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PITT-07-7-008

July 9, 2007

Project No. 112G00477

Mr. Howard Hickey
NAVFAC MW
201 Decatur Avenue
Building 1A, Code EV
Great Lakes, Illinois 60088

Reference: CLEAN Contract No. N62467-04-D-0055
Contract Task Order (CTO) No. 0042

Subject: Draft Interim Measures Work Plan (IMWP) for Solid Waste Management Unit (SWMU) 9 (Pesticide Control Area) Dated June 2007
Naval Surface Warfare Center (NSWC) Crane
Crane, Indiana

Dear Mr. Hickey:

On June 13, 2007 a Draft SWMU 9 IMWP was submitted to the Navy for review and transmittal to the Environmental Multi-Award Contractor (EMAC) for proposal. The Navy forwarded the draft SWMU 9 IMWP to the United States Environmental Protection Agency (EPA) Region 5 for review.

On June 14, 2007 EPA issued comments on the Draft SWMU 9 IMWP via electronic mail (e-mail). On June 21, 2007, the Navy forwarded the responses to the EPA June 14, 2007 comments to EPA. Comments on these responses were received from EPA on June 21, 2007.

Review of the June 21, 2007 EPA comments resulted in responses to the June 15, 2007 being revised. Attachment 1 contains the final updated responses to the June 14, 2007 EPA comments and the responses to the June 21, 2007 EPA comments.

To expedite the proposal process, the responses to the June 21, 2007 EPA comments including the revisions to the June 14, 2007 EPA comments have been incorporated into the Draft SWMU 9 IMWP. Attachment 2 contains the updated document PDF and one hardcopy of the changed Sections, Table, Figures, and Appendix as listed below:

- Table of Contents and Acronyms,
- Sections 2, 3, and 5,
- Table 3-2,
- Figures 1-2, 2-6, 2-7, 3-1, 3-2, and 3-3, and
- Appendix A-3 (new third section in Appendix A).

Complete Sections have been included due to pagination changes from the inserted text. Please update your version of the document as shown in the following Table.

Description	Action	
Table of Contents (TOC) and Acronyms	Remove existing TOC and Acronyms	Replace with the new TOC and Acronyms from Attachment 2
Section 1	Remove the existing Figure 1-2	Replace with the new Figure 1-2
Section 2	Remove existing Section 2 text	Replace with the new Section 2 text from Attachment 2
	Remove the existing Figures 2-6 and 2-7	Replace with the new Figures 2-6 and 2-7
Section 3	Remove existing Section 3 text	Replace with the new Section 3 text from Attachment 2
	Remove existing Table 3-2	Replace with the new Table 3-2 from Attachment 2
	Remove the existing Figures 3-1, 3-2, and 3-3	Replace with the new Figures 3-1, 3-2, and 3-3
Section 5	Remove existing Section 5 text	Replace with the new Section 5 text from Attachment 2
Appendix A	Remove the existing Appendix A Coversheet	Insert the New Appendix A Coversheet
	--	Insert the New Appendix A-3 at the end of Appendix A

Please update your copy of the document by replacing those Sections, Table and Figure that are listed above with the enclosed revised Sections, Table, and Figures. Additionally, please add the new Appendix A-3 at the end of Appendix A.

Entire Sections are being issued due to pagination changes from the text changes. The Subsections where text changes have occurred include:

- Section 2:
  - 2.3.1,
  - 2.3.3,
  - 2.5.3;

- Section 3:
  - 3.1,
  - 3.2.1,
  - 3.2.2,
  - 3.2.4,
  - 3.5.1,
  - 3.5.2,
  - 3.5.4,
  - 3.5.5,
  - 3.2.6,
  - 3.2.8; and

- Section 5:
  - 5.2.

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Please contact Valerie Plachy at 412-921-8389 (e-mail Valerie.Plachy@ttnus.com) or me at 412-921-8308 (e-mail Ralph.Basinski@ttnus.com) regarding any questions or comments.

Sincerely,

Please contact Valerie Plachy at 412-921-8389 (e-mail Valerie.Plachy@ttnus.com) or me at 412-921-8308 (e-mail Ralph.Basinski@ttnus.com) regarding any questions or comments.

Ralph R. Basinski

Ralph R. Basinski
Task Order Manager

VJP:RRB/mlg
Enclosure

cc: Mr. Tom Brent, NSWC Crane (letter, 4 copies of enclosure, 1 copy of attachment, and 1 PDF)
Ms. Lee Anne Rapp, NAVFAC Atlantic (PDF copy of letter via e-mail)
Ms. Bonnie Capito, NAVFAC Atlantic (PDF copy of letter via e-mail)
Mr. John Trepanowski, Tetra Tech (letter, enclosure, and attachment)
Mr. Ralph Basinski, Tetra Tech (letter, enclosure, and attachment)
Mr. Timothy Smith, Tetra Tech (letter, enclosure, and attachment)
Ms. Valerie Plachy, Tetra Tech (letter, enclosure, attachment, and PDF)
Mr. Garth Glenn, Tetra Tech (letter only)
Project File – CTO 0042 (Midwest) – (enclosure)

ATTACHMENT 1

RESPONSE TO EPA COMMENTS DATED JUNE 14 AND 21. 2007 FOR DRAFT INTERIM MEASURES WORK PLAN (IMWP) FOR SOLID WASTE MANAGEMENT UNIT (SWMU) 9 (PESTICIDE CONTROL AREA) NAVAL SURFACE WARFARE CENTER (NSWC) CRANE CRANE, INDIANA

EPA comments are shown in bold font. Navy responses to each comment are shown in regular font. Text changes to the IMWP are shown in italic font enclosed in quotation marks within the response.

REVISED RESPONSE TO EPA COMMENTS OF JUNE 14, 2007

NOTE: The following responses to the EPA comments of June 14, 2007 have been revised to address additional comments received from EPA on June 21, 2007.

Comment EPA-1: Could you tell me how you arrived at the "acceptable risk levels" you want to use for verification sampling as noted in the table on page 5-3? Are those driven by ecological/human risk?

Response to EPA-1: With one exception, the media clean-up goals (MCGs) presented below and in Section 5.2 are the TSCA standards for polychlorinated biphenyls (PCBs) for high occupancy and low occupancy areas ***or*** risk-based concentrations (RBCs) derived based on standard human health risk assessment exposure assessment assumptions and risk management benchmarks:

- The recommended MCGs for PCBs are the TSCA high occupancy areas standard of 1 ppm [40 CFR 761.61(a)(4)(i)(A)] and low occupancy areas standard of 25 ppm [40 CFR 761.61(a)(4)(i)(A)],

- The recommended MCG for diesel range organics (DRO) is the IDEM Default Closure Level for direct contact with soil assuming a residential land use scenario, and

- The MCGs for DDT, DDD, DDE, dieldrin, heptachlor, alpha-chlordane, and gamma chlordane are RBCs developed for exposure to soil assuming a residential land use scenario. The RBCs are based on a target hazard index of 0.1 or a cancer risk level (CRL) of 1E-05 (i.e., a one-in-one-hundred thousand probability of developing cancer) whichever value is lower. The risk-based MCGs were calculated based on an HI of 0.1 and a CRL of 1E-05 to assure that the "acceptable" ***cumulative*** non-cancer and cancer risk levels/benchmarks of a H1 = 1 and a CRL =1E-04 would not be exceeded.

All of these MCGs are based on the protection of human health (direct contact exposures). Please note that the cumulative non-cancer and cancer risk management benchmarks referenced above are those historically used to make risk management decisions at the NSWC Crane (i.e., an HI of 1 and a cumulative cancer risk level of 1E-04). <u>The goal of the remediation is to assure that the receptor risk does not exceed these cumulative risk benchmarks</u>. It should be noted that based on the current excavation plan, the somewhat isolated DDT detection in the subsurface soils at location 09SB046 which does exceed the MCG will not be excavated (surface soils at that location will be excavated). However, this detection (10,000 mg/kg) does not exceed a RBC established at a HI = 1 (36,000 mg/kg). When evaluated with other contaminant concentrations anticipated to be left in place (not excavated) this detection does not result in risk estimates exceeding the stated cumulative non-cancer and cancer risk levels/benchmarks. This conclusion will be further evaluated when data for the post-excavation soil confirmation samples are available.

The second table in Section 5.2 has been revised as follows:

"Contaminant Group	*COCs*	*Media Clean-up Goals*
PCBs	*Total PCBs (surface soil)*	*1 ppm*[1]
	Total PCBs (subsurface soil)	*25 ppm*[1]
DRO	*DRO*	*1,600 ppm*[2]
Pesticides	*4,4'-DDD*	*24,300 ppb*[4]
	4-4'-DDE	*17,150 ppb*[4]
	4,4'-DDT	*3,600 ppb*[3]
	Dieldrin	*300 ppb*[4]
	Heptaclhor	*1,050 ppb*[4]
	Alpha-chlordane	*3,500 ppb*[3]
	Gamma-chlordane	*3,500 ppb*[3]

1 - Toxic Substances Control Act (TSCA) high occupancy areas standard of 1 ppm [40 CFR 761.61(a)(4)(i)(A)] and low occupancy areas standard of 25 ppm [40 CFR 761.61(a)(4)(i)(A)].

2 - IDEM Default Closure Level for direct contact to soil under a residential scenario.

3 - Risk-based concentration for residential exposures to soil based on a target hazard index (HI) of 0.1.

4 - Risk-based concentration for residential exposure to soil based on the 1E-05 cancer risk level.

As discussed in response to Comment EPA-5, risks to ecological receptors were also considered in the identification of soil excavation areas.

The first sentence of the second paragraph of Section 5.2 has been replaced with the following text:

> *"The COC media cleanup goals for achieving acceptable human health risks in soil at SWMU 9 are listed in the following table:"*

A new second paragraph has been added to Section 5.2 as follows:

> *"Risks to ecological receptors are based on the evaluation of average chemical concentrations at a particular site. Based on the proposed excavation areas, risks to ecological receptors will be acceptable at SWMU 9 because the excavated areas will be backfilled with clean fill as detailed in Section 3.2.7 and the average concentrations of COCs left in place at SWMU 9 will not exceed remediation goals established for the protection of ecological receptors."*

Comment EPA-2: What QAPP are you using for this work?

Response to EPA-2: The Quality Assurance Project Plan (QAPP) for this work will be developed.

Comment EPA-3: You need to use grab samples for DRO verification.

Response to EPA-3: The Navy agrees. Details on the Diesel Range Organic (DRO) verification gab samples will be included in the QAPP.

For clarification, the following has added to the end of the first paragraph in Section 5.2:

> *"In the case of DRO, grab samples will be analyzed at a rate of one grab sample per 1,000 square feet of excavation floor area and one grab sample per 100 square feet of exposed sidewall."*

Comment EPA-4: How many points make up your proposed composites?

Response to EPA-2: Although the QAPP has not been developed, it is anticipated that the composite sample procedures will be similar to those for SWMU 8 (Building 106 Pond) where composite were collected from four discrete locations.

JUNE 21, 2007 EPA COMMENTS

Comment EPA (6-21-07)-1: For the pesticides, why not apply RISC Residential Default Closure numbers as the Media Cleanup Goals [DDT - 20,000 ppb; Dieldrin - 46 ppb; Heptachlor - 930 ppb; Chlordanes - 9,600 ppb]? It doesn't seem to increase any excavation volumes. In looking at Figure A-1, it looks like everything is pretty well laterally bounded to "No Exc" of screening numbers (which appear to be lower than the Residential Defaults noted above).

Response to EPA (6-21-07)-1: The Media Cleanup Goals (MCGs) for soils were selected or calculated as detailed in the Navy's response to Comment EPA-1 of June 14, 2007. With the exception of reviewer's referenced value for dieldrin (a groundwater protection criterion), the MCGs recommended by the Navy are similar to (or even more conservative than) the IDEM default closure values. As noted above, the Navy's MCGs were derived to assure that cumulative cancer and non-cancer risk benchmarks are not exceeded (for direct contact exposure to soils). The MCGs are not based on groundwater protection because the COCs have not been detected in groundwater at significant concentrations (i.e., the soil COCs are not COCs for groundwater).

