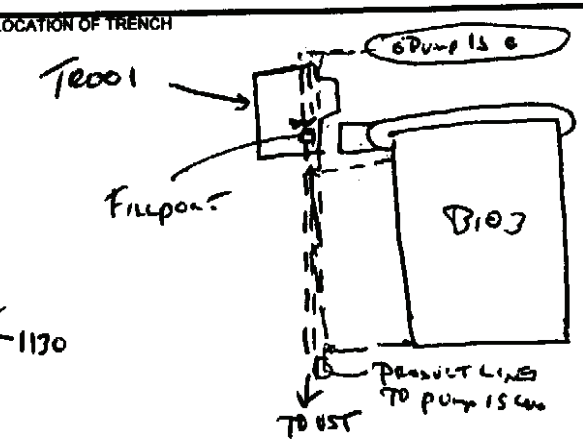
SHEET 1 OF 1

DRILLING

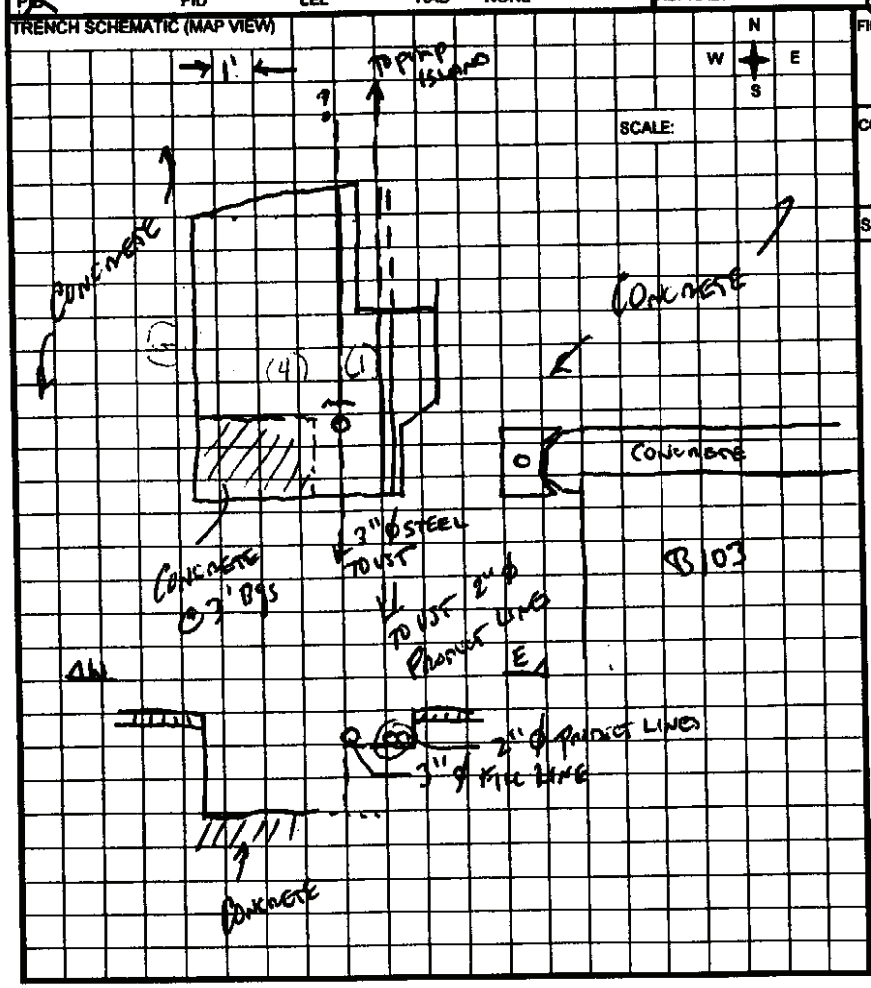
START		FINISH
TIME 1100		TIME ~~1115~~ 1130
DATE 6/10/99		DATE 6/10/99

SURFACE CONDITIONS (CIRCLE ONE): ASPHALT ~~CONCRETE~~ DIRT ~~GRAVEL~~ WET OTHER

LOCATION OF TRENCH



TRENCH SCHEMATIC (MAP VIEW)



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COARSE GRAINED SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, GRADATION (g/s/f), SIZE DISTRIBUTION, PLASTICITY, SHAPE, ANGULARITY, MOISTURE, ODOR, STRUCTURE, CEMENTATION, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, MINERALOGY, CONTACT DESCRIPTION

SAMPLE TYPE: INTERVAL: DESCRIPTION

0-6" CONCRETE

6" - 3 FEET GRAVELLY SILT (ML) - 10YR 5/4, BRN. FILL, VF-CSE, GRAVEL ~6" INSIZE, UNCONSOLIDATED, SOME SAND (VF-F), LOW DRY STRENGTH, LOW-MOD K. (10, 10, 80)

TD = 3 FEET

0
5
0
5
0

BROWN AND CALDWELL

TRENCH LOG

CLIENT: USACE

LOCATION: 900 Jackson Street

PROJECT NAME: B103

JOB NUMBER: 00701

EXCAVATION CONTRACTOR: Nielsen Construction

EXCAVATOR TYPE (CIRCLE ONE) OTHER: ~~BACKHOE~~ HAND SHOVEL OTHER: _____

SOIL SAMPLING METHOD (CIRCLE ONE) OTHER: ~~Dames Sampler~~ None

SPLIT SPOON GRAB

MONITORING INSTRUMENT (CIRCLE ONE) OTHER: _____

~~PID~~ FID LEL RAD NONE

SURFACE CONDITIONS (CIRCLE ONE) OTHER: _____

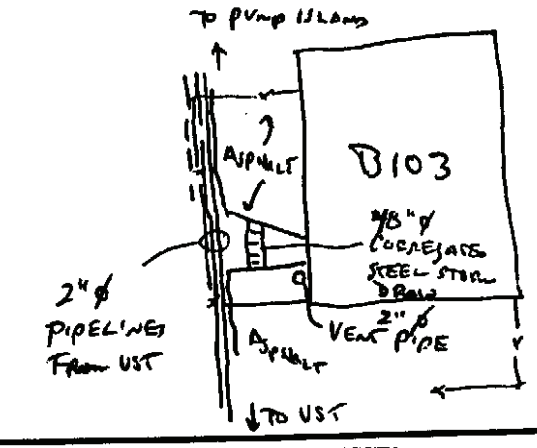
~~ASPHALT~~ CONCRETE DIRT ~~DRY~~ WET

TRENCH NUMBER: B103T0002

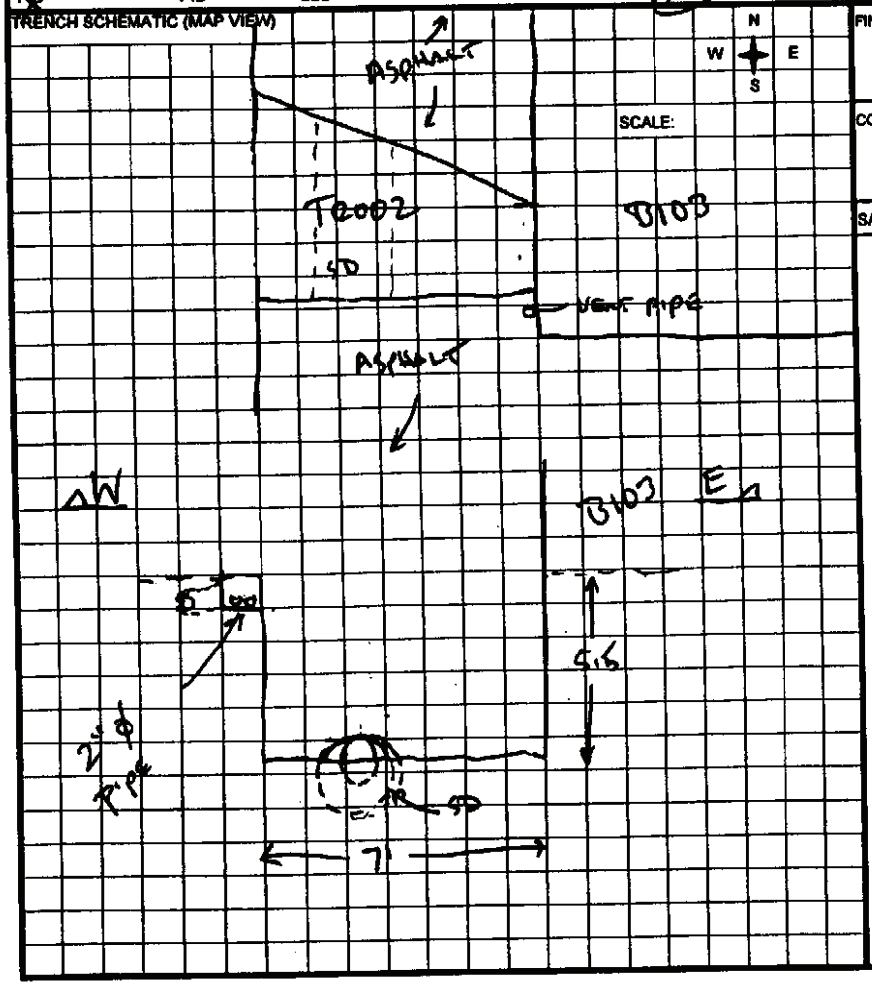
SHEET 1 OF 1

DRILLING	START	FINISH
TIME	0930	1100
DATE	6/10/99	6/10/99

LOCATION OF TRENCH



TRENCH SCHEMATIC (MAP VIEW)



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SAMPLE TYPE: INTERVAL: DESCRIPTION

0 – 0 – 2" Asphalt

2" – 5.5' Sandy Silt (ML) - 10 YR 5/4, Reddish Brn, (Fill) gravelly @ 2" – 1.5 Feet, VFGSN, Low Dry Strength, Low Toughness, Dry, No Odor (0 ppm) Low-Mod K (5, 30, 75)

TD = 5.5 Feet Bgs

BROWN AND CALDWELL

TRENCH LOG

CLIENT: USACE

LOCATION: 900 Jackson St

PROJECT NAME: B103 Test Pits

JOB NUMBER: 00701

EXCAVATION CONTRACTOR: Nielson Construction

EXCAVATOR TYPE (CIRCLE ONE): BACKHOE HAND SHOVEL OTHER OTHER

SOIL SAMPLING METHOD (CIRCLE ONE): SPLIT SPOON GRAB OTHER Drive Sampler NONE

MONITORING INSTRUMENT (CIRCLE ONE): PID FID LEL RAD NONE OTHER

TRENCH NUMBER: B103TR003

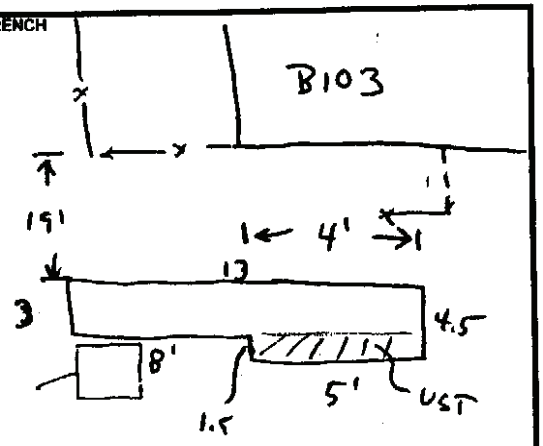
SHEET 1 OF 1

DRILLING

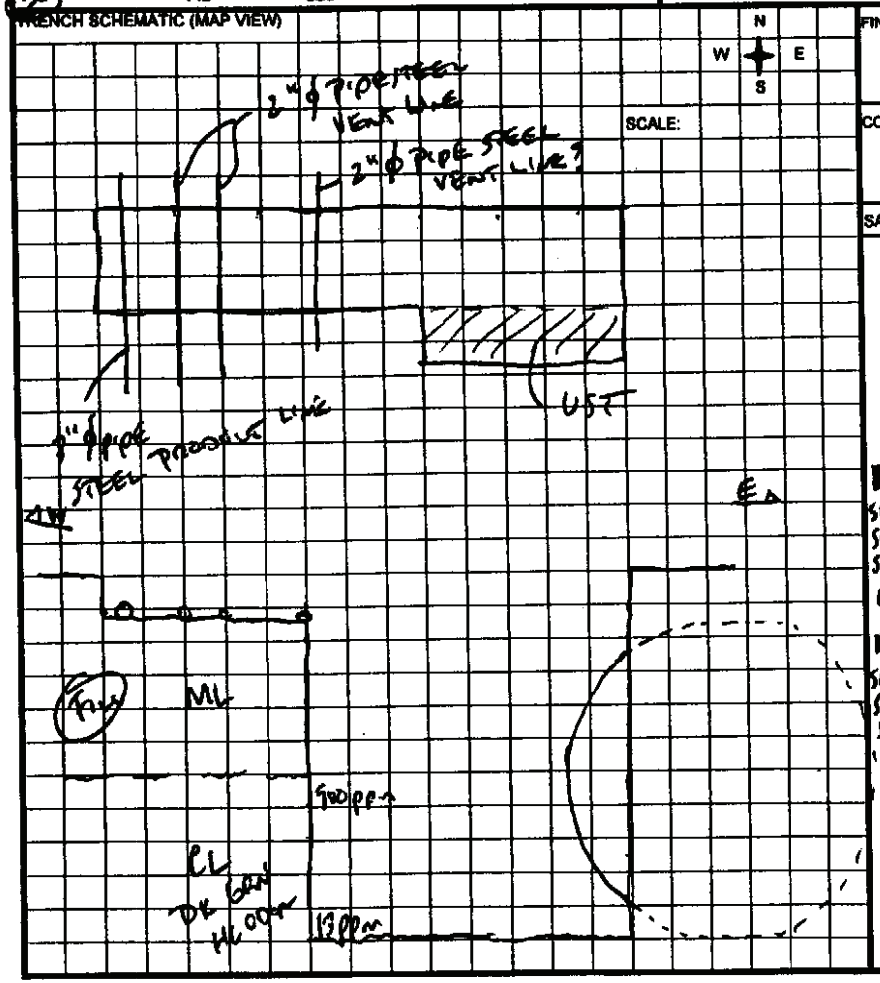
START	FINISH
TIME 0810	TIME 0920
DATE 6/10/99	DATE 6/10/99