MCGs are the maximum concentration, which if present at the excavation sidewalls or floors, would not result in excess human health risk [i.e., ILCR (Incremental Lifetime Cancer Risk) greater than than 1E-04 or Hazardous Indices (HIs) greater than 1]. These values are based on the assumption that all excavation material will be replaced with clean fill as detailed in Section 3.2.7. Achieving these concentrations at the excavation boundaries would result in a no further action (NFA) determination for both human and ecological receptors.

In order to determine whether the proposed soil removal action at SWMU 9 would be protective of ecological receptors, Preliminary Remediation Goals (PRGs) were developed for the short-tailed shrew and American Woodcock, for 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT. The pesticide concentrations remaining in the surface soils post the planned excavation were then compared to the PRGs. The following briefly discusses this evaluation.

Tables 1 and 2 in Attachment 1 present the calculation of the PRGs for the shrew and the woodcock. The PRGs were calculated in an iterative manner by lowering the potential exposure concentration (i.e., the potential PRG) until the Ecological Effects Quotients (EEQs) were slightly less than 1.0. Tables 1 and 2 provide the equations and exposure factors that were used in these calculations. The PRGs were calculated for both receptors using No Observed Adverse Effects Levels (NOAELS) and Lowest Observed Adverse Effects Levels (LOAELs). Table 3 in Attachment 1 is a summary of the PRGs from Tables 1 and 2. The Table 3 shaded cells are the lower value for the NOAEL and LOAEL PRGs between the shrew and woodcock receptors.

Table 4 in Attachment 1 lists the concentrations of selected pesticides for each surface soil sample at SWMU 9. The shaded lines of cells in the spreadsheet list the sample locations that

will be removed as a result of the soil excavation recommended under this Interim Measure. The shaded concentrations in Table 4 are one-half of the contaminant detection limit and are used as surrogate concentrations for the calculation of statistics representing the COC levels post the removal action. The pre-removal pesticide concentrations for the samples to be excavated are presented at the end of Table 4. Additionally, Table 4 presents the recalculated average concentrations, the lowest NOAEL and LOAEL PRGs, and the EPA Region 5 Ecological Screening Levels (ESLs). As shown in Table 4, the PRGs are actually lower than the EPA Region 5 ESLs because different assumptions were used in the food-chain model used to derive the PRGs. The average post-removal SWMU 9 contaminant concentrations are lower than, or just slightly greater than the NOAEL PRGs, and are also lower than the Region 5 ESLs. Therefore, this evaluation indicates that the proposed removal action will be protective of ecological receptors.

Also, why not include cleanup goals for those few other pesticides noted on Figure A-1 as being over screening such as DDD, DDE? That way, we can confirm you're OK across the board for pesticides post-IM removal.

See response to Comment EPA-1. The Navy has calculated and they have been added to the second table in Section 5.2 MCGs for DDD and DDE as presented in the response to Comment EPA-1 on June 14, 2007.

Additionally, clean fill limits have been incorporated into the IMWP through the addition of new seventh and eighth new bullets in the first paragraph of Section 3.2.7 as follows:

- *"4,4'-DDE, USEPA method SW-846 8081 – Less than 3.2 milligrams per kilogram (mg/kg)*
- *4,4'-DDD, USEPA method SW-846 8081 – Less than 3.2 mg/kg"*

Excavation areas were determined based on a risk-based "Media Pick-up Level" (MPL) approach to establish excavation/treatment areas for SWMU 9 because the approach is both protective and cost effective. MPLs are the highest concentrations which, if left in place at a site (i.e., not excavated/treated), would not result in risk estimates exceeding cumulative cancer and non-cancer risk benchmarks established for receptor exposure. The MPLs are determined by an iterative evaluation of the dataset available for a site to determine the concentrations (and associated sampling locations) that are "driving" the risk estimates to exceed acceptable risk management benchmarks. MPLs are determined as follow:

1) The available data (and associated sampling locations) for each significant chemical of concern is listed from highest to lowest concentration for purposes of identifying those samples (and associated contaminant concentrations) most likely to be causing the risk estimates to exceed risk management benchmarks (i.e., the contaminant "hot spot" locations are identified).

2) Once the most significant (i.e, most contaminated) sample locations are identified, exposure point concentrations (EPCs) are re-calculated assuming the most contaminated location(s) are excavated/treated. The risk assessor then recalculates risk estimates based on the new EPCs to determine if the presumed excavation of a sample location(s) would result in risk estimates not exceeding risk management benchmarks established for the project. If the resultant risk estimates still exceed risk management benchmarks, the EPCs (and risk estimates) are re-calculated again based on the assumption that the ***next*** most contaminated sample location(s) are excavated. This iterative process continues until all samples with concentrations causing risk management benchmarks to be exceeded are identified.

3) The maximum concentration that may be left in place (i.e., not excavated/treated) for a particular chemical because risk estimates based on the EPC calculated for ***all*** detected concentrations at or below that value do not exceed risk management benchmarks is referred to the MPL. (MPLs are not strictly risk-based concentrations for a particular chemical [i.e., the values do not represent a particular cancer risk benchmark or a hazard index equal to 1 for a chemical]).

Comment EPA (6-21-07)-2: The DRO goal is noted as 1,600 ppm and the footnote states that is the RISC default residential number. In looking at Table 3-1 of the June 15, 2006 RISC TPH guidance, I find 80 ppm as the residential default closure value for DRO Industrial is 1,000 ppm.

Response to EPA(6-21-07)-2: The DRO value of 1,600 ppm is for direct contact exposures and is listed in the appendix to the RISK TPH guidance. The referenced value from Table 3-1 is the *lowest* of the IDEM criteria values presented in the appendices and is the groundwater protection criterion. All of the MCGs presented in Section 5.2 are based on the protection human receptors potentially directly contacting soils at SWMU 9.

Comment EPA (6-21-07)-3: How do sediments look?

Response to EPA (6-21-07)-3: The draft Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) report did not identify any ecological or human risk for contaminants in sediments.

Comment EPA (6-21-07)-4: Any idea on QAPP submittal timeline?

Response to EPA (6-21-07)-4: Development of the QAPP will commence upon resolution of EPA comments. The draft QAPP is anticipated to be available for EPA review during the first week of August 2007.

<u>Additional Technical Changes</u>

1. To ensure due diligence for backfill material, new third and fourth sentences in the first paragraph of Section 3.2.7 have been added as follows:

   "The backfill soil should come from a source where due diligence shows no evidence of a release of a regulated substance (i.e., clean fill). A certification must be provided regarding the origin of the clean fill, including a statement that, to the best of the provider's knowledge, the backfill soil has not been contaminated with the release of regulated substances."

TABLE 1

SHORT-TAILED SHREW - NOAEL AND LOAEL PRG CALCULATION
SWMU 9 SOUTH (FORMER BUILDING 55)
NSWC CRANE, INDIANA

NOAEL PRG

Parameter	PRGs (mg/kg)(1)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Inverts.	Total Dose (mg/kg/day)	NOAEL (mg/kg/day)	NOAEL EEQ
4,4'-DDD	0.338	1.499	2.97E-04	1.46E-01	1.47E-01	1.47E-01	9.98E-01
4,4'-DDE	0.0953	1.503	8.38E-05	1.47E-01	1.47E-01	1.47E-01	9.99E-01
4,4'-DDT	0.138	1.498	1.21E-04	1.46E-01	1.46E-01	1.47E-01	9.96E-01

NOAEL PRG

Parameter	PRGs (mg/kg)(1)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Inverts.	Total Dose (mg/kg/day)	LOAEL (mg/kg/day)	LOAEL EEQ
4,4'-DDD	0.825	2.793	7.25E-04	2.73E-01	2.74E-01	2.74E-01	9.98E-01
4,4'-DDE	0.193	2.798	1.70E-04	2.73E-01	2.73E-01	2.74E-01	9.98E-01
4,4'-DDT	0.283	2.795	2.49E-04	2.73E-01	2.73E-01	2.74E-01	9.97E-01

(1) - The PRGs were calculated in an interative approach by changing the values until the EEQs were close to 1.0.

Body Weight = (BW)	1.687E-02	kg
Food Ingestion Rate = (If)	1.648E-03	kg/day
Soil Ingestion Rate = (Is)	1.483E-05	kg/day
Home Range = (HR)	9.700E-01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1)	1	

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (invertebrates) = (Ci * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (surface water) + Dose (invertebrates)

Definitions:
EEQ - Ecological Effects Quotient
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

TABLE 2

AMERICAN WOODCOCK - NOAEL AND LOAEL PRG CALCULATION
SWMU 9 SOUTH (FORMER BUILDING 55)
NSWC CRANE, INDIANA

NOAEL PRG

Parameter	PRGs (mg/kg)(1)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Inverts.	Total Dose (mg/kg/day)	NOAEL (mg/kg/day)	NOAEL EEQ
4,4'-DDD	0.396	1.674	3.38E-03	2.23E-01	2.27E-01	2.27E-01	9.98E-01
4,4'-DDE	0.109	1.692	9.30E-04	2.26E-01	2.26E-01	2.27E-01	9.98E-01
4,4'-DDT	0.155	1.657	1.32E-03	2.21E-01	2.22E-01	2.27E-01	9.79E-01

LOAEL PRG

Parameter	PRGs (mg/kg)(1)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Inverts.	Total Dose (mg/kg/day)	LOAEL (mg/kg/day)	LOAEL EEQ
4,4'-DDD	0.537	2.070	4.58E-03	2.76E-01	2.81E-01	2.81E-01	9.98E-01
4,4'-DDE	0.139	2.096	1.19E-03	2.79E-01	2.81E-01	2.81E-01	9.98E-01
4,4'-DDT	0.202	2.085	1.72E-03	2.78E-01	2.80E-01	2.81E-01	9.95E-01

(1) - The PRGs were calculated in an interative approach by changing the values until the EEQs were close to 1.0.

Body Weight = (BW)	1.895E-01	kg
Food Ingestion Rate = (If)	2.526E-02	kg/day
Soil Ingestion Rate = (Is)	1.617E-03	kg/day
Home Range = (HR)	6.133E+01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1)	1	

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (invertebrates) = (Ci * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (surface water) + Dose (invertebrates)

Definitions:
EEQ - Ecological Effects Quotient
NOAEL - No Observed Adverse Effects Level
PRG - Preliminary remediation Goals
Cs = Contaminant concentration in soil
Ci = Contaminant conc. in soil invertebrates (from U.S. EPA (2005)
4,4'-DDD = EXP(0.6975*ln(Cs)+1.1613)
4,4'-DDE = EXP(0.8804*ln(Cs)+2.4771)
4,4'-DDT = EXP(0.8689*ln(Cs)+2.1247)

TABLE 3

SUMMARY OF PRGS FOR SHORT-TAILED SHREW AND AMERICAN WOODCOCK
SWMU 9 SOUTH (FORMER BUILDING 55)
NSWC CRANE, INDIANA

Chemical	Short-Tailed Shrew		American Woodcock	
	SUF 1		SUF 1	
	NOAEL PRG (mg/kg)	LOAEL PRG (mg/kg)	NOAEL PRG (mg/kg)	LOAEL PRG (mg/kg)
4,4'-DDD	**0.34**	0.825	0.396	**0.537**
4,4'-DDE	**0.095**	0.193	0.109	**0.139**
4,4'-DDT	**0.14**	0.283	0.155	**0.202**

The shaded cells are the values that were selected as the PRGs for evaluating the residual site data. (see Table 4)

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
PRG - Preliminary Remediation Goal

TABLE 4

CALCULATION OF AVERAGE PESTICIDE CONCENTRATIONS AFTER THE PROPOSED REMOVAL ACTION IS COMPLETED
SWMU 9 SOUTH (FORMER BUILDING 55)
NSWC CRANE, INDIANA

Sample Location	4,4'-DDD	4,4'-DDE	4,4'-DDT	ALPHA-CHLORDANE	DIELDRIN	GAMMA CHLORDANE	HEPTACHLOR
09SB012	1.65	1.65	1.65	0.8	1.65	0.8	0.8
09SB013	1.6	1.6	1.6	0.75	1.6	0.75	0.75
09SB014	1.6	1.6	1.2	2.4	1.6	3.9	0.75
09SB015/TW001	49	8.1	81	0.75	1.55	0.75	0.75
09SB016	5.1	320	140	3.3	8.1	0.7	0.7
09SB017	1.55	3.8	1.5	0.75	1.55	0.75	0.75
09SB018	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB019	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB020	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB021	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB022	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB023/TW004	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB024/TW006	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB025	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB026	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB027/TW005	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB028	0.785	0.785	6.6	0.378	0.785	0.378	0.378
09SB029	0.825	0.825	0.825	0.3965	0.825	0.3965	0.3965
09SB030	0.885	0.885	0.885	0.426	0.885	0.426	0.426
09SB042	0.835	13	13	0.4015	0.835	0.4015	0.4015
09SB043	0.78	60	66	0.3765	0.78	3.3	0.3765
09SB044	1500	2200	570	900	0.835	820	0.403
09SB045	0.8	0.8	0.8	0.3855	0.8	0.3855	0.3855
09SB046	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB047	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB048	**250**	**560**	**830**	**0.4265**	**0.885**	**0.4265**	**0.4265**
09SB049	0.815	28	9.3	0.3935	0.815	0.3935	0.3935
09SB049A	92	900	690	0.389	0.81	9.6	0.389
09SB065	39	48	34	7.6	0.75	20	0.365
09SB066	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB067	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB068	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB069	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB070	**1.6**	**1.6**	**1.6**	**0.75**	**1.6**	**0.75**	**0.75**
09SB071	0.8	0.8	6.7	0.395	0.8	0.395	0.395
09SB072	36	210	71	0.42		0.42	0.42
09SB073	5.8	230	68	0.385	0.8	2.1	0.385
09SB074	10	76	83	4.6		5.3	0.345
09SB075	0.8	0.8	0.8	0.385	0.8	0.385	0.385
New Average Concentrations	**52**	**120**	**69**	**24**	**1**	**23**	**0.6**
NOAEL PRG[1]	**338**	**95**	**138**	**NA**	**NA**	**NA**	**NA**
LOAEL PRG[2]	**537**	**139**	**202**	**NA**	**NA**	**NA**	**NA**
Region 5 ESL[3]	**758**	**596**	**170**	**224**	**2.38**	**224**	**5.98**

Shaded cells are locations that will be excavated. The concentrations in the cell are 1/2 of the laboratory detection limits.

(1) - No Observed Adverse Effects Level (NOAEL) Preliminary Remediation Goal (PRG) is is based on the shrew (see Table 1 for calculation).

(2) - Lowest Observed Adverse Effects Level (LOAEL) Preliminary Remediation Goal (PRG) is is based on the woodcock (see Table 2 for calculation).

(3) - U.S. EPA Region 5 Ecological Screening Level (U.S. UPA, 2003).

Analytical results for Removed Samples

Sample Location	4,4'-DDD	4,4'-DDE	4,4'-DDT	ALPHA-CHLORDANE	DIELDRIN	GAMMA CHLORDANE	HEPTACHLOR
09SB018	22000	130000	2200000	170000	1650	210000	48000
09SB019	820	3100	27000	700	7	700	3.4
09SB020	1700	670	3500	140	420	150	1.985
09SB021	220	45	180	74	12	50	0.397
09SB022	65	10	66	19	0.845	11	0.406
09SB023/TW004	0.815	0.815	0.815	0.392	0.815	0.392	0.392
09SB024/TW006	0.795	70	350	7.2	0.795	16	0.3835
09SB025	19	400	990	800	17	760	59
09SB026	1800	30000	110000	1000	210	1100	46.9
09SB027/TW005	83	80	47	170	0.77	190	0.371
09SB046	517	1900	130000	249	517	249	249
09SB047	120	300	320	0.3995	6.6	0.3995	0.3995
09SB066	290	730	2500	220		260	
09SB067	160	1500	2000	790	6000	860	0.36
09SB068	0.85	5.9	17	0.42	0.85	0.42	0.42
09SB069	170	180	6400	78	360	73	21
09SB070	5400	3700	190000	360	4200	540	42

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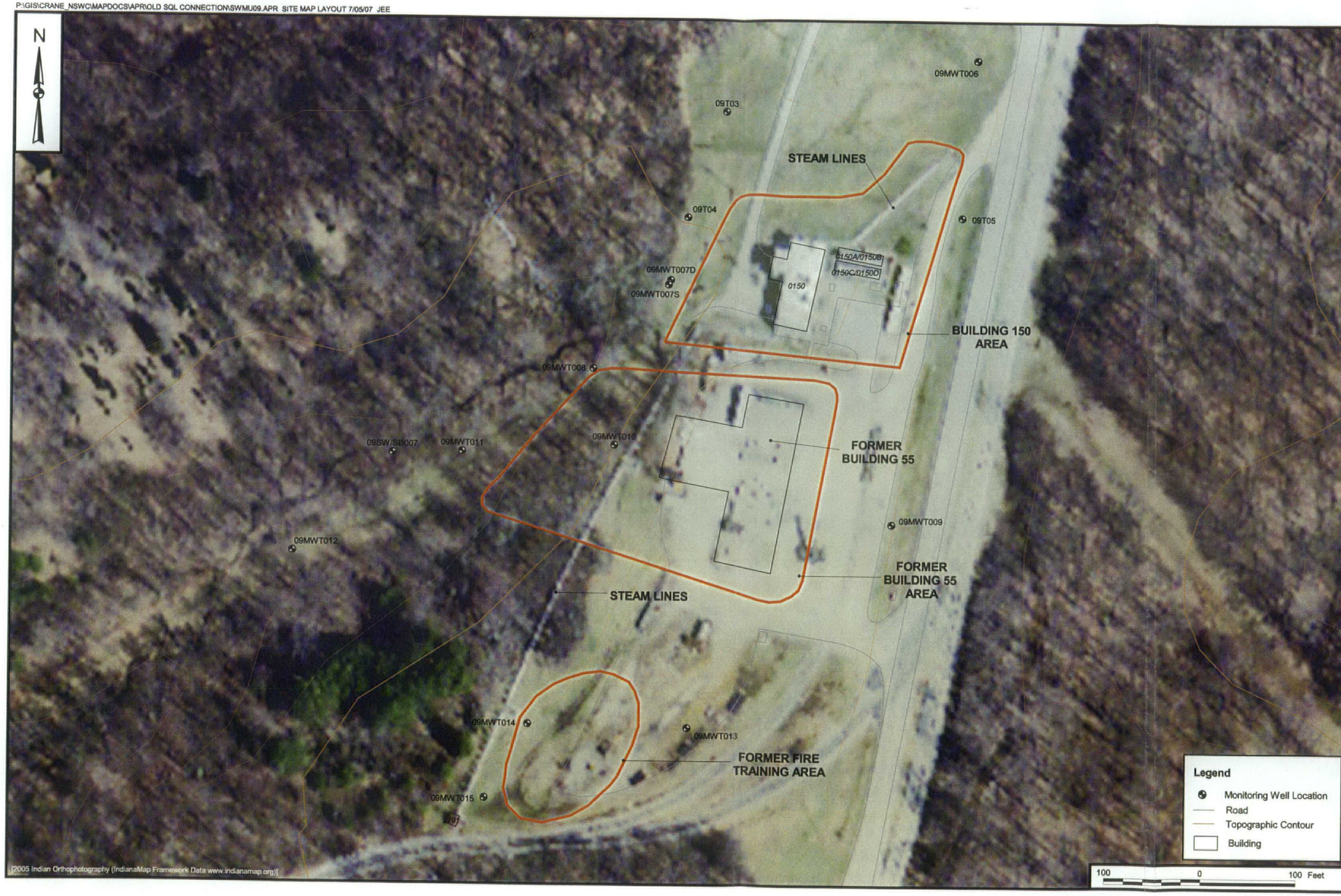
ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AST	aboveground storage tank
bgs	below ground surface
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action Navy
COC	chemical of concern
CTO	Contract Task Order
cy	cubic yard
DNR	Department of Natural Resources
DRMO	Defense Reutilization Marketing Office
DRO	diesel range organics
EMAC	Environmental Multiple Award Contract
ESA	Endangered Species Act
HI	Hazard index
HSWA	Hazardous and Solid Waste Amendments
IAS	Initial Assessment Study
IDEM	Indiana Department of Environmental Management
IMWP	Interim Measures Work Plan
IR	Installation Restoration
LDPE	Low density polyethylene
mg/kg	milligram(s) per kilogram
MSDS	Material Safety Data Sheet
NSWC	Naval Surface Warfare Center
OICC	Officer in Charge of Construction
PCB	polychlorinated biphenyl
ppb	parts per billion
ppm	parts per million
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RISC	Risk Integrated System of Closure
Sf	square feet

SWMU	Solid Waste Management Unit
TPH	total petroleum hydrocarbon
TtNUS	Tetra Tech NUS, Inc.
µg/kg	micrograms/kilogram
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UST	underground storage tank

P:\GIS\CRANE_NSWC\MAPDOCS\APR\OLD SQL CONNECTION\SWMU09.APR SITE MAP LAYOUT 7/05/07 JEE



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DRAWING NO. FIGURE 1-2 REV 0

SITE LAYOUT MAP
SWMU 9
INTERIM MEASURES WORK PLAN
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY S. PAXTON DATE 2/12/07

CHECKED BY T. SMITH DATE 7/05/07

COST/SCHED-AREA

SCALE AS NOTED

2.0 SITE SUMMARY

2.1 SITE SUMMARY

This section describes the physical and geophysical conditions of areas addressed in the SWMU 9 IMWP. These descriptions were excerpted from the SWMU 9 RCRA Corrective Measures Study Report (TtNUS, 2004).

2.1.1 Physiography and Topography

SWMU 9 is located in the Crawford Upland area of the NSWC facility. The topography at SWMU 9 consists of undulating terrain dissected by many small drainageways. SWMU 9 lies along the northwestward slope of a topographic high created by a road (Highway 45) and a railroad located east of the site and oriented north to south.

Elevations at SWMU 9 range from a low of approximately 690 feet above mean sea level (msl) along the unnamed tributary west of SWMU 9 to approximately 720 feet above msl along Highway 45 east of SWMU 9. Thus, there is a total relief of approximately 30 feet across SWMU 9.

2.1.2 Surface Water Hydrology

As indicated above, the topography at SWMU 9 consists of a ridge that runs along Highway 45 in a north-south orientation with gradual slopes to the west. The crest of the ridge forms the eastern limits of SWMU 9. Surface water runoff east of the topographic high runs east through several drainage ditches that convey flow to an unnamed stream, which in turn, flows southward and discharges into Turkey Creek. Surface water west of the topographic high (SWMU 9 surface water) runs west across SWMU 9 and enters several drainage ditches that convey flow to an unnamed stream that also flows southward and discharges to Boggs Creek.

2.1.3 Geology

SWMU 9 is underlain by up to 10 feet of unconsolidated natural material overlying Pennsylvanian age sedimentary rocks of the Raccoon Creek Group Mansfield Formation. Soils mapped at SWMU 9 are representative of residual soils derived from the Pennsylvanian bedrock. The encountered subsurface materials at SWMU 9 include natural unconsolidated materials and bedrock. The natural unconsolidated materials are extensive across the SWMU 9 area and consist primarily of silt and clay. Bedrock was

encountered at depths as shallow as 5 feet below ground surface (bgs) and consists primarily of sandstone with lenses of siltstone, shale, and coal.

2.1.4 Hydrogeology

Groundwater is present beneath the NSWC Crane in both the natural unconsolidated materials and bedrock. The depth to groundwater ranges from less than 5 feet bgs in low areas near surface water bodies to 25 feet bgs at higher elevations. The majority of the monitoring wells at SWMU 9 were completed within the first groundwater-yielding unit encountered during drilling, which existed in either the natural unconsolidated material or the shallow bedrock. Groundwater flows through the unconsolidated material or in fractures in shallow bedrock where it appears to be hydraulically connected. This shallow groundwater system flows generally west and southwest toward the stream valleys that serve as groundwater discharge points. The hydraulic gradient in the shallow groundwater system is approximately 0.08 foot/foot. A well (0914A) was installed deeper in bedrock in an interbedded shale and sandstone was found to contain no groundwater. A shale unit was also encountered less than 10 feet bgs in this boring. It may be possible that shallow groundwater becomes perched on the shale and other lower permeable units that act as localized aquitards within the bedrock, therefore limiting the vertical hydraulic connection in the bedrock.