SURFACE CONDITIONS (CIRCLE ONE): ASPHALT CONCRETE DIRT DRY WET OTHER

LOCATION OF TRENCH



TRENCH SCHEMATIC (MAP VIEW)



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COARSE GRAINED SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, GRADATION (g/s/l), SIZE DISTRIBUTION, PLASTICITY, SHAPE, ANGULARITY, MOISTURE, ODOR, STRUCTURE, CEMENTATION, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, MINERALOGY, CONTACT DESCRIPTION (10,20,70)

SAMPLE TYPE: INTERVAL: DESCRIPTION (5,10,BS)

0 – 6' FILL, GRAVELLY SILT (ML) - 10 YR 5/4 YELLOWISH BRN WITH SOME VF-MED SAND, PIECES OF BRICK, LOW DRY STRENGTH, LOW TOUGHNESS, DRY, NO ODOR, UNCONSOLIDATED, LOW-MED K (10,20,70)

6 – 11' GRAVELLY SANDY CLAY (CL) - 10 GY 4/1 DK GREENISH GRAY, VF, LOW-MED PLASTICITY, LOW DRY STRENGTH, SLOW DIL, MOIST, STRONG HC ODOR (900 ppm) TO SLIGHT HC ODOR AT 11 FEET BGS, LOW K, (5,10,BS), GRAVEL < 2" IN SIZE

TD = 11 FEET BGS NO GW

BROWN AND CALDWELL

TRENCH LOG

CLIENT: USACE

LOCATION: LINCOLN ST

PROJECT NAME: B53, B73, B103, B154 TEST PITS

JOB NUMBER: 00701

EXCAVATION CONTRACTOR: NIELSON CONSTRUCTION

EXCAVATOR TYPE (CIRCLE ONE): BACKHOE HAND SHOVEL OTHER OTHER

SOIL SAMPLING METHOD (CIRCLE ONE): SPLIT SPOON GRAB OTHER DRIVE SAMPLER NONE

MONITORING INSTRUMENT (CIRCLE ONE): PID FID LEL RAD NONE OTHER

SURFACE CONDITIONS (CIRCLE ONE): ASPHALT CONCRETE DIRT GRASS WET OTHER

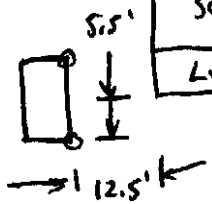
TRENCH NUMBER: B154TR001

SHEET 1 OF 1

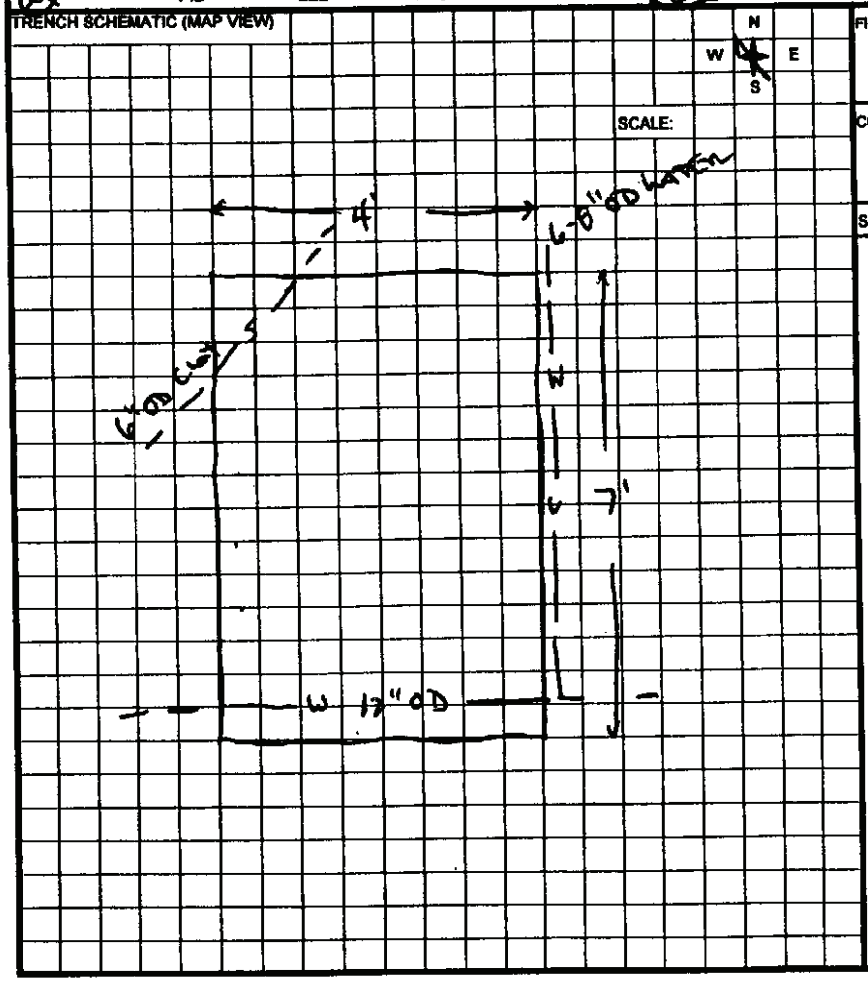
DRILLING

START	FINISH
TIME 0810	TIME 1000
DATE 6/9/99	DATE 6/9/99

LOCATION OF TRENCH: B56A SW CORNER LOADING DOCK



TRENCH SCHEMATIC (MAP VIEW)



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SAMPLE TYPE: INTERVAL: DESCRIPTION

0 - 2" ASPHALT

2" - 2.0 SILTY SAND (SM) - 7.5 YR 4/3, BROWN, (FILL) VF-F GRAINED, LOW DRY STRENGTH, LOW TOUGHNESS, NO HC ODOR (0.0 PPM), ~~UNCONS~~ - UNCONSOLIDATED, (FILL) GRAVELLY (<6" IN SIZE) SANDSTONE, FCW PIECES OF BRICK ~~(10, 30, 70)~~ (10, 50, 40)

2.0 - 4 SILTY CLAY (CL) - 10 Y 2.5/4, MED BROWN, (FILL) VF GRAINED, GRAVELLY (<6" IN SIZE) BLOCK & SANDSTONE, LOW-MOD PLASTICITY, NO DILATANCY, LOW DRY STRENGTH, MOD TOUGHNESS, NO ODOR, UNCONSOLIDATED, LOW PERMEABILITY (20, 20, 60)

TD = 4 FEET ∇ WATER AT 4 FEET BGS.

BROWN AND CALDWELL

TRENCH LOG

CLIENT: VSACE

LOCATION: LINCOLN STREET

PROJECT NAME: B154 FSIP

JOB NUMBER: 00701

EXCAVATION CONTRACTOR: NIELSON CONSTRUCTION

EXCAVATOR TYPE (CIRCLE ONE): OTHER OTHER _____
BACKHOE HAND SHOVEL

SOIL SAMPLING METHOD (CIRCLE ONE): OTHER Drive Sampler
SPLIT SPOON GRAB NONE

MONITORING INSTRUMENT (CIRCLE ONE): OTHER _____
PID FID LEL RAD NONE

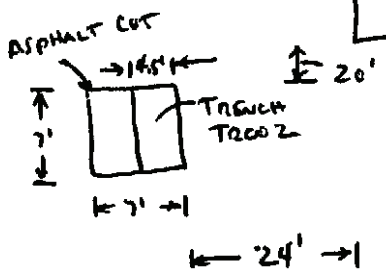
SURFACE CONDITIONS (CIRCLE ONE): OTHER _____
ASPHALT CONCRETE DIRT DRY WET

TRENCH NUMBER: B154TR002

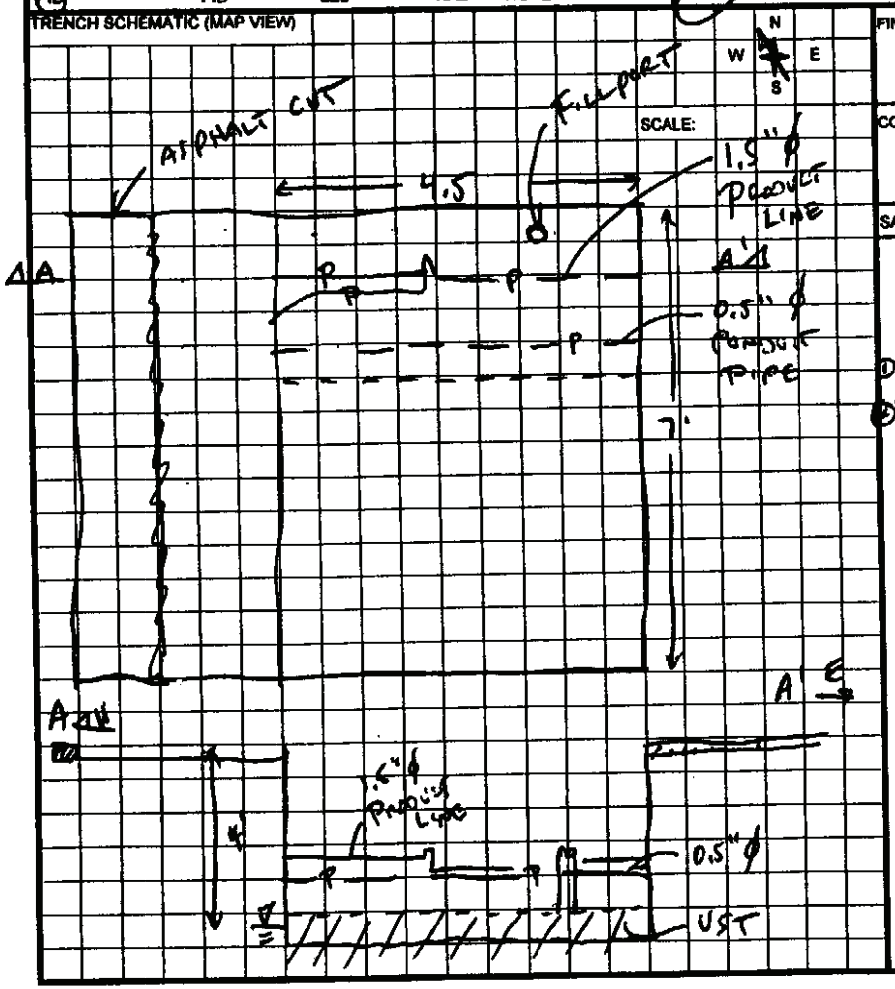
SHEET 1 OF 1

DRILLING	START	FINISH
TIME	1220	1350
DATE	6/8/99	6/8/99

LOCATION OF TRENCH: B56A SW CORNER



TRENCH SCHEMATIC (MAP VIEW)



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SAMPLE TYPE: INTERVAL: DESCRIPTION

0

0-2" ASPHALT

2"-1.5' FILL GRAVELLY SANDY SILT (ML) - 10 GY 4/1, DARK GREENISH GRAY, LOW PLASTICITY, LOW DRY STRENGTH, SLOW DILATANCY, MOIST, MOD TO STRONG HC ODOR, PID = 600 PPM, UNCONSOLIDATED MODERATE K (20, 20, 60)

1.5-4.5 SILTY CLAY (CL) 10 GY 4/1, DK GRNISH GRAY, GRAVELLY, SANDSTONE FRAGMENTS (< 6" IN SIZE) SAND - SUBROUND FIX, VF GRN, LOW-MED PLASTICITY, LOW TOUGHNESS, MOIST TO SATURATED, BLOCKY, MOD - STRONG HC ODOR (600 PPM), LOW-MOD K, (10, 20, 70)

5

TD = 4.5 FEET DTW = 4 FT BGS

10

① B154TR002-S01, S02, S03

② B154TR002-U01

5

0

BROWN AND CALDWELL

TRENCH LOG

CLIENT: VSACE

LOCATION: LINCOLN STREET

PROJECT NAME: BISH FSIP

JOB NUMBER: 00701

EXCAVATION CONTRACTOR: NIELSON CONSTRUCTION

EXCAVATOR TYPE (CIRCLE ONE): BACKHOE HAND SHOVEL OTHER OTHER

SOIL SAMPLING METHOD (CIRCLE ONE): SPLIT SPOON GRAB OTHER DRIVE SAMPLER NONE

MONITORING INSTRUMENT (CIRCLE ONE): PID FID LEL RAD OTHER NONE

SURFACE CONDITIONS (CIRCLE ONE): ASPHALT CONCRETE DIRT DRY WET OTHER

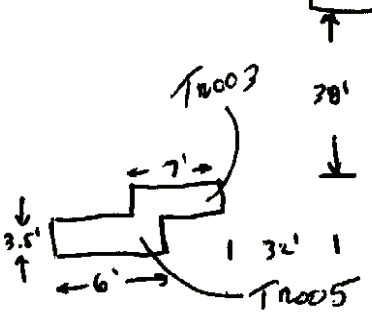
TRENCH NUMBER: BISHTR003 / BISHTR005

SHEET 1 OF 1

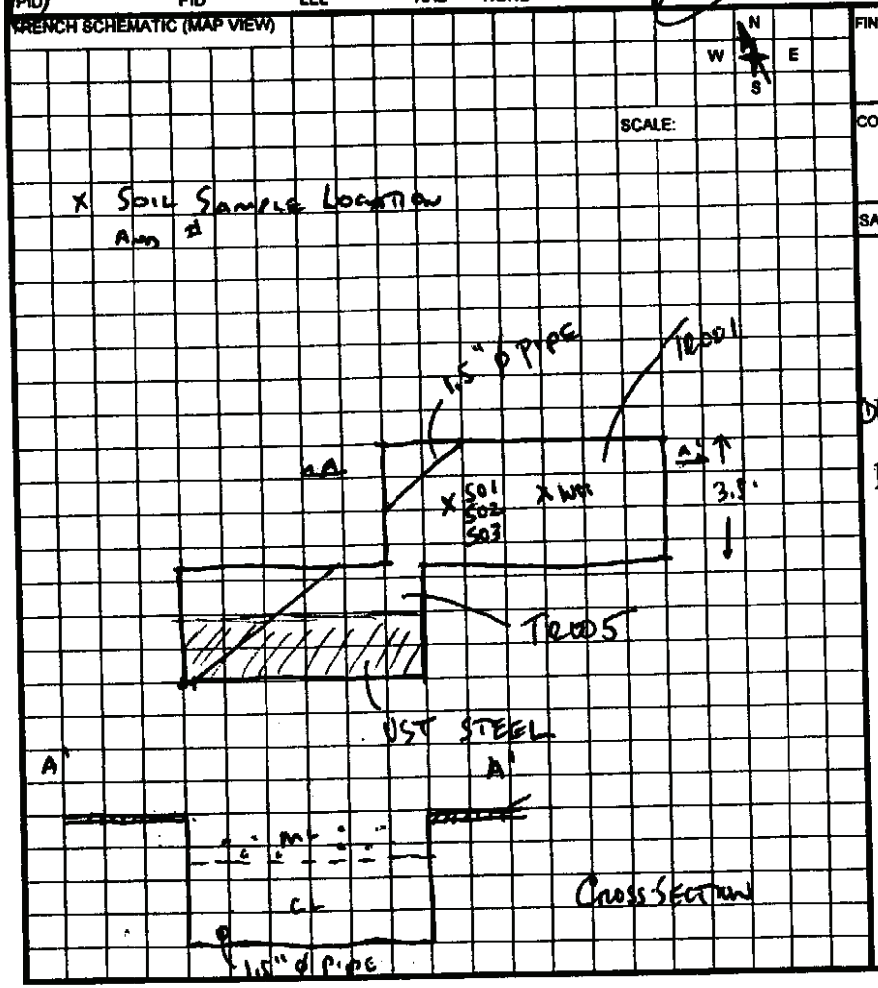
DRILLING

START		FINISH
TIME 0750		TIME 1000
DATE 6/8/99		DATE 6/8/99

LOCATION OF TRENCH: B56A SW CORNER



TRENCH SCHEMATIC (MAP VIEW)