2.2 PREVIOUS INVESTIGATIONS

The major sources of contamination at SWMU 9 include the rinsing of pesticide containers and minor spills near former Building 55, fuel spills from tanks located in the vicinity of Building 150, and activities conducted at the former fire training area south of former Building 55. Various environmental investigations have been conducted at SWMU 9. Because of the detection of significant concentrations of known contaminants in soil, the discovery of unsuspected contaminants during field sampling, information gathered on historical operations from facility documents, and revisions to the IDEM Risk Integrated System of Closure (RISC) TPH guidance, these various environmental investigations have evolved through multiple field efforts. For ease of discussion, the SWMU 9 investigations are referred to in the following paragraphs as Phase 1, Phase 2, Phase 3, and Phase 4 Investigations. Prior to sampling during Phases 1, 2, 3, and 4, SWMU 9 was believed to be located north of its actual location. Sampling at the believed SWMU location was conducted in 1992 and 2000. The locations of the samples collected during these earlier investigations that are within the vicinity of the actual SWMU 9 location are shown on Figures 2-1, 2-2, 2-3, and 2-4). The analytical results from these investigations are presented in Appendix A. Since the focus of the IMWP is to address soil contamination at SWMU 9, the following sections will focus on the results from the Phases 1, 2, 3, and 4 soil investigations.

2.2.1 Phase 1 Investigation (March 2005)

Field activities for the Phase 1 investigation consisted of collecting surface soil, subsurface soil, groundwater, surface water, and sediment samples within the area of historical pesticide operations (former Building 55). Analytical results indicated that pesticides were present beyond the area sampled. In addition, the area adjacent to the assumed pesticide operations area (south of former Building 55) showed evidence of PCBs in groundwater. Figure 2-1 presents the Phase 1 sampling locations.

2.2.2 Phase 2 Investigation (May 2005)

The Phase 2 investigation included further delineation of the nature and extent of contamination found in Phase 1. Figure 2-2 presents the Phase 2 sampling locations. The analytical results from the two phases indicated the following:

- Significant pesticide and petroleum contamination was present in the soil and confined primarily to an area along a hillside adjacent to a former wash rack located immediately west of former Building 55.
- Petroleum products were detected in sediment within a nearby (downgradient) tributary.
- High levels of PCBs were found in surface and subsurface soils in an area immediately to the south of the assumed pesticide operations area (the fire training area).

Based on these findings, additional discussions were held with the base historian and the following two additional findings were made:

- Fire training exercises were conducted in the past using burning pans (and possibly transformer oil) in the area where the Phase 2 investigation indicated elevated levels of PCBs in surface and subsurface soils. Other than the presence of an aluminum pan and lid in that area, there is no visual evidence of where the training was actually conducted. The duration of the fire training and the types and volumes of fuel used are unknown.
- An oil spill occurred on March 6, 2003 at a location immediately to the north of where the current SWMU 9 investigation is being conducted. The reported 100-gallon spill was from one of the two aboveground storage tanks (ASTs) located on the northeastern side of Building 150. The spill flowed from the AST to a nearby drainage ditch that discharges to the small tributary on the western side of

Building 150 that was identified in the Phase 2 investigation as containing petroleum contamination. The spill was reported to IDEM, and correspondence and response actions were documented in the NSWC Crane Spill Log.

A site visit was conducted by the Navy, USEPA, and TtNUS on August 3, 2005 in preparation for the Phase 3 investigation. During the visit, a NSWC Crane drawing (PW Drawing 64 dated February 1946) was reviewed. This drawing indicated the presence of a former gas station and two ASTs located approximately 70 feet southeast of former Building 55. The presence of these ASTs indicated the need to perform additional sampling within the area of the former gas station located east of the former Building 55 area.

2.2.3 Phase 3 Investigation (October 2005)

Based on the findings during Phases 1 and 2, the Phase 3 investigation focused on six areas: the hillside adjacent to the wash rack, the fuel spill of March 6, 2003, the tributary downgradient of the site, the fire training area, restroom piping, and the former gas station. The following paragraphs describe the results of the investigations at these locations and Figure 2-3 presents the sampling locations.

Hillside Adjacent to the Wash Rack – Previous investigations showed elevated concentrations of pesticides in surface and subsurface soil along a hillside immediately west of former Building 55. Additionally, two samples collected during Phase 2 were visually stained and had a strong petroleum odor and therefore were analyzed for TPH. In order to delineate the nature and extent of soil contamination along the hillside adjacent to the wash rack, seven additional soil borings (SB042 through SB045 and SB047 through SB049) were installed. Three permanent groundwater monitoring wells (T08, T011, and T012) were installed downgradient of the hillside and close to a tributary immediately downgradient of the hillside (monitoring well locations identified on Figure 1-2).

Fuel Spill of March 6, 2003 – Prior to Phase 3, no known sampling and analysis had been conducted related to the fuel spill of March 6, 2003 at the Building 150 ASTs. No visual evidence of the spill was observed during the site visit on August 3, 2005. During Phase 3, soil samples were collected adjacent to the ASTs along the northeastern part of the building where the spill reportedly occurred. Two soil samples were collected from within the drainage ditch and along the bank of the parking lot adjacent to the area of the spill. A smaller, AST (approximately 250 gallons) is located along the southern wall of Building 150. The soil close to the concrete pad for the AST was stained with petroleum, and therefore samples from two soil borings were collected at this area.

Tributary Downgradient of Site – A small tributary is located in the western downgradient portion of SWMU 9 as seen on Figure 2-3. Surface water flow within this tributary originates toward the north within the vicinity of Mine Fill A and flows in a southwesterly direction along the western side of SWMU 9 South. Surface water and sediment samples were collected within this tributary to delineate the nature and extent of contamination detected during phases 1 and 2. Pesticides and petroleum products were also detected within this tributary in surface water and sediment.

Fire Training Area – During Phase 1, PCBs were detected in a perched water sample collected from a temporary well point within the area of former fire training operations. This area is located approximately 250 feet south of the former Building 55. Groundwater sampling during Phase 2 investigation from three temporary well points did not confirm the presence of PCBs in the groundwater. It should be noted that the sample collected during Phase 1 was unfiltered and the samples collected during Phase 2 were filtered. Five surface soil samples were analyzed for PCBs during Phase 2, and all had detectable concentrations of PCBs ranging from 42 to 260,000 micrograms/kilogram (µg/kg). Because of the high concentrations of PCBs, the area surrounding these sample points was delineated with a fence of rebar and caution tape. During Phase 3, eight additional soil samples (SB050 through SB057) were collected within this area to determine the nature and extent of PCB contamination. The locations of these borings are shown on Figure 2-3. Three permanent groundwater monitoring wells were also installed within this area; T013 serves as an upgradient well and T014 and T015 as downgradient wells. PCBs were not detected in samples from these wells.

Restroom Piping – It was determined that the three pipes protruding above the ground within the footprint of the former Building 55 are the remains of plumbing within a former restroom. The pipes are currently plugged with soil. No soil staining is present within the area. Although a surface soil sample (SB064) was scheduled to be collected from the largest pipe with a flanged head connection, an insufficient volume of soil was contained within the pipe for analysis. An effort will be made during subsequent sampling efforts to collect a soil sample from within this pipe and within the general area.

Former Gas Station – The remains of a concrete fuel dispenser foundation are the only remaining structure that indicates the presence of the former gas station. During Phase 3, soil samples were collected from two openings within the existing concrete pad (SB058 and SB059) that may have supported fuel dispensers. Four additional soil borings (SB060 to SB063) were collected from the area where the aboveground storage tanks (ASTs) were thought to be located. One upgradient groundwater monitoring well (T09) and one downgradient well (T013) were also installed. It should be noted that well T13 also serves as the upgradient well for the Fire Training Area.

2.2.4 Phase 4 Investigation (August 2006)

Analytical results from the first three phases of investigation did not fully delineate the extent of surface and subsurface soil contamination in the area west of former Building 55 and within the former gas station area. Additionally, soil samples needed to be collected and analyzed at the fuel spill area at Building 150 for specific PAHs and related constituents using the IDEM RISC TPH guidance and the USEPA speciation recommendation. In total, 21 additional soil borings were advance in these areas and samples were collected from various depths at each location (see Figure 2-4).

2.3 EXTENT OF CONTAMINATION

Using the analytical data obtained from the four SWMU 9 field investigations within and around Building 150, former Building 55, and the fire training area, TtNUS has started the process of developing human health and ecological risk assessments. The preliminary results of these risk assessments were used to develop a list of chemicals of concern (COCs) detected at concentrations that present unacceptable risks to ecological and human receptors. The COC detections were used to establish the locations that require excavation to reduce the risks associated with the site to acceptable levels.

2.3.1 Human Health

The results of the preliminary risk assessment identify seven COCs as causing unacceptable human health risks. Under an industrial land use scenario, the COCs include total PCBs, 4,4'-DDT, and diesel range organics (DRO) in the surface soil (0 to 2 feet bgs) and total PCBs and DRO in the subsurface soil (deeper than 2 feet bgs). Under a residential land use scenario, the COCs include total PCBs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, heptachlor, alpha-chlordane, gamma-chlordane, and DRO in the surface soil (0 to 2 feet bgs) and total PCBs and DRO in the subsurface soil (deeper than 2 feet bgs).

Using average COC concentration values, an unacceptable cancer risk level of $1x10^{-5}$, and an unacceptable hazard index (HI) of 0.1, locations requiring excavation to ensure an acceptable cancer risk level of $1x10^{-4}$ and an acceptable HI of 1.0 were identified by replacing elevated COC concentrations with clean fill that theoretically had COC concentrations equal to one half the analytical detection limits. Under an industrial land use scenario, these calculations identified sample locations 09SB018 (surface soil only), 09SB031 (surface and subsurface soil), 09SB032 (surface and subsurface soil), and 09SB034 (surface soil only) as locations to be excavated (locations identified on Figure 2-5). Under a residential land use scenario, these calculations identified sample locations 09SB018 (surface and subsurface soil), 09SB019 (subsurface soil), 09SB024 (subsurface soil), 09SB026 (surface soil only), 09SB031 (surface and subsurface soil), 09SB032 (surface and subsurface soil), 09SB034 (surface soil only), 09SB040

(surface soil only), 09SB046 (surface and subsurface soil), and 09SB070 (surface soil only), as locations to be excavated (locations identified on Figure 2-6).

2.3.2 Ecological

In addition to the preliminary human health risks, preliminary ecological risks were identified. The preliminary ecological risk assessment identified COCs including 4-4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, gamma-chlordane, dieldrin, and heptachlor. Although ecological preliminary remediation goals were not developed, the preliminary ecological risk assessment identified locations where a minimum of 2 feet of soil needs to be removed to reduce the risks to ecological receptors to acceptable levels. These locations include former Building 55 soil boring locations 09SB018, 09SB019, 09SB020, 09SB021, 09SB022, 09SB025, 09SB026, 09SB046, 09SB066, 09SB067, 09SB069, 09SB070 and fire training area soil borings 09SB031, 09SB032, and 09SB034 (see Figure 2-7).

2.3.3 Extent of Unacceptable Risk

A review of the results of the preliminary human health and ecological risk assessments indicates that the remedial action required under an industrial land use scenario is similar to the remedial action required under a residential land use scenario. That is, the soil required to be excavated to reduce ecological risks encompasses the soil that requires removal to reduce human health risk to acceptable levels under both the industrial and residential scenarios. Figure 2-7 presents the extent of contamination that requires remediation to achieve acceptable human health and ecological risks. Figures provided in Appendix A present the COCs and the concentrations of the COCs.

Note, although contamination within the subsurface of soil boring 09SB046 presented an unacceptable risk, the COC concentrations only slightly exceeded the cleanup goals. Therefore, it was determined that this subsurface soil could be left in place. However, prior to backfilling the surface soil in this area a discrete verification sample will be collected following surface soil removal at the 09SB046 location. If COCs within this sample exceed present concentrations, additional soil will be removed.

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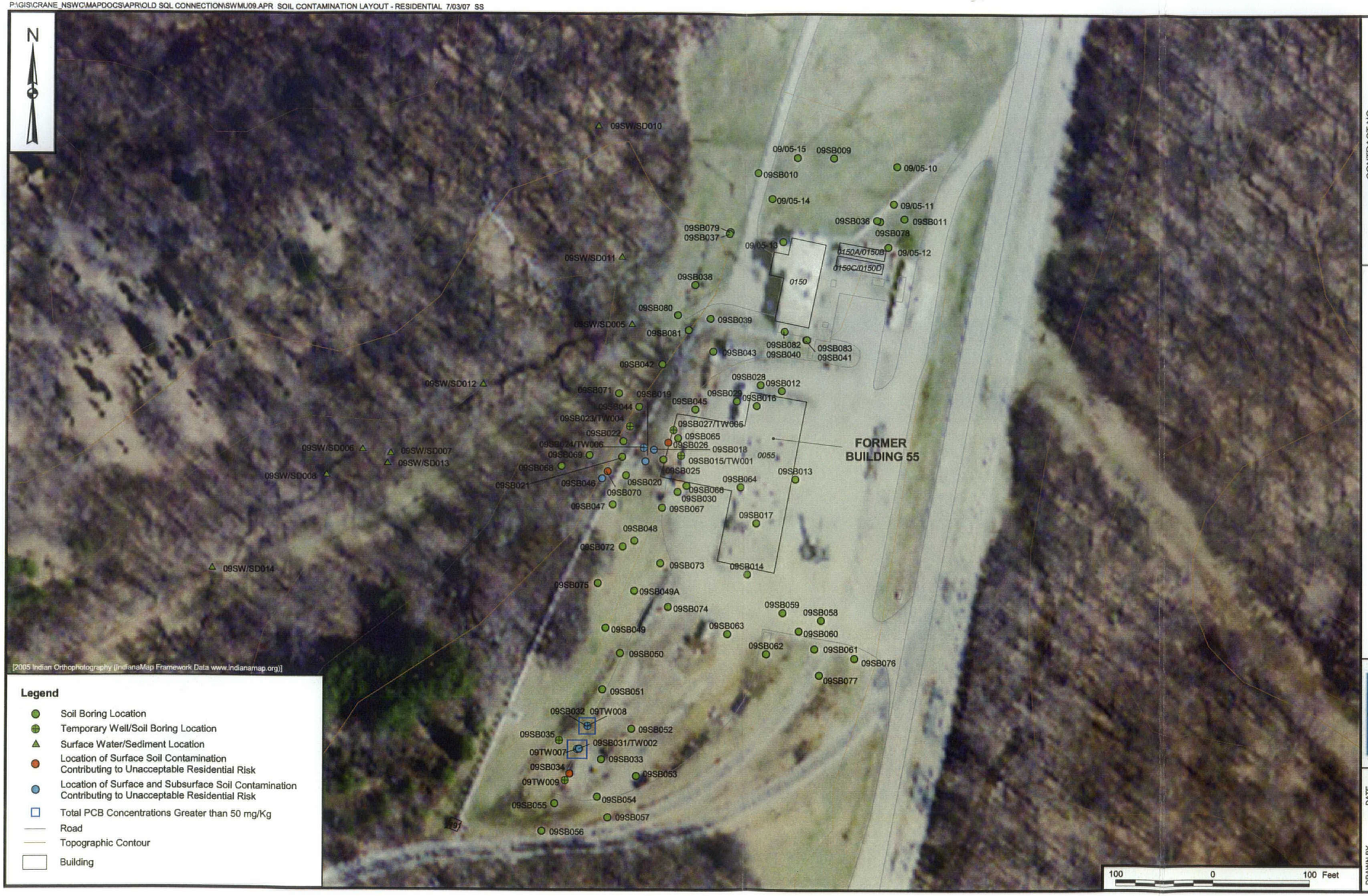

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REV 0

SOIL CONTAMINATION CAUSING RESIDENTIAL RISK
SWMU 9
INTERIM MEASURES WORK PLAN
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY J. ENGLISH DATE 6/07/07

CHECKED BY T. SMITH DATE 7/03/07

COST/SCHED-AREA

SCALE AS NOTED

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CTO 00042

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 2-7

REV 0

EXTENT OF CONTAMINTION
SWMU 9
INTERIM MEASURES WORK PLAN
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY S. PAXTON DATE 6/08/07

CHECKED BY T. SMITH DATE 7/03/07

COST/SCHED-AREA

SCALE AS NOTED

3.0 INTERIM MEASURES WORK PLAN

The intent of this IMWP is to remove surface and subsurface soil at SWMU 9 containing COCs at concentrations resulting in unacceptable risks to human health and ecological receptors As per Section 2.3.3, the remedial action needed to reduce the ecological risks to acceptable levels will result in achieving acceptable residential direct contact human health risks. The remainder of this section describes the remedial activities and soil volumes to be removed in order to satisfy human and ecological risk reduction requirements in SWMU 9 surface and subsurface soil.

3.1 DESCRIPTION OF THE INTERIM MEASURES

The IMWP specifies the removal of contaminated surface and subsurface soil within the limits of SWMU 9 that has been identified as containing COCs at concentrations that result in unacceptable ecological and human health risks. The excavation volumes presented in this IMWP are in-place estimates; in an unconsolidated state, it is expected that these volumes will increase based on an expansion factor of 5 to 10 percent.

A work assignment responsibility chart (Table 3-1) identifies the responsibilities of the Environmental Multiple Award Contract (EMAC) contractor, NSWC Crane, and TtNUS in the implementation of this IMWP.

Specifically, the IMWP consists of the following major components:

- Surface Soil Excavation – Three areas within the limits of SWMU 9 require surface soil excavation to achieve acceptable human health and ecological risks. These locations include an area approximately 130 feet by 100 feet by 2 feet deep located south and west of former Building 55, an area approximately 120 feet by 50 feet by 2 feet deep located at the former fire training area, and an area approximately 30 feet by 15 feet by 2 feet deep located at the southern end of Building 150. The surface soil will be excavated, characterized for disposal purposes, and transported and disposed off site at an approved facility. The surface soil excavation areas are identified on Figures 3-1 and 3-2.

- Subsurface Soil Excavation – Two areas within the limits of SWMU 9 require subsurface soil excavation to achieve acceptable human health risk levels. These locations include an area approximately 90 feet by 50 feet by 5 feet deep (2 to 7 feet bgs) located at the former fire training area and an area approximately 30 feet by 25 feet by 4 feet deep (2 to 6 feet bgs) located west of

former Building 55. The subsurface soil will be excavated, characterized for disposal purposes, and transported and disposed off site at an approved facility. The subsurface soil excavation areas are identified on Figures 3-1 and 3-2.

- Steam Line Support – Due to the proximity of the former Building 55 and Building 150 excavation areas to active steam lines, steam line support systems will need to be erected. The support systems will allow for the continual operation of the steam lines while excavation is conducted around the steam line foundation concrete pier structures. Where supports are required across surface soil excavation areas (0 to 2 feet bgs), the support system need only prevent lateral movement of the steam lines since excavation is not expected to extend to depths greater than the existing concrete foundations (existing concrete piers extend at a minimum to a depth of 2.5 feet bgs). Where supports are required across subsurface excavation areas (greater than 2.5 feet bgs), the support system may need to prevent lateral and horizontal movement of the steam lines since the excavation may encompass and extend to depths grater than the existing concrete foundations. The anticipated extent of steam line that is affected by the soil excavation is identified on Figure 3-1.

- Disposal of Debris – A pile of debris consisting primarily of scrap steel and creosoted wood product is located at the former SWMU 9 fire training area. This pile, which contains approximately 10 cubic yards of material, will be removed from SWMU 9 and stockpiled separately from other soils removed from SWMU 9. The creosoted wood product will be disposed along with the excavated soil. The scrap steel will be salvaged if possible. If scrap steel cannot be salvaged, the scrap steel will be cut into manageable pieces for characterization and off-site disposal. The location of the debris pile is identified on Figure 3-2.

- Dewatering of Subsurface Soils – In the event that subsurface excavation extends below the water table, subsurface soils may need dewatering prior to disposal to meet transportation and disposal requirements. The water drained from the stockpiled soil during dewatering will be containerized, filtered, and characterized. If following characterization treatment will not be required, then the collected water will be discharged to a local stabilized drainage channel or the nearest storm drain. However, if characterization indicates treatment is necessary, the EMAC contractor will arrange for off-site disposal or treatment. The volume of water collected through dewatering is not expected to be large unless excavation/removal is performed during periods of heavy rain.

- Sampling and Analysis – Following the excavation/removal of identified surface and subsurface soil, the exposed surfaces of the excavation areas will be sampled to verify contaminant removal. The

Contracting Officer may require additional excavation based on the analytical results of verification sampling. In addition, at the completion of this IMWP and following the removal of the support facilities (e.g., dewatering pad, access road, decontamination pad, and material storage area), the Contracting Officer will require verification samples to confirm that the lining systems of the support facilities did not fail during the implementation of this IMWP. If it is determined that the lining system under any of the support facilities did fail, potentially resulting in the contamination of the soil below a support facility, the EMAC contractor will be required to remove that contamination at their own expense. Section 5.0 presents sampling and analysis procedures.

- Off Site Disposal of Soils – Excavated soil will be disposed at an off-site, NSWC Crane-approved waste disposal facility. Based on in place concentrations, some of this material will be disposed at a hazardous waste disposal facility. Section 3.2 describes the locations and volumes of hazardous and non-hazardous waste. Verification of proper disposal will be the responsibility of the EMAC contractor by segregating materials and conducting characterization sampling and analysis to the satisfaction of the approved waste disposal facility.

- Backfilling and Restoration – After verification that the contaminated surface and subsurface soils have been removed, the excavated areas will be backfilled and regraded to match pre-construction grades and surrounding surfaces. In addition, the backfilled areas will be restored to pre-construction surface conditions using permanent stabilization practices that include vegetation and gravel pavement.

- Detailed Characterization Sampling Plan – The EMAC contractor will prepare a characterization sampling plan as indicated in Table 3-1. This plan must describe sampling procedures for excavated soils collected wastewaters, and removed debris. The sampling procedures and analytical methods must comply with acceptable methods and must also comply with the requirements of the approved waste disposal facility.

3.2 PERFORMANCE STANDARDS

Performance standards for the IMWP are presented in the following sections.

3.2.1 Surface Soil Excavation

All surface soils excavated from SWMU 9 that are identified as having COCs at concentrations that result in unacceptable risks to human and ecological receptors will be removed, characterized, and disposed at

an approved off-site hazardous and/or non-hazardous waste disposal facility. Soil from each surface soil excavation area will be stockpiled or containerized separately for characterization purposes. The stockpiled soil will be placed on a material handling pad located adjacent to each excavation area or at a central location. The material handling pad(s) will be constructed in accordance with Section 3.2.12. Alternatively, removed soil may be placed in roll-off boxes or other approved containers placed adjacent to each excavation area or in a central location. When transporting soil, appropriate measures such as lining the roll-off boxes or containers or providing sealed tailgates must be used to prevent loss of stored material during transportation. All excavated soil will remain on site until waste characterization has been completed.

The planned surface soil excavation (0 to 2 feet bgs) areas are identified on Figures 3-1 and 3-2. The area located at the former fire training area (south of former Building 55) measures approximately 3,013 square feet (sf) and includes approximately 223 cubic yards (cy) of non-hazardous soil (based on contaminant concentrations). The area located south and west of the former Building 55 measures approximately 8,990 sf and includes approximately 666 cy of hazardous soil (based on contaminant concentrations and process). The area located south of Building 150 measures approximately 350 sf and includes approximately 26 cy of non-hazardous soil (based on contaminant concentration). The excavation areas south and west of former Building 55 and south of Building 150 extend below existing steam lines. Excavation around steam line supports (concrete piers) and directly beneath the steam lines must be conducted by hand.