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COARSE GRAINED SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, GRADATION (gr/s/f), SIZE DISTRIBUTION, PLASTICITY, SHAPE, ANGULARITY, MOISTURE, ODOR, STRUCTURE, CEMENTATION, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, MINERALOGY, CONTACT DESCRIPTION

SAMPLE TYPE: INTERVAL: DESCRIPTION

0-2" ASPHALT GRAVELLY
2" - FILL CLAYEY SANDY SILT (ML) - 10 YR 4/1, DK GRNISH GRAY, 1.5' VF GRN, LOW PLASTICITY FINES, LOW DRY STRENGTH, SLOW DILATANCY, MOIST STRONG HC ODOR, PID: 1600 PPM, UNCONSOLIDATED, MOD CMTD K. (20, 20, 60) GRAVEL, ANGULAR (2)

~~UNCONS.~~
~~FILL~~
1.5-6' SILTY CLAY (CL) - 10 YR 4/1, DK GRNISH GRAY, GRAVELLY W/ SANDSTONE FRAGMENTS (<6" IN SIZE), ANGULAR CX, VF GRAINED, LOW-MED PLASTICITY, LOW ~~DRY~~ - MOD DS, MOD DILATANCY, MOIST, STRONG HC ODOR (1600 - 1600 PPM). (10, 20, 70)

SANDSTONE BOULDER (1-2' WIDE) AT BOTTOM OF NORTHERN SECTION OF TRENCH

TD = 6 FEET DTW = 6 FEET BGS

(1) BISHTR003 - SO1, SO2, SO3
(2) BISHTR003 - WO1

BROWN AND CALDWELL

TRENCH LOG

CLIENT: USACE

LOCATION: LINCOLN STREET

PROJECT NAME: B154

JOB NUMBER: 00701

EXCAVATION CONTRACTOR: NIELSON CONSTRUCTION

EXCAVATOR TYPE (CIRCLE ONE) OTHER: OTHER _____
BACKHOE HAND SHOVEL

SOIL SAMPLING METHOD (CIRCLE ONE) OTHER: _____
SPLIT SPOON GRAB NONE

MONITORING INSTRUMENT (CIRCLE ONE) OTHER: _____
PID FID LEL RAD NONE

SURFACE CONDITIONS (CIRCLE ONE) OTHER: _____
ASPHALT CONCRETE DIRT DRY WET

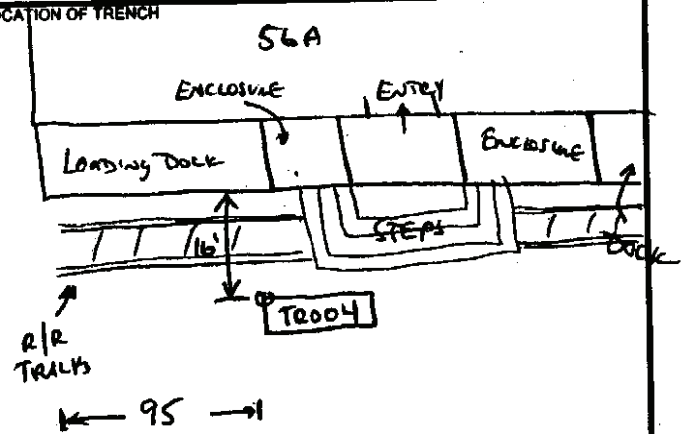
TRENCH NUMBER: B154TR004

SHEET 1 OF 1

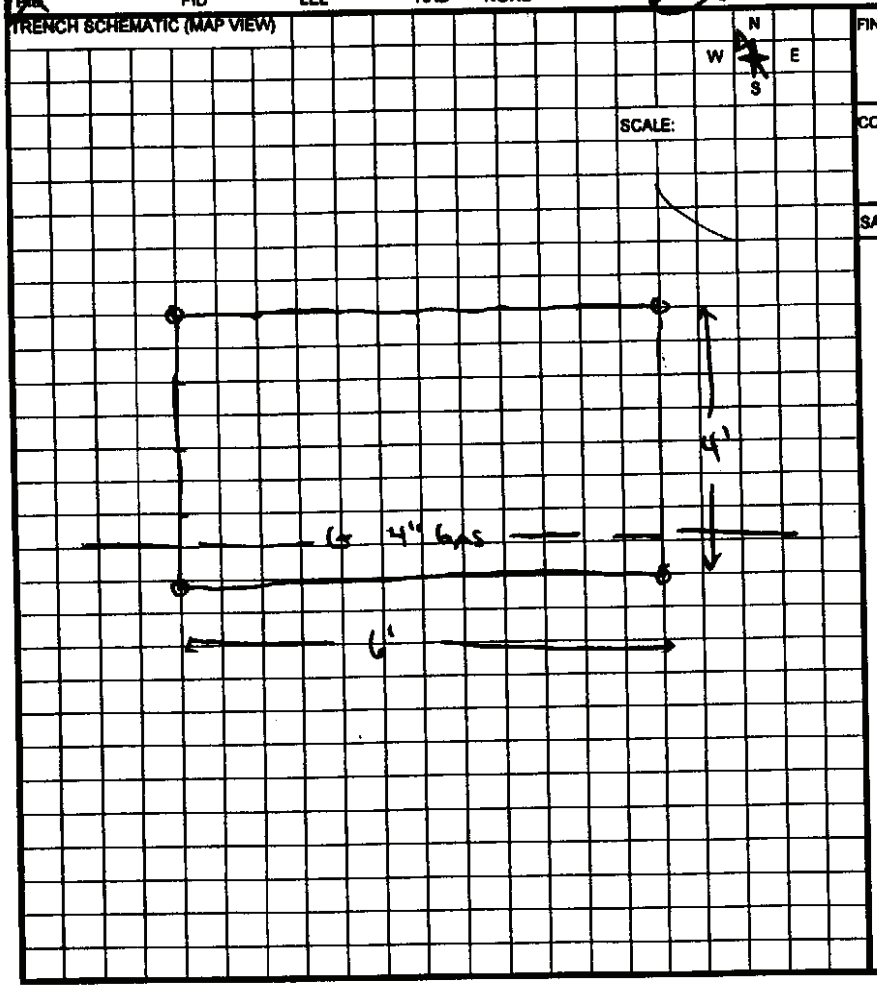
DRILLING

START	FINISH
TIME 1510	TIME 1416 10
DATE 6/9/99	DATE 6/9/99

LOCATION OF TRENCH



TRENCH SCHEMATIC (MAP VIEW)



FINE GRAINED AND ORGANIC SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, SIZE DISTRIBUTION, PLASTICITY, DRY STRENGTH, DILATANCY, TOUGHNESS, MOISTURE, ODOR, STRUCTURE, CONSISTENCY, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, CONTACT DESCRIPTION

COARSE GRAINED SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, GRADATION (g/s/f), SIZE DISTRIBUTION, PLASTICITY, SHAPE, ANGULARITY, MOISTURE, ODOR, STRUCTURE, CEMENTATION, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, MINERALOGY, CONTACT DESCRIPTION

SAMPLE TYPE: INTERVAL: DESCRIPTION

0 - 4" ASPHALT

4" - 3' FILL UNCONSOLIDATED GRAVELLY SANDY SILT (ML), 10 YR 5/4 YELLOWISH BRN TO 5 Y 5/2 REDDISH BRN, 10-20% ANGULAR BALLAST ROCK, 20-30% VF-MED FILL SAND, 40-50% SILT, LOOSE, MOD - HIGH K (20, 20, 60)

TD = 3 FEET BGS

BROWN AND CALDWELL

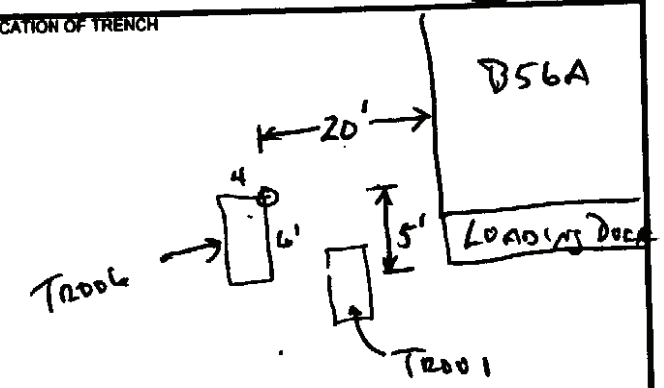
TRENCH LOG

CLIENT: USACE
LOCATION: LINCOLN ST.
PROJECT NAME: B154
JOB NUMBER: 00701
EXCAVATION CONTRACTOR: NIELSON CONSTRUCTION
EXCAVATOR TYPE (CIRCLE ONE): BACKHOE HAND SHOVEL OTHER OTHER
SOIL SAMPLING METHOD (CIRCLE ONE): SPLIT SPOON GRAB OTHER DRIVE SAMPLER NONE
MONITORING INSTRUMENT (CIRCLE ONE): PID FID LEL RAD NONE OTHER
SURFACE CONDITIONS (CIRCLE ONE): ASPHALT CONCRETE DIRT DRY WET OTHER

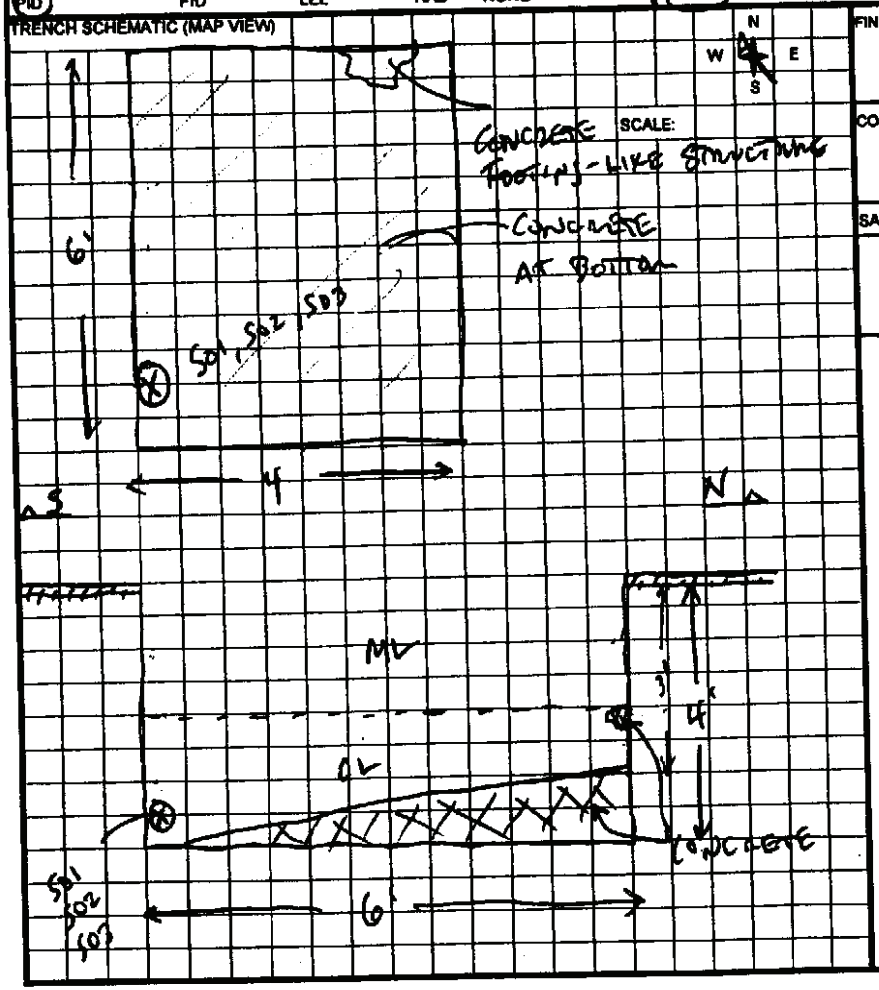
TRENCH NUMBER: B154TR006
SHEET 1 OF 1
DRILLING

START	FINISH
TIME 1010	TIME 1200
DATE 6/9/99	DATE 6/9/99

LOCATION OF TRENCH



TRENCH SCHEMATIC (MAP VIEW)



FINE GRAINED AND ORGANIC SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, SIZE DISTRIBUTION, PLASTICITY, DRY STRENGTH, DILATANCY, TOUGHNESS, MOISTURE, ODOR, STRUCTURE, CONSISTENCY, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, CONTACT DESCRIPTION

COARSE GRAINED SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, GRADATION (g/s/f), SIZE DISTRIBUTION, PLASTICITY, SHAPE, ANGULARITY, MOISTURE, ODOR, STRUCTURE, CEMENTATION, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, MINERALOGY, CONTACT DESCRIPTION

SAMPLE TYPE: INTERVAL: DESCRIPTION

0
0-2" ASPHALT
2"-2' GRAVELLY SANDY SILT (ML) - 10 YR 5/4 BROWN, UNCONSOLIDATED FILL, VF-CSE GRAINED, LOW PLASTICITY, LOW STRENGTH, DRY, SLIGHT HC ODOR NEAR 2 FEET BGS, LOW K (20, 30, 50) PIECES OF BRICK
5
2-4' SILTY CLAY / CLAY (ML CH) 5Y 5/3, GRAYISH GRAY, VF GRAINED, MOD PLASTICITY TO HIGH, LOW STRENGTH, SLOW DILATANCY, LOW TOUGHNESS TO MODERATE, MOIST, HC ODOR (200 ppm) UNCONSOLIDATED, SOME GRAVEL, BRICK, CONCRETE (20, 20, 60)
0
UNDERLYING FILL MATERIALS.
5
TD = 4 FEET BGS
NO W ENCOUNTERED DUE TO CONCRETE
0

BROWN AND CALDWELL

TRENCH LOG

CLIENT: USACE

LOCATION: LINCOLN STREET

PROJECT NAME: B154

JOB NUMBER: 00701

EXCAVATION CONTRACTOR: NIELSON EXCAVATION CONSTRUCTION

EXCAVATOR TYPE (CIRCLE ONE): BACKHOE HAND SHOVEL OTHER OTHER

SOIL SAMPLING METHOD (CIRCLE ONE): SPLIT SPOON GRAB NONE OTHER Drive Sample

MONITORING INSTRUMENT (CIRCLE ONE): PID FID LEL RAD NONE OTHER

SURFACE CONDITIONS (CIRCLE ONE): ASPHALT CONCRETE DIRT DRY WET OTHER

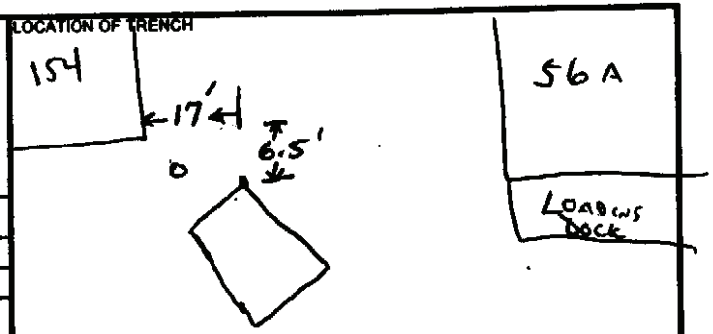
TRENCH NUMBER: B154TN007

SHEET 1 OF 1

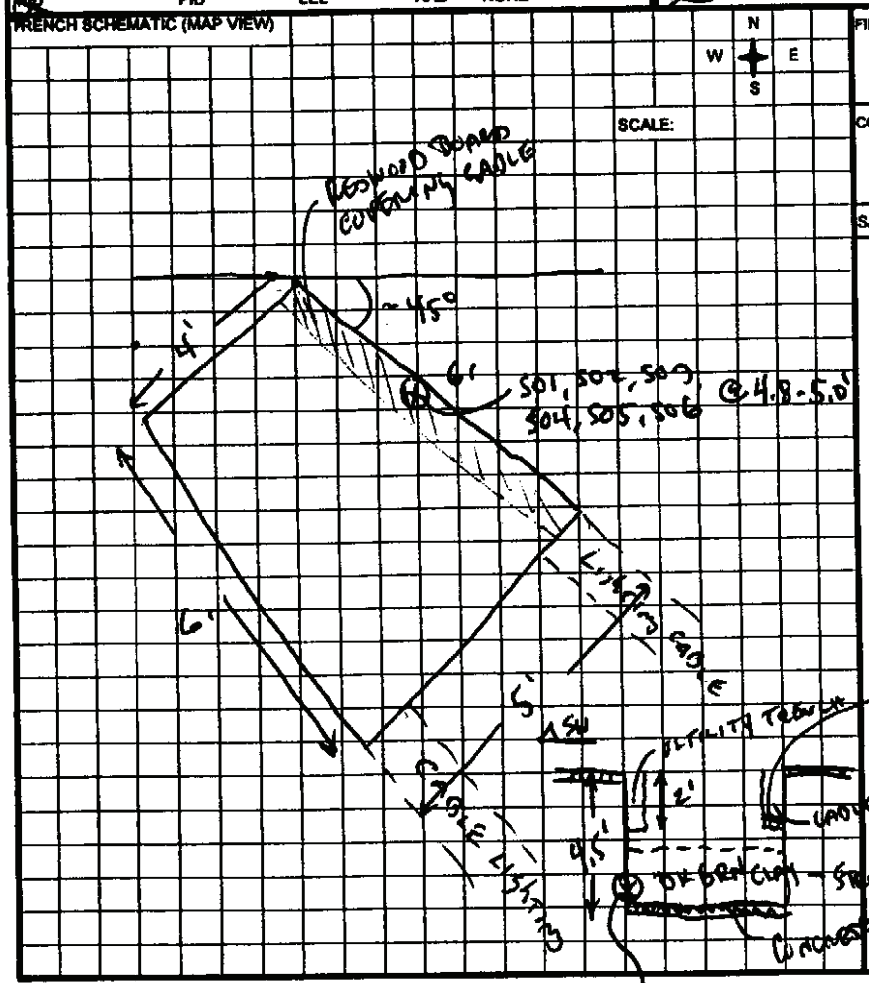
DRILLING

START	FINISH
TIME 1230	TIME 1500
DATE 6/9/99	DATE 6/9/99

LOCATION OF TRENCH



TRENCH SCHEMATIC (MAP VIEW)



FINE GRAINED AND ORGANIC SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, SIZE DISTRIBUTION, PLASTICITY, DRY STRENGTH, DILATANCY, TOUGHNESS, MOISTURE, ODOR, STRUCTURE, CONSISTENCY, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, CONTACT DESCRIPTION

COARSE GRAINED SOIL DESCRIPTION: GROUP NAME, MUNSELL COLOR, COLOR, GRADATION (g/s/f), SIZE DISTRIBUTION, PLASTICITY, SHAPE, ANGULARITY, MOISTURE, ODOR, STRUCTURE, CEMENTATION, RELATIVE PERMEABILITY, LOCAL GEOLOGIC NAME, MINERALOGY, CONTACT DESCRIPTION

SAMPLE TYPE: INTERVAL: DESCRIPTION

0-3" ASPHALT

3" - 2' GRAVELLY SANDY SILT (ML) - 10YR 5/4, BRN, VF-CSE, LOW DRY STRENGTH, LOW TOUGHNESS, DRY, SLIGHT TO MODERATE HC ODOR, UNCONSOLIDATED (FILL), LOW TO MOD K, (10, 20, 70)

2' - 4.5' SILTY CLAY / CLAY W/ GRAVEL (CL) - 5BY 5/1, DK BRN, LOW - MOD PLASTICITY, NONE - SLOW DILATANCY, MOIST TO WET AT 4.5', OVERLYING CONCRETE SURFACE

TD = 4.5

V @ 4.5' ±

VERY STRONG HC ODOR (2600 - 3200 ppm)

REDWOOD BOARD

TRENCH BACKFILLED WITH SAND FILL

HC ODOR (2600 ppm - 3200 ppm)

APPENDIX B

APRIL 2, 1999 NORCAL GEOPHYSICAL CONSULTANTS SURVEY OF BUILDINGS 53, 73 AND 154

NORCAL GEOPHYSICAL CONSULTANTS, INC.

LETTER OF TRANSMITTAL

TO: Brown and Caldwell
9616 Micron Avenue, Suite 600
Sacramento, CA 95827-2627

ATTN: Mr. Dave Zuber

REF: Geophysical Survey
Benicia Arsenal Environmental Restoration Project, Benicia, CA

VIA: MAIL: REG:( )2ND:(X)EXP:( )**UPS:(X)**AIRBRN:( )FED.X:( )DELIVERED:( )

ENCLOSED PLEASE FIND THE FOLLOWING/COMMENTS:

Two (2) copies of final report for the above referenced work.

BY: Donald J. Kirker

DATE: April 2, 1999

REGIONAL OFFICE
17151 NEWHOPE ST., SUITE 101 • FOUNTAIN VALLEY, CA 92708
TELEPHONE (714) 708-7727 • FAX (714) 708-7720

CORPORATE OFFICE
1350 INDUSTRIAL AVENUE, SUITE A • PETALUMA, CA 94952
TELEPHONE (707) 763-1312 • FAX (707) 762-5587

NORCAL GEOPHYSICAL CONSULTANTS, INC.

April 2, 1999

Mr. Dave Zuber
Brown and Caldwell
9616 Micron Avenue, Suite 600
Sacramento, CA 95827-2627

Dear Mr. Zuber:

Geophysical investigations were performed by NORCAL Geophysical Consultants, Inc. at the Benicia Arsenal Environmental Restoration project in Benicia, California. These investigations were conducted under the guidelines presented in Brown and Caldwell's scope of work, Task Order 1, Exhibit A, dated December 31, 1998, and the Revisions to Task Order 1, Exhibit A, dated February 22, 1999. As stated in Revisions to Task Order 1, Exhibit A, the scope of work for this project will be conducted in two phases. Phase 1 consists of geophysical surveys at Buildings 98 (former Bldg. 73), 53, 56A,103, and 154. Phase 2 will consist of geophysical surveys at Buildings 55 through 59, 65, and 66. The Phase 2 work will also include subsurface investigations at seven proposed soil boring locations.

This report presents the findings of the Phase 1 investigation. The field survey for Phase 1 was performed on March 15 and 16, 1999 by NORCAL Geophysicist Donald J. Kirker and Geophysical Technician Lee S. Hurvitz. Logistical support was provided by Brown and Caldwell personnel Wendy Linck, and Paul E. Lopez. All geophysical work performed at the Benicia Arsenal was governed by the Brown and Caldwell Quality Assurance Program Plan (QAPP) dated February 1999.

MODIFICATION TO SCOPE OF WORK

The Brown and Caldwell scope of work for Phase 1 includes geophysical surveys at Buildings 98 (former Bldg. 73), 53, 56A,103, and 154. However, changes were made to this scope by Brown and Caldwell regarding the investigations at Buildings 98 (former Bldg. 73), and 103. At Building 98, the survey area comprises both the exterior and interior portions of the southwest corner of the building. Inside of the building, heavy equipment and machinery are located within the survey area. This equipment precluded access to the interior portion of the site. As specified by Brown and Caldwell, investigations within Building 98 were omitted from the scope. At Building 103, large amounts of surface debris were scattered throughout the survey area. This debris precluded access to the survey area. As specified by Brown and Caldwell, geophysical investigations at Building 103 will be conducted during the Phase 2 investigations. In addition, Brown and Caldwell specified that we conduct surveys at three of the seven proposed boring locations originally included in the Phase 2 investigations.

A summary of the revised Brown and Caldwell scope of work for the Phase 1 investigation is presented below:

- Conduct geophysical investigations outside of and adjacent to the southwest corner of Building 98 (former Bldg. 73).

- Conduct geophysical investigations east and southeast of Building 154.
- Conduct investigations south of Building 56A.
- Investigate the interior of the southeast corner of Building 56A, and the exterior portion extending from Building 56A to Building 53.
- Investigate three proposed boring locations.

PURPOSE

Information, provided by Brown and Caldwell, indicates that underground storage tanks (UST's), cisterns, and dip tanks were used for various industrial purposes at Buildings 98 (former Bldg.73), 53, 56A, and 154. However, records are incomplete regarding the existence or exact location of these below ground features. Therefore, the purpose of the geophysical investigation is to obtain subsurface information that will aid in determining the location and extent of these various subsurface features within each survey area.

For the proposed boring site surveys, the purpose is to locate detectable utilities and subsurface features in the vicinity of each proposed drilling location to minimize the potential for encountering utilities and other possible subsurface obstructions.

SITE DESCRIPTION

The area of investigations for the surveys at Buildings 98 (former Bldg.73), 53, 56A, and 154 are shown on the Site Map, Former Building 73, and the Site Map, Buildings 53, 56A, and 154 Plates 1 and 2, respectively. The locations of the three proposed boring sites are also shown on Plate 2. A brief description of each site is presented below.

Building 98 (former Bldg. 73)

The survey area at Building 98 comprises approximately 1,250 square feet. It is located adjacent to the west and south sides of the building. The northwest portion of the survey area is covered with reinforced concrete. The southern portion is covered by asphalt. East-west trending railroad tracks are located along the south boundary. The survey area is generally free of above ground cultural objects.

Building 53

The survey area at Building 53 measures approximately 50 by 125 feet. It is bound by Building 56A to the west, Building 53 to the east, and a planter and steep slope to the north. The survey area is open to the south. An approximate 45 by 50 foot portion of the survey area is located within the southeast corner of Building 56A. Access within this building is limited to areas free of furniture, counters, and equipment. The interior floor is comprised of concrete and is approximately 3.5 feet higher than ground surface. The planter and steep slope to the north comprises the northern most 20 feet of the survey area between Buildings 56A and 53. Access

to this portion of the survey area is limited to areas of the planter located adjacent to the asphalt surface. With exception to a loading ramp along the south boundary of the survey area, the site is generally free from above ground cultural objects. The Brown and Caldwell provided site map indicates that three underground storage tanks (UST's) may exist within this survey area. Two of the suspected tanks have volumes of approximately 1,000 and 10,000 gallons, and may be located beneath Building 56A. The other tank has a reported volume of 4,000 gallons and may be located adjacent to Building 53 in the planter. This map also indicates that the UST associated lines from Building 154 are connected to these tanks and trend to the northeast corner of Building 53.