Northing and Easting coordinates for the surface soil excavation area vertices are provided in Table 3-2. The volume of soil removed from each excavation area is based on the area of each excavation and the 2-foot excavation depth, with no sloping of the excavation sides. Volume calculations are provided in Appendix B and summarized below:

Surface Soil Excavation				
Excavation Area	**Area**	**Depth of Excavation**	**Volume**	**Weight**
Fire Training Area*	3,013 sf	2 feet bgs	223 cy	331 tons
Former Building 55 Area**	8,990 sf	2 feet bgs	666 cy	989 tons
Building 150 Area	350 sf	2 feet bgs	26 cy	39 tons
Total Surface Soil to be Excavated			915 cy	1,359 tons

* Non-hazardous material
** Hazardous material

Physical features will not be removed during the excavation of surface soils. Physical features include, but are not limited to, steam lines, monitoring wells, buildings, concrete pads, railroad track, and bituminous concrete paved roads. The NSWC Crane Officer in Charge of Construction (OICC) will clearly identify the physical features that are not to be removed or disturbed prior to implementation of this IMWP. The volume estimates presented in this IMWP assume that these physical features remain in place.

Sediment that accumulates in the erosion and sediment control devices (see Section 4.0) prior to verification that all contaminated soil has been removed from the associated surface soil excavation areas will be disposed off site along with the excavated contaminated surface soil. Following verification of contaminant removal, sediment that accumulates in the erosion and sediment control devices will be placed in the excavation as backfill material or spread across the disturbed ground surface of the associated soil excavation area.

3.2.2 Subsurface Soil Excavation

All SWMU 9 subsurface soils identified as having COCs at concentrations that results in unacceptable risks to ecological and human receptors will be removed, characterized, and disposed at an approved off-site hazardous and non-hazardous waste disposal facility. Excavated/removed soil will be stockpiled or containerized for characterization purposes. If the excavated soil is stockpiled, it will be placed on a material handling pad located adjacent to the excavation area or at a central location. The material handling pad(s) will be constructed in accordance with Section 3.2.12. Alternatively, removed soil may be placed in roll-off boxes or other approved containers placed adjacent to each excavation area or in a central location. When transporting soil, appropriate measures such as lining the roll-off boxes or containers or providing sealed tailgates must be used to prevent loss or stored material during transportation. All excavated soil will remain on site until waste characterization has been completed.

The planned subsurface soil excavation areas are identified on Figures 3-1 and 3-2. The area located at the former fire training area (south of former Building 55) measures approximately 2,344 sf by 5 feet deep (2 to 7 feet bgs) and includes approximately 395 cy of non-hazardous and 39 cy of hazardous soil (based on contaminant concentrations). The hazardous material (PCB concentrations greater than 50 mg/kg) must be excavated and stockpiled separately. This area is identified on Figure 3-2 and measure 350 square feet by 3 feet deep. The area located west of former Building 55 measures approximately 750 sf by 4 feet deep (2 to 6 feet bgs) and includes approximately 111 cy of hazardous soil (based on contaminant concentration and process). The side sloping of the excavation area west of former

Building 55 extends below existing steam lines. Excavation around steam line supports (concrete piers) and directly beneath the steam lines must be conducted by hand.

Northing and Easting coordinates for the subsurface soil excavation area vertices are provided in Table 3-2. Due to the depth of this excavation, the sidewalls will be sloped to provide stable excavation surfaces. This layback of side slopes requires the removal of an additional 312 cy of soil from the former fire training area excavation and an additional 82 cy of soil from the area west of former Building 55. This soil will be disposed off-site with the other excavated soils but should be kept separate from identified hazardous materials to the extent possible for disposal characterization purposes. It is expected that this material will be characterized as non-hazardous waste (at the former fire training area) and hazardous waste (west of former Building 55). The side sloping for the excavation areas are identified on Figures 3-1 and 3-2. Excavation volume calculations, including the side slope volumes, are provided in Appendix B and summarized below:

Subsurface Soil Excavation				
Excavation Area	**Area**	**Depth of Excavation**	**Volume**	**Weight**
Fire Training Area*	2,344 sf	5 feet bgs	395 cy(1)	586 tons
Fire Training Area**	350 sf	4–7 feet bgs	39 cy	58 tons
Fire Training Area Side Slopes*	--	5 feet bgs	312 cy	463 tons
Former Building 55**	720 sf	4 feet bgs	111 cy	165 tons
Former Building 55 Side Slopes**	--	4 feet bgs	84 cy	125 tons
Total Subsurface Soil to be Excavated			**820 cy**	**1,397 tons**

* Non-hazardous
** Hazardous
(1) This volume is the total subsurface volume (434 cy) minus the hazardous material (39 cy).

Physical features will not be removed during the excavation of subsurface soils. Physical features include, but are not limited to, steam lines, monitoring wells, buildings, concrete pads, railroad track, and paved roads. The NSWC Crane OICC will clearly identify the physical features that are not to be removed or disturbed prior to implementation of this IMWP. The volume estimates presented in this IMWP assume that these physical features remain in place.

Sediment that accumulates in the erosion and sediment control devices (see Section 4.0) prior to verification that all contaminated soil has been removed from the associated soil excavation will be

disposed off site along with the excavated contaminated surface soil. Following verification of contaminant removal, sediment that accumulates in the erosion and sediment control devices will be placed in the excavation as backfill material or spread across the disturbed ground surface of the associated soil excavation area.

3.2.3 Steam Line Support

The excavation of contaminated soils at SWMU 9 will result in the requirement to support the existing active steam lines that traverse the proposed excavation area west of former Building 55 and south of Building 150. The excavation in these areas include the removal of soil from beneath active steam lines. As shown on the drawing provided in Appendix C, the existing concrete piers used for steam line support in this area extend to a minimum depth of 2.5 feet bgs. Therefore, the surface soil excavation will not undermine the concrete piers south of Building 150. However, because of the subsurface excavation west of former Building 55 it appears that the concrete piers in this area will be undermined (Verification of undermining will depend upon side sloping and actual concrete pier locations).

As indicated above, it is likely that the steam line concrete piers will be undermined due to subsurface excavation activities west of former Building 55. Therefore, the support system for the steam lines in this area, and any other area where verification samples require deeper excavation, need to be capable of supporting the existing steam lines at their current horizontal and vertical alignment. In this situation, the temporary steam line support system will be installed prior to undermining the existing concrete piers and the existing concrete piers will be disconnected from the steam line support structure and disposed off site with the excavated soils. To re-establish the steam line support system the following requirements shall be met.

- Because of the existing steam line arrangements, placing the concrete piers directly below the steam lines will not be possible. Therefore, a minimum of two concrete piers will be required to re-support the steam lines within the excavation area.

- Backfilled soil placed within the excavation below steam lines will compacted to 95 percent standard proctor. The EMAC contractor will be required to perform compaction tests to verify adequate compaction.

- New pier holes will be drilled following backfilling of the entire excavation. The pier holes will be sized to allow the installation of a 2.5 foot inside-diameter sonitube placed at a minimum depth of 2.5 feet bgs.

- Concrete used to fill the sonitubes will be 4,000 psi strength. Refer to the drawings provided in Appendix C for concrete pier construction requirements.

- The steel steam line support frame will be reconstructed to accommodate the required two pier support system. Refer to the drawings provided in Appendix C for steel framing requirements and framing/concrete pier attachment requirements.

The EMAC contractor will be required to submit a proposed temporary steam line support system plan for NSWC Crane approval. Additionally, the EMAC contractor will be required to submit a steam line support replacement plan along with proposed construction drawings for NSWC Crane approval. Excavating around steam line supports will not be permitted until these plans are approved.

3.2.4 Dewatering

It is not anticipated that excavated soil will require dewatering. However, in the event that subsurface excavation limits require the removal of saturated soil, dewatering of the soil will be required prior to transportation and off-site disposal. Excavated soil that requires dewatering will be dewatered adjacent to the excavation area. This material will be placed on a material handling pad at a lift thickness no greater than 3 feet and allowed to drain by gravity. Material handling pad(s) will be constructed in accordance with Section 3.2.12. Following dewatering, the EMAC contractor will collect the required soil disposal characterization samples (including moisture content), and if required, the EMAC contractor will mix the soil on the material handling pad to promote additional dewatering. It is estimated that following the second day of dewatering, the moisture content of the soil will have been sufficiently reduced and the soil will not require the addition of an absorbent agent to be suitable for transportation and disposal.

Water that has drained from the staged soil lifts and collected within the material handling pad, along with any standing water removed from excavations, will be containerized for characterization prior to off-site disposal or local discharge. Local discharge will be permitted based on favorable characterization sampling results and must be approved by NSWC Crane. Local discharges may include discharging to a stabilized drainage channel, a local storm drain, or a local sanitary drain.

3.2.5 Sampling and Analysis

Verification samples will be collected from the excavation floors and sidewalls to confirm the removal of COCs at concentrations that result in unacceptable human health and ecological risk. Based on the

comparison of verification sample results to the risk based cleanup goals, the Navy may or may not direct the EMAC contractor to perform additional excavation and soil removal. In addition, verification samples will be collected from the surface soil below the decontamination pad, material handling pad(s), gravel construction entrance and any other support facility constructed by the EMAC contractor. Verification sampling and analysis procedures and acceptable COC concentrations are provided in Section 5.0.

3.2.6 Disposal

Excavated soil and removed debris will be sampled and analyzed for waste disposal characterization per the approved characterization sampling plan provided by the EMAC contractor as part of this work plan and in accordance with the methods required by the NSWC Crane-approved waste disposal facility. The soil will be sampled following the dewatering process, if dewatering is required. To prevent loss of material stored in containers or trucks, measures such as lining and covering containers and trucks or providing sealed tailgates on trucks will be performed. The EMAC contractor is responsible for satisfying all transportation and disposal requirements (solid and liquid) and providing TtNUS with all disposal facility sampling requirements including disposal facility name, contact information (including permit number), waste profile, and responsible parties. This information will then be incorporated into the SWMU Quality Assurance Project Plan (QAPP). The following is a summary of the in-place volumes expected to be disposed off site:

Location	Non-Hazardous	Hazardous
Fire Training Area	930 cy	39 cy
Former Building 55 Area	0 cy	861 cy
Building 150 Area	26 cy	0 cy
Volume of Debris	10 cy	0 cy
Total Volume Disposed Off-site	966 cy	900 cy

3.2.7 Backfilling

Excavation areas will be backfilled to preconstruction grades. The backfill soil obtained from an off-site borrow source will have properties similar to the native SWMU 9 soils. The backfill soil should come from a source where due diligence shows no evidence of a release of a regulated substance (i.e., clean fill). A certification must be provided regarding the origin of the clean fill, including a statement that, to the best of the provider's knowledge, the backfill soil has not been contaminated with the release of regulated substances. The backfill soil will be subject to analytical testing to assure that the material satisfies the following requirements:

- TPH, diesel range organics, USEPA method SW-845 8015M DRO - less than 1 milligram per kilogram (mg/kg)

- TPH, gasoline range organics, USEPA method SW-845 8015M GRO - less than 1 mg/kg

- Sum of benzene, toluene, ethylbenzene, and xylenes, USEPA method SW-846 5030 / 8021 - less than 1 mg/kg

- Characteristic waste determination (ignitability, corrosivity, reactivity, and toxicity), USEPA method SW-846 1311 - shall not fail the test for characteristic waste

- Total PCBs, USEPA method SW-846 8082 – Less than 1 mg/kg

- 4,4'-DDD, USEPA method SW-846 8081 - Less than 3.2 micrograms per kilogram (µg/kg)

- 4,4'-DDE, USEPA method SW-8468081 - Less than 3.2 µg/kg

- 4,4'-DDT, USEPA method SW-846 8081 – Less than 3.2 µg/kg

- Dieldrin, USEPA EPA method SW-846 8081 – Less than 3.2 µg/kg

- Heptachlor, USEPA method SW-846 8081) – Less than 1.5 µg/kg

- Alpha-chlordane, USEPA method SW-846 8081 – Less than 1.5 µg/kg

- Gamma-chlordane, USEPA method SW-846 8081 – Less than 1.5 µg/kg

- DRO, USEPA method SW-846 8015B – Less than 1,600 µg/kg

Based on the Restoration Plan (Figure 3-3), three types of backfill material are required for site restoration, common fill, topsoil, and gravel. The physical characteristics required for each type of backfill material are discussed below.