Building 56A

The survey area at Building 56A measures approximately 30 by 320 feet and is asphalt covered. It is located adjacent to the loading dock along the south side of the building. East-west trending railroad tracks are located within the survey area along its length. With exception to the railroad tracks, the site is generally free of above ground cultural objects and debris. The Brown and Caldwell provided site map indicates that UST associated lines may trend east-west through the survey area from the suspected tanks at Building 154.

Building 154

The survey area at Building 154 is covered with asphalt and measures approximately 60 by 140 feet. It is bound by Building 154 to the west, a steep slope to the north, and Building 56A to the east. The survey area is open to the south. Two large concrete/metal vault lids are located near the west boundary. The site is generally free of above ground cultural objects. A site map, provided by Brown and Caldwell, indicates that three underground storage tanks (UST's) may exist within this survey area. The suspected volumes of these tanks are 1,400, 7,000, and 10,000 gallons.

METHODOLOGY

For this investigation, we used the electromagnetic terrain conductivity (TC), ground penetrating radar (GPR), and electromagnetic line locating (EMLL) methods. The TC method was used to determine conductivity variations that may indicate the presence of UST's, cisterns, and other buried debris and objects. The GPR method was used to aid in further characterizing the source of any detected TC anomalies. Since the GPR method is typically unaffected by above ground metal objects, it was also used to obtain subsurface information inside of buildings, and in close proximity to metal equipment and machinery. The EMLL method was used to aid in further characterizing the source of any detected TC anomalies, as well as to scan each site for near surface metal that may indicate the presence of a UST. This method was also used to locate UST associated utility alignments. In addition, the EMLL and GPR methods were used to investigate the boring locations for detectable utility alignments and drilling obstructions.

Typically, the vertical magnetic gradient (VMG) method is used in conjunction with these techniques to detect buried metal objects. However, magnetic interference caused by the nearby structures and railroad tracks precluded the use of the VMG method in these areas. Descriptions of the TC, GPR, and EMLL methods are provided in Appendix A, of this report.

Use of TC, GPR, and EMLL methods were determined by specific site conditions and access within each survey area. At Building 98, we used the GPR method to obtain the subsurface information. Interference caused by the reinforced concrete slab and the railroad tracks precluded the use of the TC and EMLL methods in this area. For the geophysical survey at Building 53, we used the GPR and EMLL methods. The GPR method was used throughout the survey area, including portions of the interior of Building 56A. The EMLL method could only be used to survey portions of the planter, and the asphalt walkway. Interference caused by the buildings, loading ramp, and railroad tracks precluded the use of the TC method in this area. At Building 56A, we used the GPR and EMLL methods. Interference caused by the railroad tracks precluded the use of the TC method in this area. At Building 154, we used the TC, GPR, and EMLL methods to obtain the subsurface information throughout the survey area.

EQUIPMENT FUNCTIONAL CHECKS

At the beginning and end of each field day, we performed equipment functional checks, as recommended by the instrument manufacturers to ensure proper equipment function. These functional checks included testing the power supply, as well as instrument response. The equipment was operated over a selected test site near Building 56A to verify appropriate gain settings and instrument repeatability. Particular attention was paid to the GPR calibration, with the same gain, filter, and time-depth scales chosen each time to check for repeatable results. This calibration check was documented by printing the calibration plot on the chart recorder. Proper functioning of the equipment was verified by determining that the trends observed in the data were repeatable. The results of these tests indicated that our equipment was functioning properly and accurately throughout the duration of the survey.

DATA ACQUISITION AND ANALYSIS

Descriptions of data acquisition and analysis procedures for the TC, GPR, and EMLL surveys are provided in Appendices B and C, respectively.

SURVEY DOCUMENTATION

We used Daily Field Reports, Borehole Site Survey Log forms, and Draft Field Diagrams to document our field work. The Daily Field Report summarizes each day's activity. The Borehole Site Survey Logs present the pertinent information associated with each proposed borehole location. The Draft Field Diagrams were used to create the computer generated site maps shown

on Plates 1 and 2. Copies of the Daily Field Reports and Borehole Site Survey Log forms are provided in Appendix D.

RESULTS

The results of the geophysical investigation are presented on Plates 1 through 4. Plate 1 is the Geophysical Survey Map for Building 98 (Former Bldg. 73). This plate shows the limits of the survey area, the structures or above ground cultural features that may be in close proximity to the site, the GPR traverses, and the locations of any detectable subsurface features. Plate 2 is the Site Map for Buildings 53, 56A, and 154. This map shows the limits of each survey area, the structures or above ground cultural features that may be in close proximity to the site, and the locations of the GPR traverses. Plate 3 is the Geophysical Survey Map for Buildings 53, 56A, and 154. This plate shows the locations of detected subsurface features and undifferentiated utility alignments. Since a utility search was not the primary objective of this survey, there may be additional utilities that are not shown. Plate 4 is the Terrain Conductivity Contour Map showing the variations in the electromagnetic terrain conductivity within the survey area at Building 154. A description of the results for the geophysical surveys at Buildings 98 (former Bldg.73), 53, 56A, and 154, are presented in the following paragraphs.

Building 98 (former Bldg.73)

The results of the GPR survey at Building 98 are shown on Plate 1. Our interpretation of the GPR data defines reflection patterns characteristic of variable subsurface conditions in the upper 2 to 3 feet. These conditions include shallow fill horizons associated with the asphalt and concrete surfaces, and small discrete reflection patterns associated with the rebar in the concrete. In the south central portion of the survey area, the GPR data defines a zone of broad subtle reflection patterns. We refer to this zone as a GPR anomaly on Plate 1. It has been our experience that broad reflection patterns typically indicate metallic or nonmetallic subsurface features such as utility vaults, cisterns, brick septic tanks, or small UST's. As mentioned above, the railroad tracks precluded the use of the EMLL method in this area. Therefore, we could not determine if the source of the GPR anomaly is a metallic or nonmetallic object. The remainder of the GPR data exhibits continuous reflecting horizons typical of undisturbed subsurface strata.

Building 53

The results of the EMLL and GPR surveys at Building 53 are shown on the Geophysical Survey Map, Plate 3. The EMLL survey defined the location of an anomalous zone of buried metal, as well as undifferentiated and natural gas utility alignments. The zone of buried metal measures approximately 10 by 13 feet and is located adjacent to Building 53 in the planter area. Upon further inspection of this area, we uncovered a UST fill port approximately 6 inches beneath the ground surface at its east end. The approximate dimension of this UST is consistent with the 4,000 gallon UST shown on the Brown and Caldwell provided site drawing. An undifferentiated

utility was detected from this tank to Building 53, then south and west into the adjacent survey area (Building 56A), as shown on Plate 3. Portions of this utility may also trend north, as shown on the Brown and Caldwell provided site map, from the tank along the west and north sides of Building 53. However, the steep terrain in the planter prohibited us from detecting this line any further to the north. We believe that this undifferentiated utility or utilities (side by side) may be associated with the UST's in this area, as shown on the Brown and Caldwell provided site map. We have labeled this utility as 'UST associated lines' on Plate 3.

GPR data were obtained between Buildings 56A and 53, as well as inside of Building 56A at the southeast corner. The GPR data obtained outside of the buildings defined reflection patterns typical of utilities, as well as deeper reflecting horizons characteristic of uniform subsurface conditions. Hyperbolic reflection patterns typical of a UST was not defined in this area. Therefore, the surface trace of the UST, as described above, could not be confirmed with the GPR. The lack of definition may be due to limited GPR depth of investigation caused by the relatively conductive fill materials associated with this area.

The GPR data obtained inside of the building defined reflection patterns typical of shallow fill horizons associated with the floor, and deeper reflecting horizons characteristic of uniform subsurface conditions. The GPR data did not define reflection patterns typical of a UST beneath the floor of the building in this area. It should be noted, however, that the floor of the building is approximately 3.5 feet higher than the ground surface outside of the building. If UST's were in place prior to the construction of this portion of the building, it is highly probable that they are buried deeper than 7 to 8 feet below the surface of the floor. At these depths, UST's are very difficult to detect using the GPR method, especially in conductive soils. Since GPR is not affected by above ground metal objects, it is the only geophysical method that can be used to search for a UST inside of this building. We are not aware of other geophysical methods available that can be used to detect possible UST's beneath this building, given the depth of investigation.

Building 56A

The results of the EMLL and GPR surveys at Building 56A are shown on Plate 3. The EMLL investigation detected the surface trace of an undifferentiated utility and a natural gas line. Both lines trend east-west through the site. Also shown on Plate 3 is a water line. The location of this line was based on the location of valve boxes and asphalt patches. As mentioned above, we believe that the undifferentiated utility represents UST associated lines that trend from the suspected UST's at Building 53 to the Building 154 survey area. The GPR data obtained in this area defined reflection patterns typical of shallow fill horizons associated with the pavement, isolated reflections typical of the railroad tracks and utilities, and deeper reflecting horizons characteristic of uniform subsurface conditions. The GPR data do not indicate hyperbolic reflections within the upper two to four feet large enough to represent a UST or other large subsurface features within the limits of the survey.

Building 154

The results of the EMLL and GPR surveys at Building 154 are shown on the Geophysical Survey Map, Plate 3. The EMLL survey defined the location of two anomalous zones of buried metal, as well as numerous utility alignments. The zones of buried metal are located in the southwest quadrant of the survey area and trend east from the vault lids, as shown on Plate 3. One is relatively small, measuring approximately 10 by 17 feet. The other is significantly larger measuring approximately 10 by 30 feet. The approximate dimensions of these zones are consistent with the 7,000 and 10,000 gallon UST's shown on the Brown and Caldwell provided site drawings. The detected utilities shown on this map include electric, natural gas, storm drain, and several undifferentiated utility alignments. Some of the undifferentiated utilities trend east, from the vaults and suspected UST's, to the adjacent survey area (Building 56A). We believe that these are the same utilities that are associated with the detected UST at Building 53.

The results of the TC Survey are shown on the Terrain Conductivity Contour Map, Plate 4. Also shown are the two EMLL anomalies representing the suspect 7,000 and 10,000 gallon UST's, as described above. The contour map indicates a highly variable TC gradient throughout most of the site. These variations are manifested by numerous circular closures that occur mainly in the central and northern portions of the survey area. The southern portion of the survey area is characterized by widely distributed contours. Closely spaced contours typically indicate effects from above and below ground sources. Whereas, widely distributed contours typically represent background conductivity values that are not influenced by above and below ground sources. Some of the closely spaced contours on this map represent effects from above ground metal objects, such as the nearby buildings. However, most of the TC variations are associated with below ground metal objects, including the two EMLL anomalies (suspected UST's) and the detected utilities.

As shown on Plate 4, the locations of the EMLL defined UST's correspond with two significant TC anomalies. These anomalies are characterized by closely spaced circular closures that exhibit a decrease in TC values. In addition to these anomalies, there is a third TC anomaly that exhibits the same characteristics, indicating that there may be a metallic source buried deeper than the detected utilities in this area. It is located in the center of the survey area northwest of the suspected UST's and is referred to as a TC anomaly on Plate 4. The areal extent of this anomaly is significantly smaller than the others, measuring approximately 5 by 11 feet. These dimensions are consistent with a 1,400 gallon UST and may represent the third tank shown on the Brown and Caldwell provided site drawings. The other TC variations appear to be due to the various utilities that trend through the area.

The GPR data obtained in this area define reflection patterns typical of small isolated objects and utilities, as well as deeper reflecting horizons characteristic of uniform or undisturbed subsurface conditions. The GPR data obtained over the suspected UST's indicated an absence of reflection patterns. Therefore, we could not confirm the surface trace of each UST with the GPR. As

mentioned above, this lack of definition is probably due to limited GPR depth of investigation caused by conductive subsurface materials.

Borehole Site Surveys

The results of the borehole site surveys are shown on the enclosed copies of the Borehole Site Survey Logs (Appendix D). As specified by Brown and Caldwell, these proposed borings are designated as #004, #005, and #006. Proposed boring #004 is located within the Building 154 survey area. Proposed borings #005 and #006 are located within the Building 56A survey area. As described above, EMLL and GPR were systematically used over each location. During the course of this investigation, we identified several undifferentiated utility alignments. The surface trace of these utilities, as well as the proposed boring locations, were marked with spray paint on the ground surface.

STANDARD CARE AND WARRANTY

The scope of NORCAL's services for this project consisted of using geophysical methods to characterize the shallow subsurface. The accuracy of our findings is subject to specific site conditions and limitations inherent to the techniques used. We performed our services in a manner consistent with the level of skill ordinarily exercised by members of the profession currently employing similar methods. No warranty, with respect to the performance of services or products delivered under this agreement, expressed or implied, is made by NORCAL.

We appreciate having the opportunity to provide you with this information.

Respectfully,

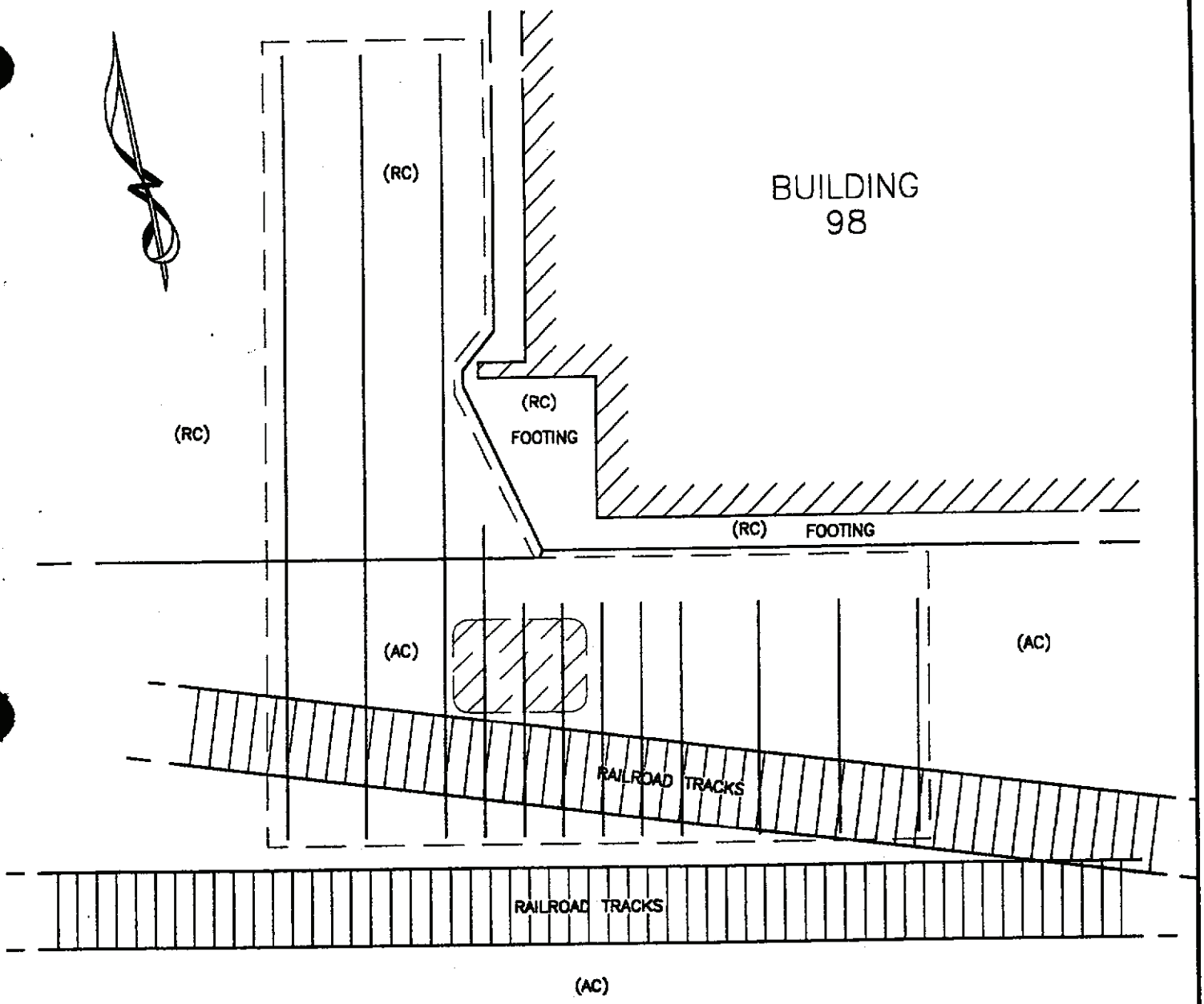
NORCAL Geophysical Consultants, Inc.

Donald J. Kirker

Donald J. Kirker
Geophysicist, GP-997

DJK/jh

Enclosure: Plates 1 through 4
Appendix A, METHODOLOGY
Appendix B, DATA ACQUISITION
Appendix C, DATA ANALYSIS
Appendix D, DAILY FIELD REPORTS AND BOREHOLE SITE SURVEY LOGS



LEGEND	
— —	LIMITS OF SURVEY AREA
———	GPR TRAVERSE
▨	GPR ANOMALY
(AC)	ASPHALT
(RC)	REINFORCED CONCRETE

SCALE

0 5 10 20

(1 inch = 10 feet)

NORCAL

GEOPHYSICAL SURVEY MAP
BUILDING 98
(FORMER BUILDING 73)

LOCATION: BENICIA ARSENAL, BENICIA, CALIFORNIA

CLIENT: BROWN & CALDWELL

NORCAL GEOPHYSICAL CONSULTANTS INC.

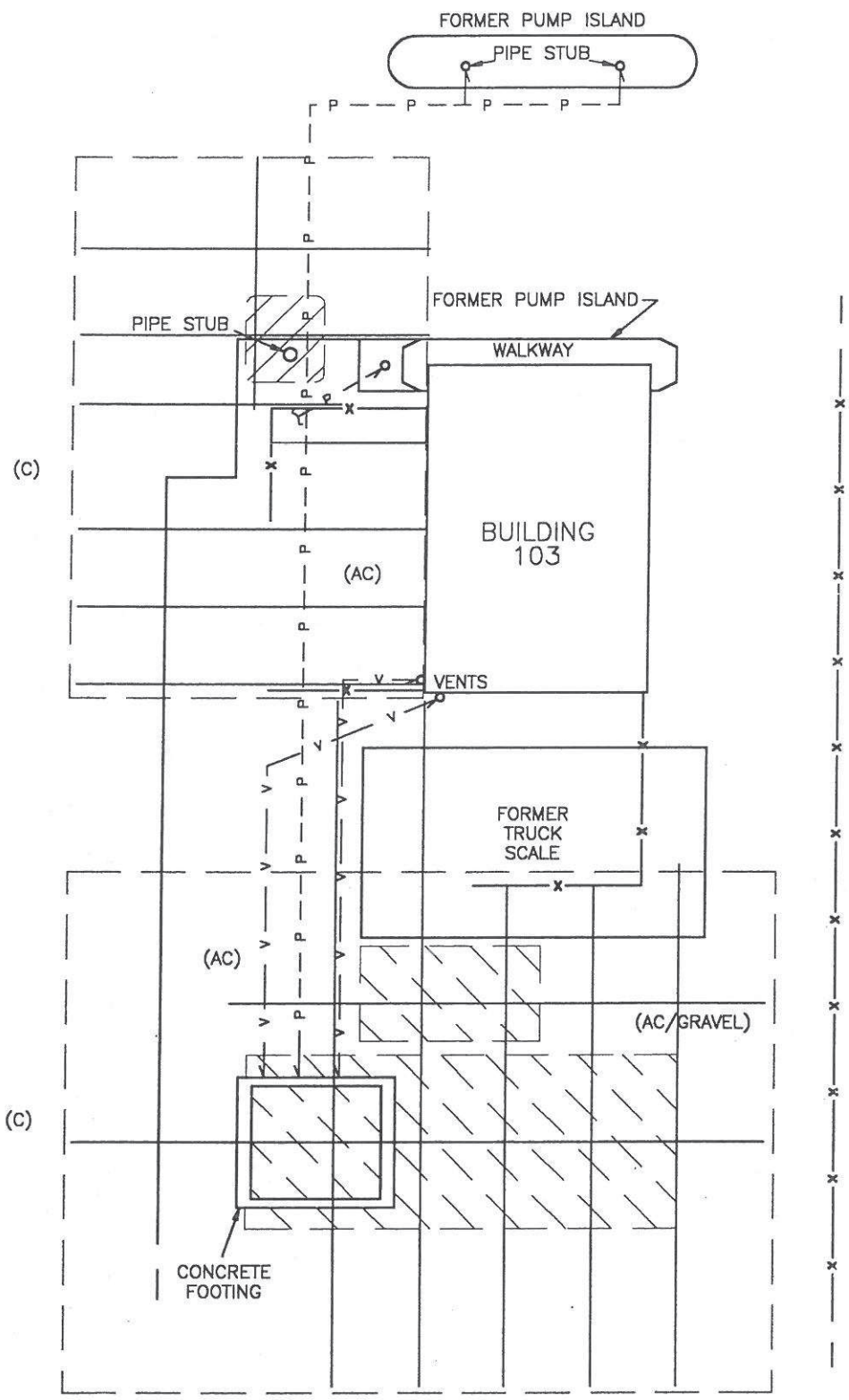
JOB #: 99-141.24

DATE: MAR. 1999

DRAWN BY: C.RANDALL

APPROVED BY: DJK

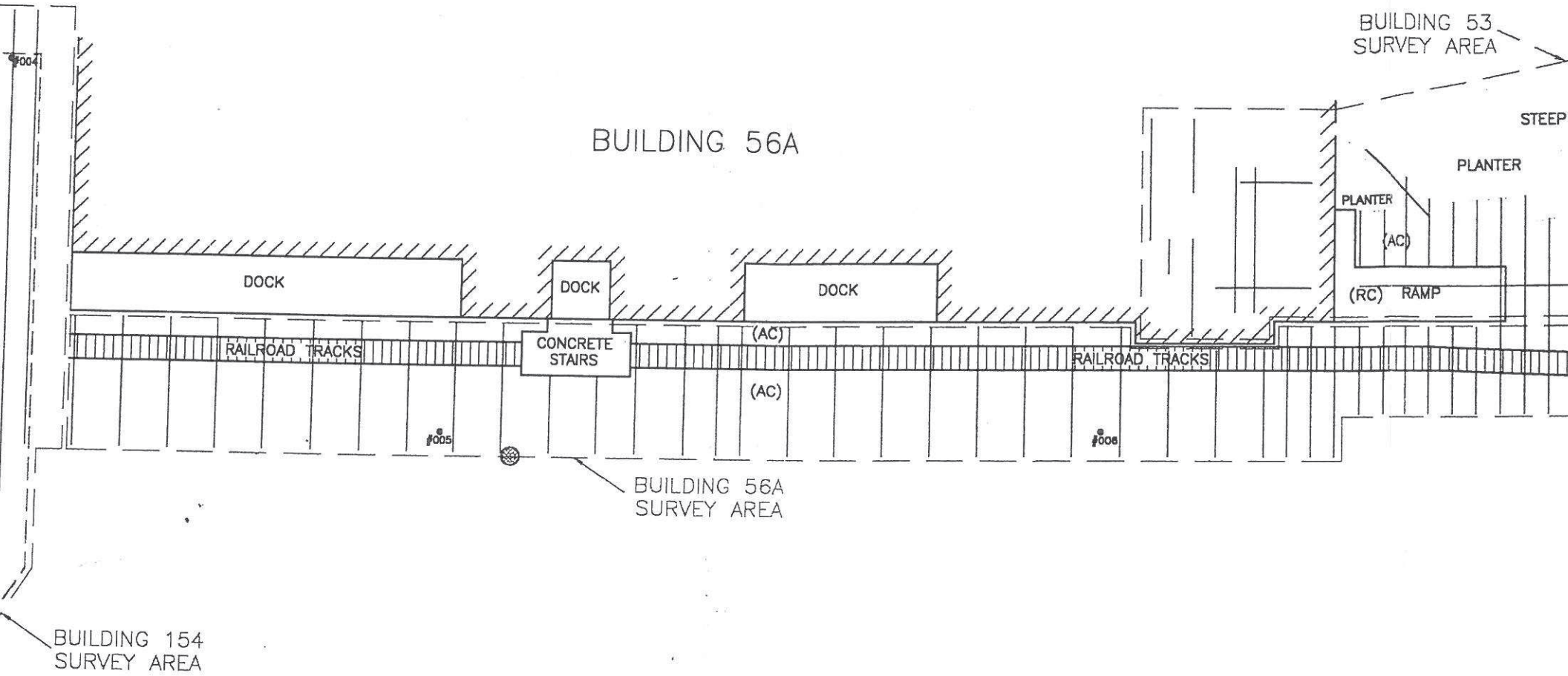
PLATE 1



S
0 5
(1 inch

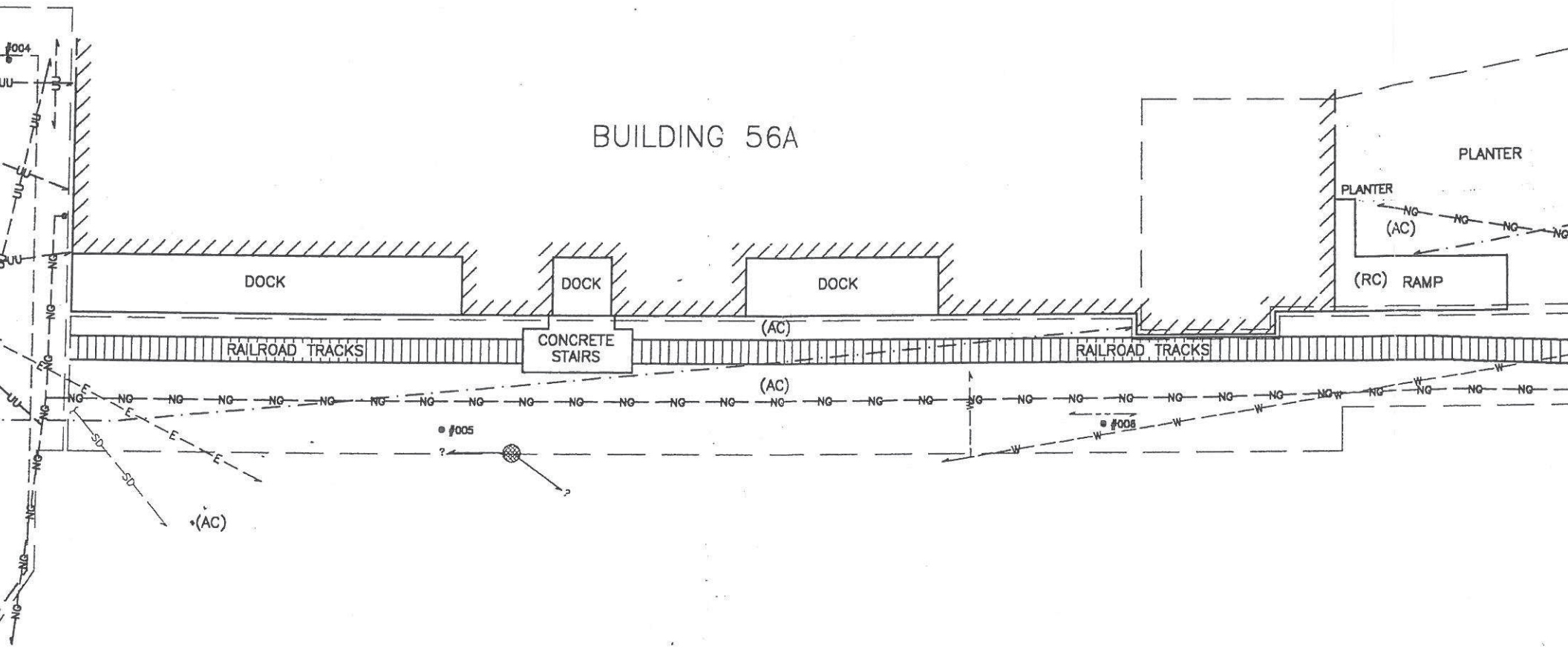
LEG	
— · —	LIMITS OF GEOP
———	GPR TRAVERSE
	GPR ANOMALY
	EMLL ANOMALY
— P — —	UST PRODUCT
— V —	UST VENT LINE
—x—	FENCE
(AC)	ASPHALT
(C)	CONCRETE

GEOPH



ON THIS MAP*

LEGEND		
UCTIVITY SURVEY		MANWAY
S	• #004	PROPOSED BORING SITE



ON THIS MAP*

LEGEND

NETIC TERRAIN	#004	PROPOSED BORING SITE
A	E	ELECTRIC LINE
ENTING POSSIBLE UST	NG	NATURAL GAS LINE
T LID	SD	STORM DRAIN
	UU	UNDIFFERENTIATED UTILITY LINE

Appendix A

GEOPHYSICAL METHODS

Electromagnetic Terrain Conductivity (TC)

The electromagnetic method is used to measure variations in subsurface electrical conductivity. The electromagnetic system utilizes two coils separated by a specified distance. One of these coils transmits a time-varying electromagnetic signal (primary magnetic field) which induces current flow in the earth. This in turn creates a secondary magnetic field which is detected by the receiver coil. The secondary signal is complex and has both quadrature and in-phase components. The amplitude of the quadrature component is proportional to the electrical conductivity of the subsurface materials. The in-phase component is proportional to conductivity, but is also affected by electrical properties associated with metal objects. The instrument displays the quadrature component in units of milliSiemens/meter (mS/m). Since this measurement represents the conductivity of the volume of material sampled, rather than individual layers, it is an apparent value and is referred to as terrain conductivity (TC).