Common Fill – Common fill will be used to backfill all excavation areas to a depth of 6 inches below final grade. This material will be placed into the excavation in 1-foot-thick lifts and compacted by track-walking

across 100 percent of the backfilled area with track-type equipment. When backfilling at depths greater than 2 feet, compaction can be performed using the bucket of an excavator or hand tamping equipment. When placed around steam line supports within the identified limits on Figure 3-3, the backfill material will be placed in 6-inch lifts and will be compacted using hand-tamping equipment to 95 percent standard proctor. Common fill will meet the following physical characteristics:

- ASTM *define acronym* D 2487, Classifications GW, GP, GM, SW, SP, or SM
- ASTM D 4318, Liquid limit, 35 maximum
- ASTM D 4318, Plasticity index, 12 maximum
- Maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve
- Maximum particle size of 1 inch

Topsoil – The uppermost 6 inches of backfill used to establish final grades will be medium-textured loam suitable for establishing vegetation.

Gravel – Where the Restoration Plan calls for the use of gravel pavement (see Figure 3-3), the uppermost 6 inches of backfill used to establish final grades will be American Association of State Highway and Transportation Officials (AASHTO) No. 7 stone that is compacted using a smooth drum roller or equivalent.

3.2.8 Restoration

To restore the excavation areas, backfilling will be performed to re-establish preconstruction grades using common fill and topsoil or gravel as indicated in Section 3.2.7. Based on the volumes excavated from SWMU 9, the estimated in place volumes of backfill material required are as follows:

- Common fill 1,571 cy
- Topsoil 222 cy
- Gravel 63 cy

Following backfilling, the entire limits of disturbance will be restored/stabilized using permanent stabilization practices. Restoration will consist of surface preparation, fertilizing, seeding, and mulching, where vegetation is proposed (Figure 3-3). Seeding procedures, and procedures for associated activities (fertilizing and mulching) are presented in detail in Section 4.4.

3.2.9 Erosion and Sediment Control

Before excavation activities begin, erosion and sediment controls will be established to prevent impacts to surface water downgradient of the disturbance areas, namely drainage channels and the unnamed streams that feed Boggs Creek (see Section 4.0). During excavation, backfilling, and restoration operations and until vegetation is established, the erosion and sediment controls will be regularly inspected and maintained. Erosion and sediment control requirements to be complied with during IMWP implementation include those presented in the Indiana Handbook for Erosion Control in Developing Areas (IDEM, 1992).

3.2.10 Gravel Construction Entrance

Ingress to and egress from the disturbed areas will be controlled using a gravel construction entrance, which is described in detail in Section 4.0. The gravel construction entrance placement requirements may result in the use of temporary access trails. If this is the case, the EMAC contractor will be required to have a gravel construction entrance at the end of each temporary access trail that connects to NSWC Crane facility roads or parking areas, regardless as to whether these areas are paved or not.

3.2.11 Decontamination Pad

A temporary decontamination pad will be set up to clean equipment used to excavate and transport contaminated soil. The pad will be sized to accommodate all the equipment to be used at the site and will be constructed in a manner that contains all the contaminated materials removed from equipment and the liquids used to clean the equipment. Contaminated materials removed from the equipment will be disposed off site with the excavated soil. Wash water will be filtered and discharged to the NSWC Crane sanitary sewer system with the approval of NSWC Crane. Additional decontamination pad requirements are discussed in Section 4.5. Care will be taken to keep off-road transport equipment clean to minimize the spread of contaminated soil to areas adjacent to the excavations or the temporary access trails. Any soil removal from these areas and the associated disposal and restoration costs will be the responsibility of the EMAC contractor.

3.2.12 Material handling Pad

Temporary material handling pads will be set up to hold and dewater if necessary, all excavated soil. The material handling pads will be sized to accommodate excavated soil and loading equipment as necessary. Material handling pads will be constructed in such a manner that they will retain all materials and allow the water that drains by gravity from the soil to be collected in a sump. At a minimum, the

material handling pads shall be constructed of an 8-mil-thick polyethylene geomembrane overlain by a gravel drainage layer. During rain events and downtime, stockpiled materials within the material handling pads must be covered with a minimum 8-mil-thick polyethylene geomembrane to prevent movement of material to surrounding areas and to minimize the collection of additional water. The geomembrane cover will be secured daily using sandbags and rope or equivalent methods. Material handling pads must be constructed so that water discharges to a containment system. Prior to discharging from the containment system, the water must be filtered and an initial characterization sample must be collected and analyzed. Following the filtering and characterization of the water, and if approved by NSWC Crane, the filtered water will be discharged to a NSWC Crane-approved stabilized drainage channel or storm drain.

3.2.13 Clearing

Clearing will be performed only within the limits of excavation shown on Figures 3-1 and 3-2. Clearing activities will be kept to a minimum to minimize impacts to natural habitat. Cleared vegetation will be chipped and disposed off site. Standing trees will not be removed between April 15 and September 15 to comply with Indiana bat regulations, which are further addressed in Section 3.5.2, unless approval is granted by the NSWC Crane Natural Resources Office. Prior to initiating clearing activities, the EMAC contractor will meet with the NWSC Crane Biologist to define the clearing activities and receive approval to proceed. Additionally, minor tree clearing (e.g., small areas of non-habitat value trees) must be approved by the NSWC Crane Natural Resources Office.

3.3 SEQUENCE OF IMWP IMPLEMENTATION

The generalized sequence of construction activities is presented below. This sequence of construction is subject to change based on the EMAC contractor's Work Plan:

1. Hold a pre-IMWP implementation meeting with the NSWC Crane OICC, Contracting Officer, EMAC contractor, and TtNUS representative, at a minimum. The EMAC contractor must provide a minimum of 7 days notice to OICC and TtNUS prior to the pre-IMWP implementation meeting.

2. Inspect SWMU 9 to verify existing site conditions and overhead and underground utility locations, and obtain all required permits as detailed in Table 3-1. The EMAC contractor must provide a minimum of 7 days notice to OICC and TtNUS prior to the start of construction activities.

3. Install perimeter controls for the gravel construction entrance(s) and construct the gravel construction entrance(s). Install the remaining perimeter controls as indicated in the Erosion and Sediment Control Plan (Section 4.0).

4. Clear areas for support features including, but not limited to, the decontamination pad, material handling pad(s), and materials storage area. Construct the support features.

5. Install utility support/protection systems as required.

6. Excavate/remove surface and subsurface soil from the defined excavation areas at the former fire training, former Building 55 area, and Building 150 area. Place excavated soil in the material handling pad to dewater by gravity (if necessary) and for characterization. Following dewatering (if necessary), collect disposal characterization samples. Following disposal characterization, load and transport soil to the NSWC Crane-approved off-site disposal facility. During excavation, maintain erosion and sediment controls.

7. Collect verification samples (TtNUS) as identified in Section 5.0 of this IMWP. Perform additional excavation (Implementation Sequence Item No. 6) if required by the Contracting Officer. Following verification that contaminated soil is removed, restore the excavation areas as required and restore utility foundation systems if needed.

8. Following transportation and disposal of all excavated soil, remove the material handling pad(s) and decontamination pad(s), and collect verification samples from within the footprint of the support features and from the temporary access trails as described in Section 5.0. Following verification that the temporary access trails and the ground below the support features were not impacted by construction activities, regrade as necessary and establish permanent stabilization.

9. Following permanent stabilization of all disturbed areas, and with the approval of the OICC, remove all remaining perimeter controls and immediately stabilize all remaining disturbed areas.

3.4 STORMWATER CONTROLS

The SWMU 9 ground surface hydrology, grading, and cover will not be altered due to IMWP implementation activities. Since pre- and post-construction runoff from the limits of disturbance will be the same, permanent stormwater detention capacity is not required, and pre- and post-construction stormwater runoff calculations were not prepared.

The disturbed area will be approximately 0.85 acres in size; therefore, an IDEM Storm Water General Permit is not required (stormwater permits are required for disturbances greater than 1 acre). Additionally, because the IM activities do not include working in and around a water course, the IDEM 401 Permit and Department of Natural Resources (DNR) Construction in Floodway Permit is not required (refer to Table 3-1). IMWP implementation activities will require the use of best management practices for erosion and sediment control and stormwater pollution prevention as described in Section 4.0.

3.5 OTHER IMWP IMPLEMENTATION REQUIREMENTS

3.5.1 Utilities

The EMAC contractor is responsible for obtaining utility locations and adequately protecting any utilities located in the active work areas before any earth-disturbing activities begin. Since steam lines traverse an excavation area at SWMU 9, and the EMAC contractor will provide appropriate temporary support for the steam line support structures during excavation as indicated in Section 3.2.3 (prior to installation, the proposed temporary support systems must be approved by the OICC).

3.5.2 Groundwater Monitoring Wells

There are existing groundwater monitoring wells within the limits of excavation and within the vicinity of construction activities (refer to Figures 1-2, 3-1, and 3-2). The EMAC contractor shall protect these groundwater monitoring wells during construction activities. As indicated in Figure 3-1, groundwater monitoring well 09MWT010 is located within the limits of the excavation located south and west of former Building 55. Currently, groundwater monitoring well 09MWT010 is located within the limits of surface soil excavation and can be preserved by hand excavation and backfilling around the existing well. However, if subsurface excavation limits extend to include this groundwater monitoring well, the EMAC contractor will abandon groundwater monitoring well 09MWT010 in accordance with IDEM requirements. If any of the remaining groundwater monitoring wells are damaged by the EMAC contractor, those groundwater monitoring wells will be replaced by the EMAC contractor at the cost of the EMAC contractor. The available groundwater monitoring well construction logs are provided in Appendix A.

3.5.3 Protection of Natural Resources

Threatened and endangered species or species of special concern protected under Indiana or Federal regulations exist or may exist within the limits of SWMU 9 and will therefore be protected. Protected bird species that may use SWMU 9 as part of their home ranges include the bald eagle, osprey, sharp-

shinned hawk, red-shouldered hawk, broad-winged hawk, black and white warbler, hooded warbler, and the worm-eating warbler (B&RE, 1997). Also, the Indiana bat, a federal endangered species, is known to forage at NSWC Crane. During the spring and summer, Indiana bats roost in trees and forage for insects primarily in riparian and upland forests. The most important characteristic of roost trees is thought to be structural-exfoliating bark with space for bats to roost between the bark and the bole of the tree. To a limited extent, tree cavities and crevices are also used for roosting.

In 1997, NSWC Crane received a letter from the United States Fish and Wildlife Service (USFWS) stating that, in their opinion, NSWC Crane had an abundance of Indiana bat habitat and that any activity that would result in the clearing of woody vegetation may affect the Indiana bat and would require consultation under the Endangered Species Act (ESA). The USFWS recommended interim guidelines for protecting Indiana bats and their habitat from silvicultural activities, and these recommendations were immediately implemented by NSWC Crane under the timber management program.

Because of the Indiana bat and its potential habitat, the cutting of trees at NSWC Crane is restricted to certain times during the year, and the cutting of shagbark hickory trees (potential Indiana bat habitat) is prohibited. A summary of Indiana bat-related restrictions prepared by the NSWC Crane Natural Resources Office (i.e., "bat primer") is as follows:

- Woody vegetation that is 5 inches in diameter or greater at 4.5 feet above the ground surface may not be removed between April 15 and September 15.

- Standing dead trees may not be removed between April 15 and September 15.

- Timber harvesting may occur between September 15 and April 15 without a case-by-case consultation, provided the interim guidelines for silvicultural treatment issued to the NSWC Crane Natural Resources Office by the USFWS are followed.

- During emergency situations, necessary and prudent tree removal is allowed at all times without consultation.

- Tree removal from residential settings and industrial areas for safety reasons is allowed between September 15 and April 15 without further consultation. This includes tree trimming.

- Tree removal within 25 feet of railroad tracks and within 50 feet of explosive storage and explosive operating buildings is allowed between September 15 and April 15 without further consultation.

- Brush clearing of woody vegetation less than 3 inches in diameter at 4.5 feet above the ground may occur at any time of the year without consultation.

- All other tree removal or clearing projects not covered above must be submitted to the USFWS for informal consultation on a case-by-case basis.

As noted in Section 3.2.13, approval for minor tree clearing can be obtained from the NSWC Crane Natural Resources Office between April 15 and September 15.