We performed the electromagnetic survey using a Geonics EM31-DL ground conductivity meter connected to an Omnidata data recorder. The data recorder automatically stores TC values as well as station locations and annotations regarding cultural features.

Ground Penetrating Radar

Ground penetrating radar is a method that provides a continuous, high resolution cross-section depicting variations in the electrical properties of the shallow subsurface. The method is particularly sensitive to variations in electrical conductivity and electrical permittivity (the ability of a material to hold a charge when an electrical field is applied).

The system operates by continuously radiating an electromagnetic pulse into the ground from a transducer (antenna) as it is moved along a traverse. Since most earth materials are transparent to electromagnetic energy, only a portion of the radar signal is reflected back to the surface from interfaces representing variations in electrical properties. When the signal encounters a metal object, however, all of the incident energy is reflected. The reflected signals are received by the same transducer and are printed in cross-section form on a graphical recorder. Depending upon depth and/or thickness the resulting records can provide information regarding the location of UST's, sumps, buried debris, underground utilities, and variations in the shallow site materials. Generally, electrically conductive materials, such as clay, saturated silt, and rebar can reduce the penetration capability and limit radar performance.

For this investigation, we used a Geophysical Survey Systems, Inc. SIR-2 Subsurface Interface Radar System equipped with a 500 megahertz (MHz) transducer. This transducer is near the center of the available frequency range and is used to provide high resolution at the desired depths.

Electromagnetic Line Location (EMLL)

Electromagnetic line location techniques are used to locate the magnetic field resulting from an electric current flowing on a line. These magnetic fields can arise from currents already on the line (passive) or currents applied to a line with a transmitter (active). The most common passive signals are generated by live electric lines and re-radiated radio signals. Active signals can be introduced by connecting the transmitter to the line at accessible locations or by induction.

The detection of underground utilities is determined by the composition and construction of the line in question. Utilities detectable with standard line location techniques include any continuously connected metal pipes, cables/wires or utilities with tracer wires. Unless carrying a passive current these utilities must be exposed at the surface or in accessible utility vaults. These generally include water, electric, natural gas, telephone, and other conduits related to facility operations. Utilities that are not detectable using standard electromagnetic line location techniques include those made of non-electrically conductive materials such as PVC, fiberglass, vitrified clay, and pipes with insulated connections.

The induction mode is also used to detect buried near surface metal objects such as rebar, manhole covers, and various metallic debris. This is done by holding the transmitter-receiver unit above the ground and continuously scanning the surface. The unit utilizes two orthogonal coils that are separated by a specified distance. One of the coils transmits an electromagnetic signal (primary magnetic field) which in turn produces a secondary magnetic field about the subsurface metal object. Since the receiver coil is orthogonal to the transmitter coil, it is unaffected by the primary field. Therefore, secondary magnetic fields produced by buried metal will generate an audible response from the unit. The peak of this response indicates when the unit is directly over the metal object.

Our instrumentation for this investigation consisted of a Radiodetection RD-400 line locator and a Fisher TW-6 inductive pipe and cable locator.

NORCAL

Appendix B

DATA ACQUISITION

Horizontal Control

Site definition and data acquisition were based on a horizontal control grid. The grid nodes were marked using marking paint on 10 by 10 foot centers at every survey area. Survey points between these markers were paced during data acquisition. The locations of each survey area, as well as the respective TC survey boundary, and the GPR traverses are shown on Plates 1 and 2. The specific locations of the marked grid nodes are not shown on these plates.

Geophysical Survey

At Building 98 (Former Bldg. 73), GPR data were obtained along south-north trending traverses spaced 2.5 to 5 feet apart. The length of these traverses ranged from 15 to 50 feet, as shown on Plate 1.

At Building 53, GPR data were obtained along west-east and south-north trending traverses. From Building 56A to Building 53, these traverses were spaced 5 feet apart. Inside Building 56A, the GPR data were obtained in areas free of furniture and equipment. This resulted in traverses that were spaced 4 to 20 feet apart. The GPR traverses over the entire site ranged in length from 7 to 82 feet, as shown on Plate 2. The EMLL technique was scanned over these same traverses outside of the buildings.

At Building 56A, GPR data were obtained along south-north trending traverses spaced 10 feet apart. The length of these traverses range from 18 to 28 feet. The location of the GPR traverses are shown on Plate 2. The EMLL technique was scanned over these same traverses.

At Building 154, TC data were collected at 5 foot intervals (stations) along south-north trending traverses spaced 5 feet apart. Following data acquisition, we downloaded the data to a portable laptop computer and produced a preliminary contour map in the field. We reviewed the map for locations of TC anomalies that may represent buried metal objects and debris. The GPR and EMLL techniques were then systematically used over the detected TC anomalies. GPR data were obtained along south-north trending traverses that ranged in length from 90 to 130 feet. The EMLL technique was scanned over these same traverses. The location of the TC survey boundary and the GPR traverses are shown on Plate 2.

For the boring site surveys, the investigation at each of the three proposed boring locations included the use of both GPR and EMLL. GPR profiles were obtained along both north-south and east-west trending traverses with the boring positioned at their intersection. Each traverse was approximately 20 feet long. The EMLL system was operated within the same ten foot radius of the boring as the GPR. Detected utilities within these areas were identified and marked with spray paint on the ground surface.

Appendix C

DATA ANALYSIS

Computer Processing

The down loaded TC data were converted into a format for contouring. The contouring program calculated an evenly spaced array of values (gridded) based on the observed field data. Finally, these gridded values were contoured to produce the TC Contour Map.

Contour Map Interpretation

Generally, TC values vary smoothly throughout a given region with uniform conditions. Areas where variations are strong are defined by closely spaced contours and are typically considered anomalous when there are no possible above ground sources. If the source of a particular anomaly is an isolated object or a group of closely spaced objects, the contours may form circular or elliptical closures. A large accumulation of buried objects may appear as a group of closely spaced anomalies or one large anomaly.

Actual anomaly magnitude and shape are dependent on the relative position and size of the buried objects with respect to the location of the data points. In general, anomaly magnitude will decrease and anomaly width will increase as distance (depth) to the source increases. Anomalies may or may not have paired high and low values creating what are known as magnetic dipoles.

GPR Analysis

We examined the GPR records for reflection patterns characteristic of UST's, cisterns, vaults, and buried debris. We also reviewed the records for changes in reflection character that could indicate variations in fill material associated with an excavation. For this survey, we estimate the depth of detection to average approximately three feet, with a maximum penetration of up to five feet in localized areas.

NORCAL GEOPHYSICAL CONSULTANTS INC.

NORCAL

DAILY FIELD REPORT

Date: 3-15-99 **Client/Location:** BROWN & CALDWELL / BENICIA ARSENAL

Personnel: DJK / LH **Equipment:** GPR, EMLL

Project Description: LOCATE BURIED FEATURES, INCLUDING UST's, UST ASSOCIATED UTILITIES, CISTERNS, AND UTILITY LINES.

TIME	NOTES
7:30:	ARRIVE PETALUMA OFFICE, MOB FOR BENICIA ARSENAL
9:00:	ARRIVE BLDG 154
	-MEET WENDY LINCK OF B&C FOR HEALTH & SAFETY MEETING
9:40:	CALIBRATE EQUIPMENT AT NORCAL ESTABLISHED TEST SITE
	- START UST SEARCH AT BLDG 154, OBTAIN EMLL & GPR ON 5X5 GRID
1:15:	MOVE TO SURVEY AREA FOR BUILDING 53
	-OBTAIN GPR DATA INSIDE SOUTHEAST CORNER OF BLDG 56A
	(ACCESS WAS LIMITED TO AREAS FREE OF FURNITURE & EQUIPMENT)
2:00:	MOVE TO SURVEY AREA, FORMER BLDG 73
	-OBTAIN EMLL & GPR ON 5X5' GRID OUTSIDE OF BUILDING
	(AREA INSIDE OF BLDG WAS NOT SURVEYED, AT BROWN &
	CALDWELL REQUEST, BECAUSE OF VERY LIMITED ACCESS)
3:00:	MOVE BACK TO BLDG 53
	-OBTAIN GPR DATA INSIDE SOUTHEAST CORNER OF BLDG 56A,
	WEST PORTION (ACCESS WAS LIMITED TO AREAS FREE
	OF FURNITURE AND EQUIPMENT)
3:20:	INVESTIGATE AREA SOUTH OF BLDG 56A, BETWEEN 154 & 53
4:15:	RECALIBRATE EQUIPMENT AT NORCAL ESTABLISHED
	TEST SITE
4:30:	LEAVE SITE

FIELD DAY SUMMARY MOBILIZATION 2.5 HOURS, FIELD 7.5 HOURS

Donald J. Kirke **Signature**
NORCAL Representative

Signature
CLIENT Representative

1350 INDUSTRIAL AVENUE SUITE A • PETALUMA, CA 94952
TELEPHONE (707) 763-1312 • FAX (707) 762-5587

NORCAL GEOPHYSICAL CONSULTANTS INC.

NORCAL

DAILY FIELD REPORT

Date: 3-16-99 **Client/Location:** BROWN & CALDWELL / BENICIA ARSENAL

Personnel: DJK / LH **Equipment:** EM31 EMLL GPR

Project Description: LOCATE BURIED FEATURES, INCLUDING UST's, UST ASSOCIATED UTILITIES, CISTERNS, AND UTILITIES

TIME	NOTES
6:15:	ARRIVE PETALUMA OFFICE, MOB VEHICLE
7:45:	ARRIVE BENICIA ARSENAL
7:55:	CALIBRATE EQUIPMENT AT NORCAL ESTABLISHED TEST SITE
	- CONTINUE GPR SURVEY SOUTHEAST CORNER OF
	BUILDING 56A
	- OBTAIN GPR DATA IN ACCESSIBLE AREAS AT BUILDING 53
	- OBTAIN EM31 DATA AT BUILDING 154
	- SURVEY BUILDING 53 WITH EMLL TECHNIQUE, MARK
	OUT POSSIBLE 4000 GALLON UST
12:15:	- DRAW SITE MAP
	- INVESTIGATE THREE PROPOSED BORING LOCATIONS
	(#004) (#005) (#006)
1:33:	RECALIBRATE EQUIPMENT AT NORCAL ESTABLISHED TEST SITE
	- DOWN LOAD EM31 DATA TO LAPTOP COMPUTER
	- PRODUCE CONTOUR MAPS
2:45:	LEAVE SITE
	*(A SITE WALK WAS CONDUCTED NORTH & NORTHWEST OF BLDG 53.
	HOWEVER, A GEOPHYSICAL SURVEY COULD NOT BE CONDUCTED IN THIS
	AREA BECAUSE OF LIMITED ACCESS BEHIND THE BUILDING & ON
	THE EMBANKMENT)*

FIELD DAY SUMMARY MOBILIZATION 2.0 HOURS, FIELD 7.0 HOURS

Donald J. Kirker **Signature**

NORCAL Representative

_____ **Signature**

CLIENT Representative

1350 INDUSTRIAL AVENUE SUITE A • PETALUMA, CA 94952
TELEPHONE (707) 763-1312 • FAX (707) 762-5587

PERSONNEL: LSH/DJK

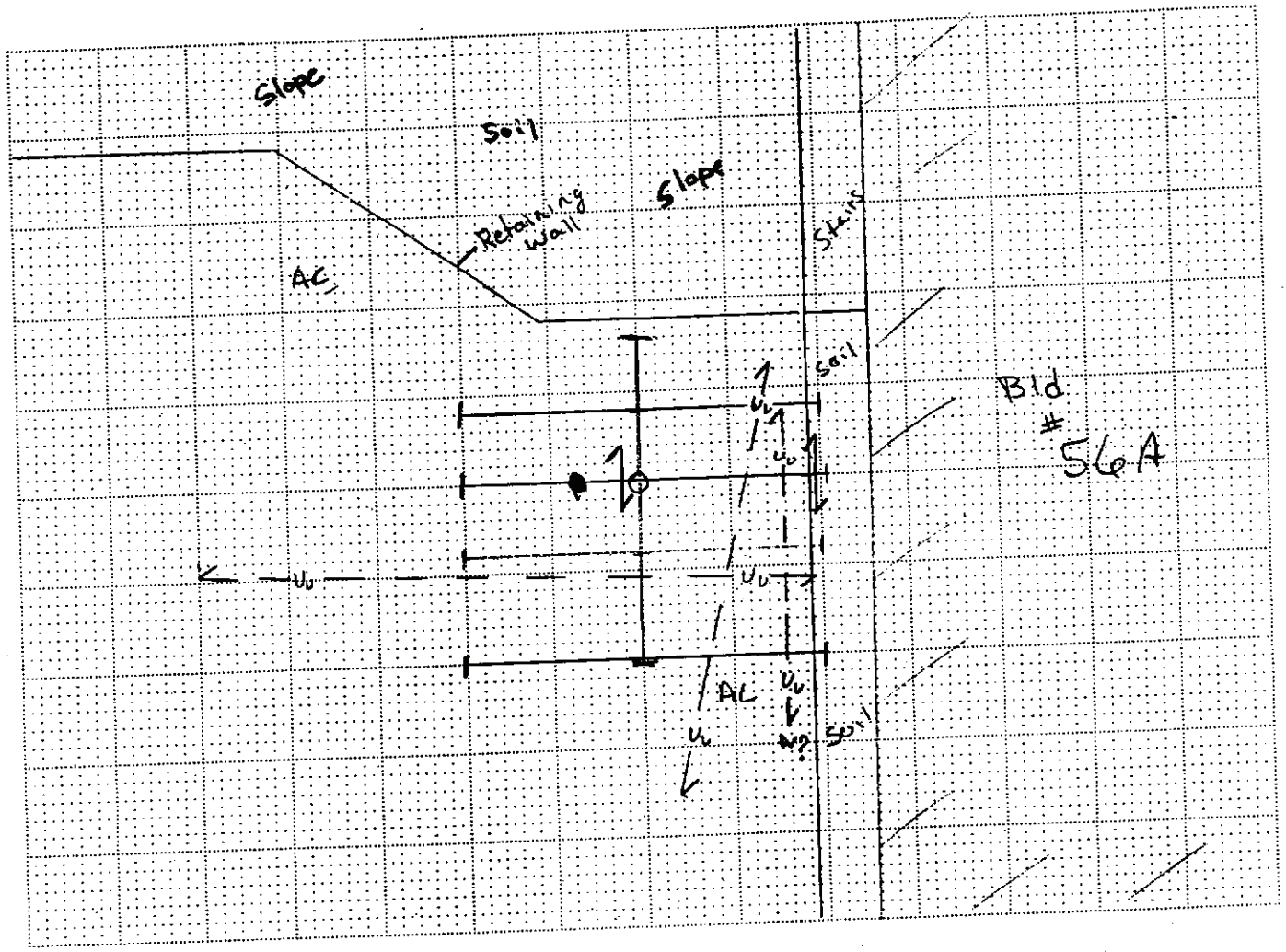
JOB: DATE: 03/16/99

NORCAL GEOPHYSICAL CONSULTANTS INC.

CLIENT: Brown + Caldwell

LOCATION: Benecia Arsenal

BORING: 004



Scale: 1" = 10'

EXPLANATION

- Original Boring Location
- Final Boring Location
- GPR Traverse
- Localized GPR Anomaly
- Utility Alignment

Utilities

- _ T (Telephone, Comm.)
- _ E (Electric)
- _ NG (Natural Gas)
- _ CA (Compressed Air)
- _ STM (Steam)
- _ SS (Sanitary Sewer)
- _ SD (Storm Drain)
- _ W (Water)
- _ FS (Fire Supression)
- ✓ UU (Undifferentiated Utility)

Surface

- _ RC (Reinforced Concrete)
- ✓ AC (Asphalt)
- _ C (Concrete)
- ✓ Soil
- _ Gravel
- _ other

NOTES

Equipment:
- ✓ GPR (Radar)
- _ RD 400
- ✓ M Scope
- _ other

Procedure:
- ✓ EMC (Conduction)
- _ EMI (Induction)
- ✓ Ambient
- ✓ GPR

Surface Conditions:
- _ Wet
- ✓ Dry
- _ other

REMARKS

Can't detect fire line in this area as shown on Brown and Caldwells supplied map.

N

PERSONNEL: LSH/DJK

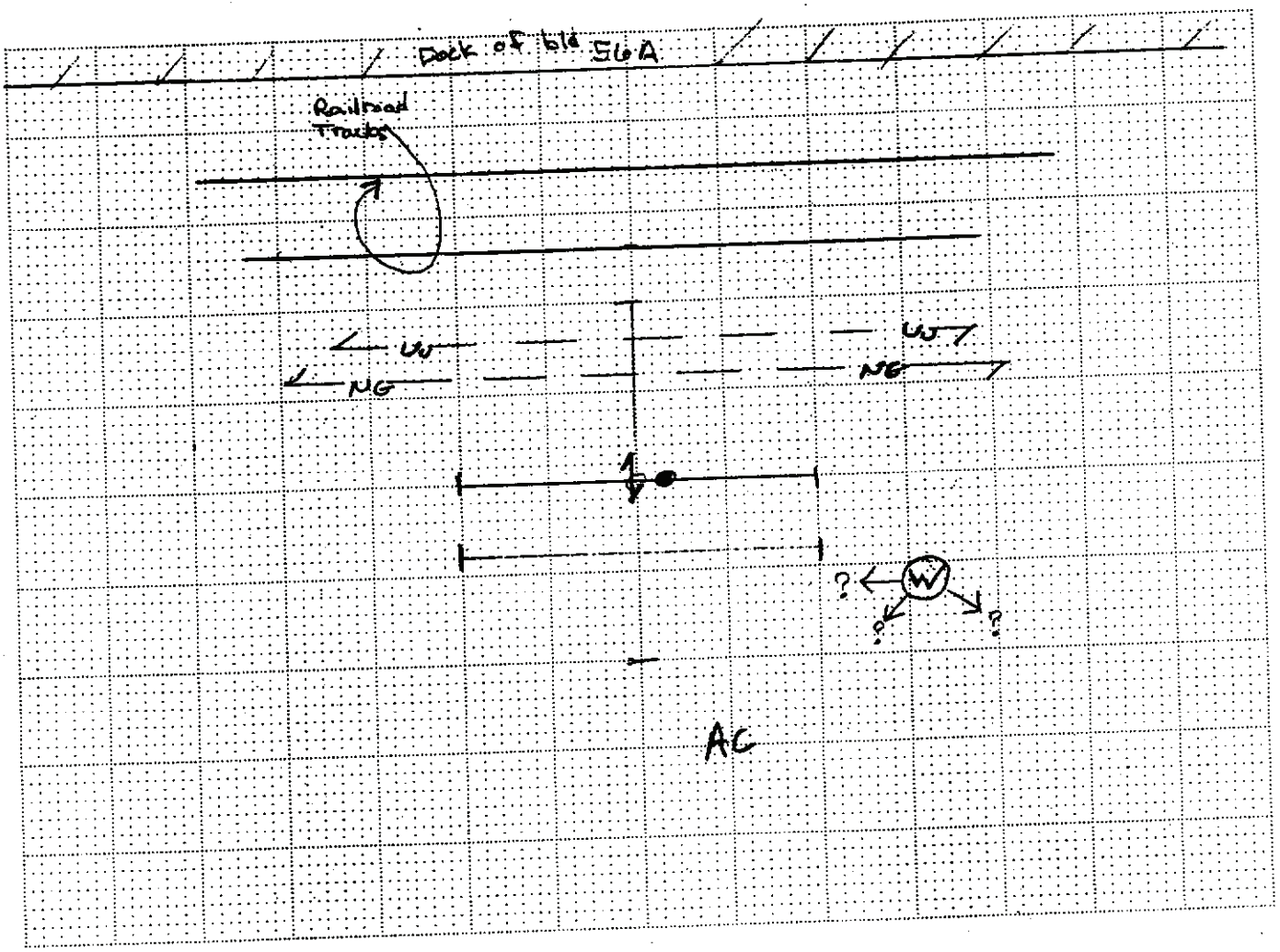
JOB: DATE: 03/16/99

NORCAL GEOPHYSICAL CONSULTANTS INC.

CLIENT: Brown + Caldwell

LOCATION: Benecia Arsenal

BORING: 005



Scale: 1" = 10'

EXPLANATION

- ○ Original Boring Location
- ● Final Boring Location
- GPR Traverse
- OR Localized GPR Anomaly
- Utility Alignment

Utilities

- _ T (Telephone, Comm.)
- _ E (Electric)
- ✓ NG (Natural Gas)
- _ CA (Compressed Air)
- _ STM (Steam)
- _ SS (Sanitary Sewer)
- _ SD (Storm Drain)
- _ W (Water)
- _ FS (Fire Supression)
- ✓ UU (Undifferentiated Utility)

Surface

- _ RC (Reinforced Concrete)
- ✓ AC (Asphalt)
- _ C (Concrete)
- _ Soil
- _ Gravel
- _ other

NOTES

Equipment:
- ✓ GPR (Radar)
- ✓ RD 400
- ✓ M Scope
- _ other

Procedure:
- ✓ EMC (Conduction)
- _ EMI (Induction)
- ✓ Ambient
- ✓ GPR

Surface Conditions:
- _ Wet
- ✓ Dry
- _ other

REMARKS

N ↑ Water line not detected our projections are based on Brown + Caldwells supplied maps

PERSONNEL: LSH/DJK

JOB:

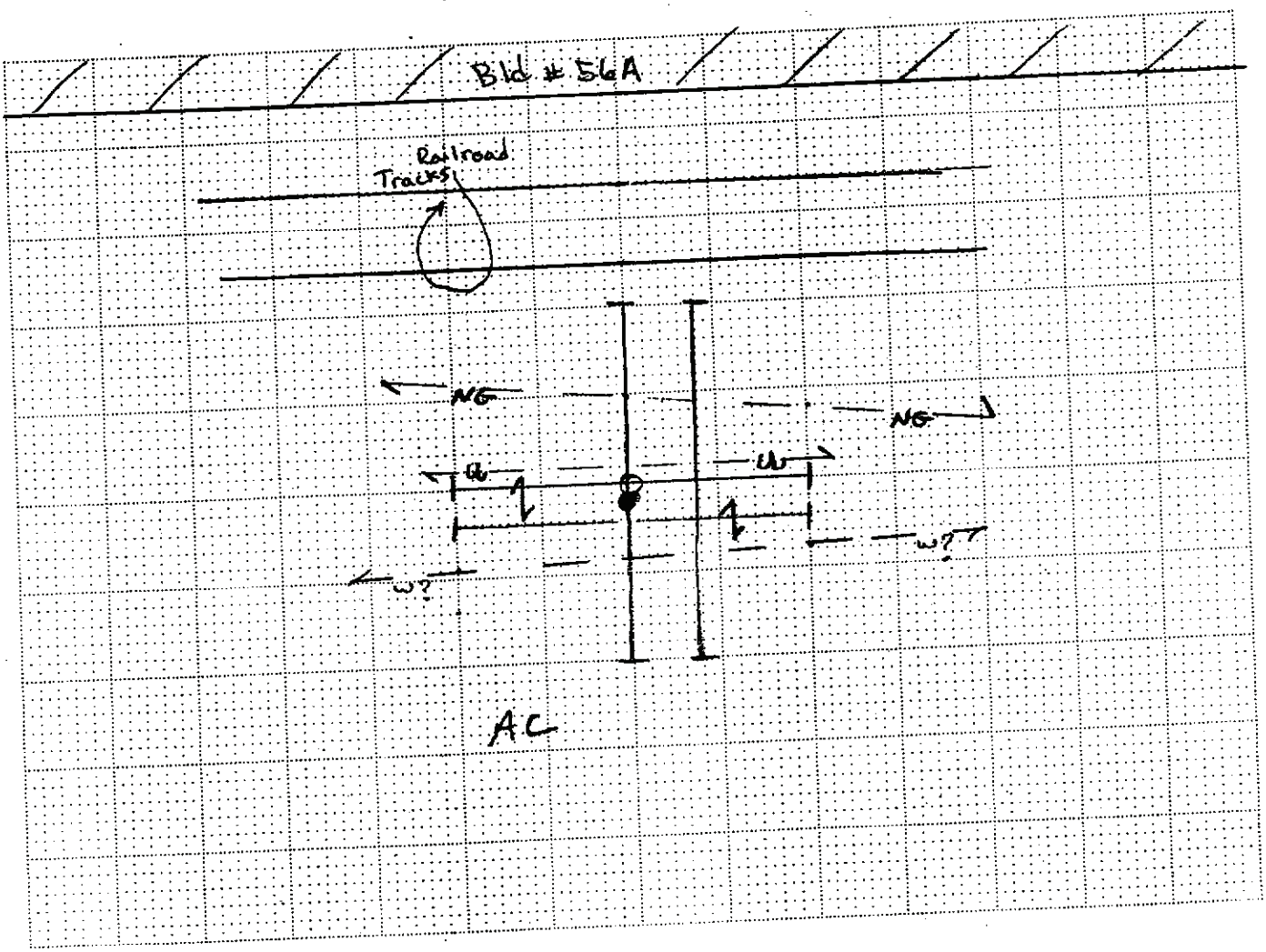
DATE: 03/16/99

NORCAL GEOPHYSICAL CONSULTANTS INC.

CLIENT: Brown + Caldwell

LOCATION: Benecia Arsenal

BORING: 006



Scale: 1" = 10'

EXPLANATION

- ○ Original Boring Location
- ● Final Boring Location
- GPR Traverse
- Localized GPR Anomaly
- Utility Alignment

Utilities

- _ T (Telephone, Comm.)
- _ E (Electric)
- ✓ NG (Natural Gas)
- _ CA (Compressed Air)
- _ STM (Steam)
- _ SS (Sanitary Sewer)
- _ SD (Storm Drain)
- _ W (Water)
- _ FS (Fire Supression)
- ✓ UU (Undifferentiated Utility)

Surface

- _ RC (Reinforced Concrete)
- ✓ AC (Asphalt)
- _ C (Concrete)
- _ Soil
- _ Gravel
- _ other

NOTES

Equipment:
- ✓ GPR (Radar)
- _ RD 400
- _ M Scope
- _ other

Procedure:
- ✓ EMC (Conduction)
- _ EMI (Induction)
- ✓ Ambient
- _ GPR

Surface Conditions:
- _ Wet
- ✓ Dry
- _ other

REMARKS

N ↑ Water line not detected our projection is based on the Brown + Caldwells Supplied Map.