3.5.4 Traffic Control Plan

Access to NSWC Crane is via four gates: the Main Gate referred to as the Bloomington Gate (Gate House No. 1) in the north, Burns City Gate (Gate House No. 2) in the west, Bedford Gate (Gate House No. 3) in the east, and Crane Gate (Gate house No. 4) in the northwest. NSWC Crane will be accessed by the EMAC contractor only through the Crane Gate. All vehicles will pass through the Crane Gate via the traffic routing plan shown on Figure 3-4. The EMAC contractor is not permitted to travel within restricted areas of the facility. All waste hauling vehicles will be weighed upon arrival and at time of departure using the certified weight scale located at the Defense Reutilization and Marketing Office (DRMO) (Building 1940). The DRMO scale is operated during normal business hours, and weight tickets are available. The DRMO scale is the preferred scale for contractors' use. Alternatively, the Army scale (Building 2913) may be used when the DRMO scale is not available. The Army scale is no longer manned, and weight tickets are not available. However, weight readout is available at the Army scale.

3.5.5 EMAC Contractor Requirements

The EMAC contractor will be required to perform all IMWP implementation activities in accordance with the EMAC Basic Contract, NSWC Crane Contractor's Operations Manual (NSWC Crane, 2002), and supplemental specifications provided in Appendix D.

The IWMP will be implemented by the EMAC contractor, NSWC Crane, and TtNUS, with work assignments as summarized on Table 3-1.

3.6 IMPLEMENTATION

The EMAC contractor will coordinate all field work through the OICC.

IMWP implementation may be impacted by NSWC Crane activities and the facility's "Protective Measures." NSWC Crane will implement a corresponding set of "Protective Measures" based on the warnings provided by the Homeland Security Advisory System in the form of graduated "Threat Conditions." The EMAC contractor will be subject to any implemented "Protective Measures."

The Navy will provide a full-time oversight representative during IMWP implementation. The EMAC contractor shall provide a minimum of 7 days notification to the OICC and the Navy's oversight representative prior to mobilization.

TABLE 3-2

NORTHING AND EASTING EXCAVATION COORDINATES
INTERIM MEASURES WORK PLAN SWMU 9
NSWC CRANE
CRANE, INDIANA

EXCAVATION NODE	EASTING	NORTHING
FTR-01	3025122.22	1311073.21
FTR-02	3025170.00	1311118.26
FTR-03	3025170.85	1311189.64
FTR-04	3025126.92	1311137.69
FTR-05	3025137.49	1311103.79
FTR-06	3025149.65	1311122.39
FTR-07	3025140.29	1311125.48
FTR-08	3025152.69	1311159.06
FTR-09	3025161.97	1311155.88
FB55-01	3025281.55	1311396.64
FB55-02	3025241.57	1311353.59
FB55-03	3025203.17	1311359.16
FB55-04	3025128.40	1311417.33
FB55-05	3025160.95	1311461.47
FB55-06	3025242.89	1311454.68
FB55-07	3025230.02	1311406.99
FB55-08	3025211.38	1311445.05
FB55-09	3025200.09	1311421.90
FB55-10	3025231.02	1311438.02
FB55-11	3025221.68	1311413.01
B150-01	3025330.41	1311577.81
B150-02	3025328.93	1311563.78
B150-03	3025357.36	1311555.86
B150-04	3025359.73	1311565.82
B150-05	3025345.90	1311568.68
B150-06	3025346.89	1311573.46

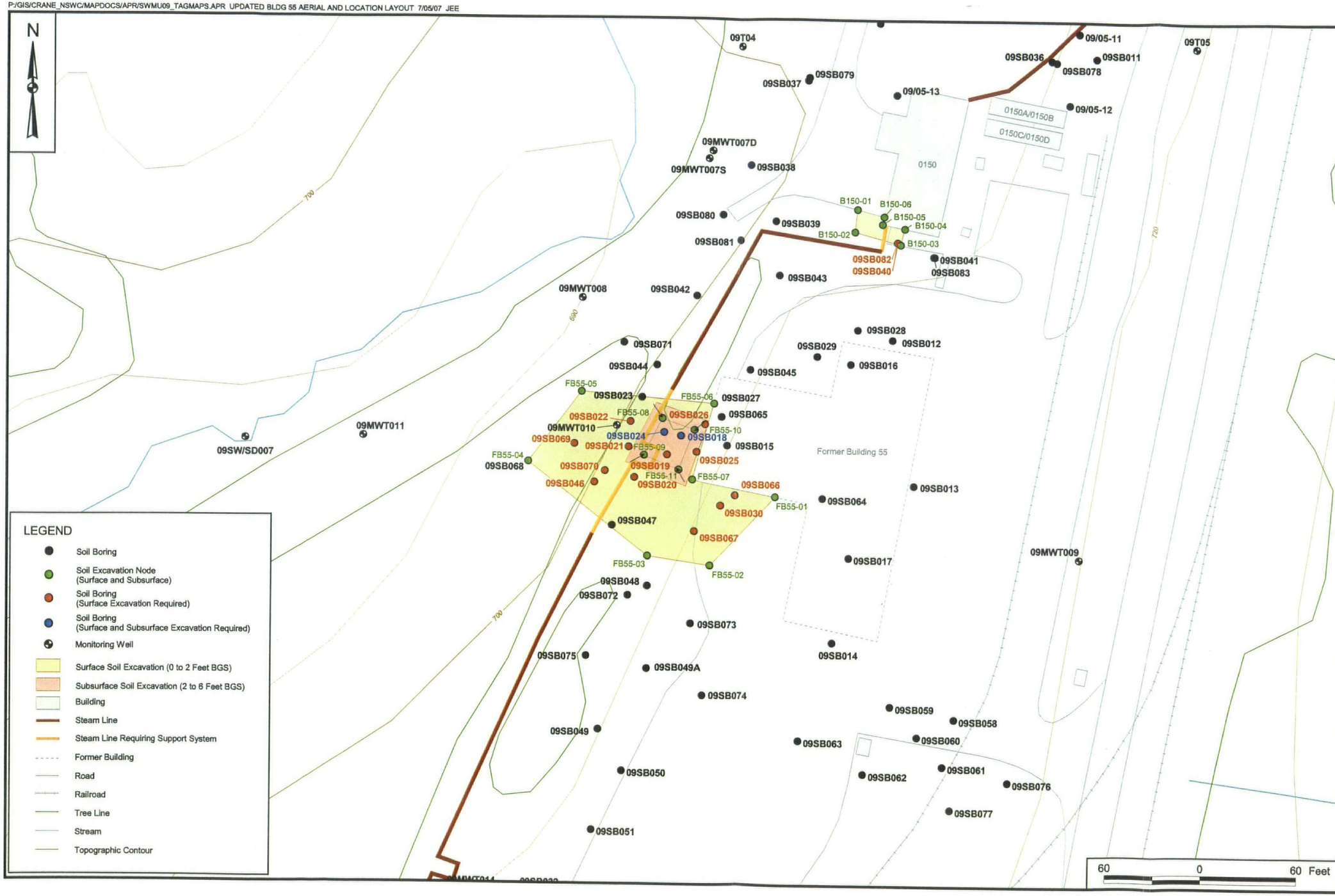
Notes:

1) Excavation nodes identified the extent of contaminated soil requiring excavtion (See Figures 3-1 and 3-2). The nodes do not identify the exent of excavtion side slope lay backs. In addion the nodes identified in this table will be locate and flag in the field by the EMAC contractor (see Table 3-1). The locations of the excavation nodes are subject to Navy approval prior to excavation.

2) Northing and easting coordinates reference NAD 1983 State Plain Coordinate System Indiana West (Feet).

FTR = Former Fire Training Excavation Area
FB55 = Former Building 55 Excavation Area
B150 = Building 150 Excavation Area

P:/GIS/CRANE_NSWC/MAPDOCS/APR/SWMU09_TAGMAPS.APR UPDATED BLDG 55 AERIAL AND LOCATION LAYOUT 7/05/07 JEE



CONTRACT NO. CTO 0367

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 3 - 1

REV 0

ORGANIC CONTAMINANTS IN SOIL EXCEEDING HUMAN HEALTH SCREENING LEVELS FORMER BUILDING 55 AND BUILDING 55 EXCAVATION AREA SWMU 9 INTERIM MEASURES WORK PLAN NSWC CRANE CRANE, INDIANA

NAVFAC

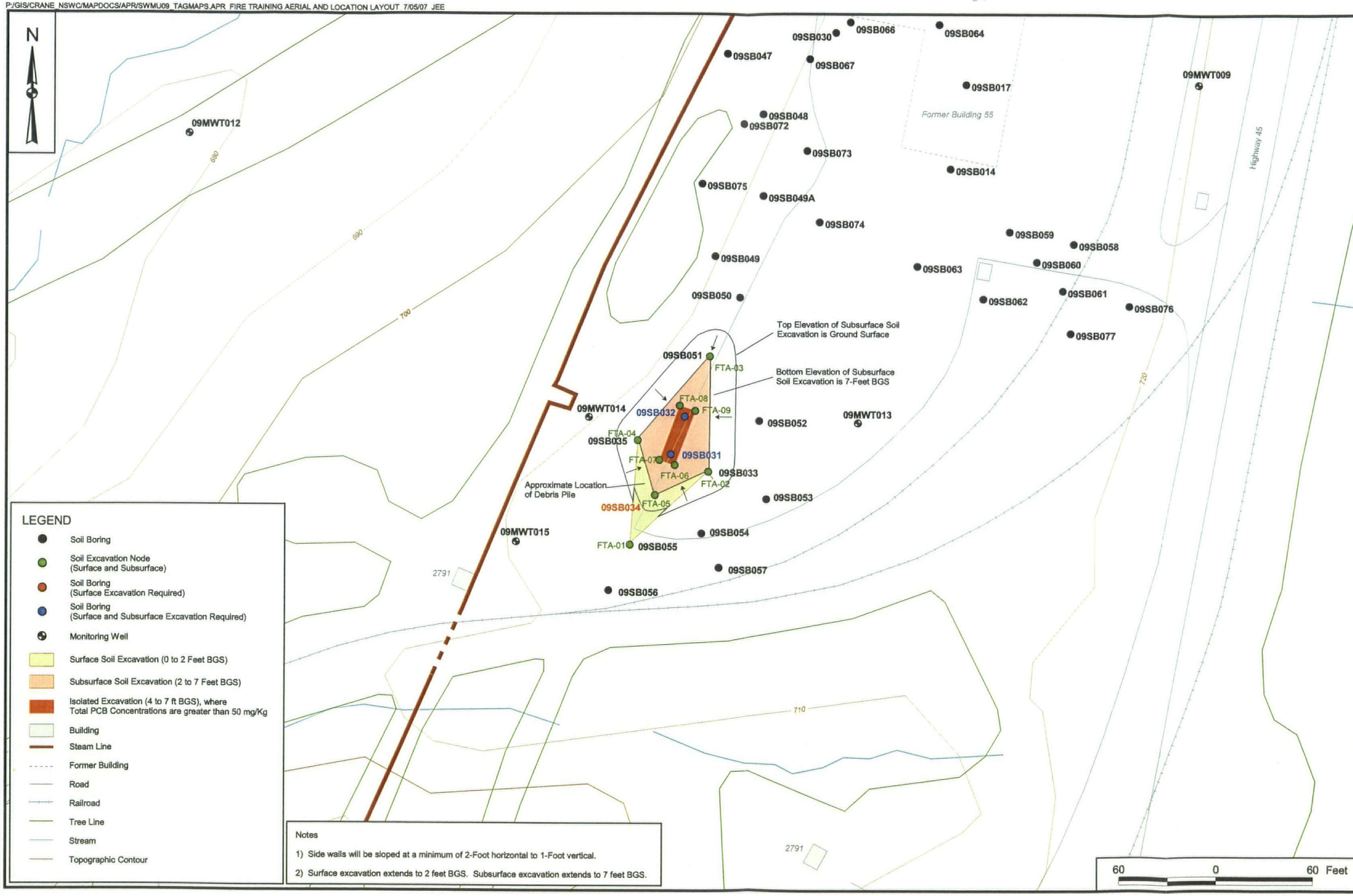
DRAWN BY S. STROZ DATE 3/29/07

CHECKED BY T. SMITH DATE 7/05/07

COST/SCHED-AREA

SCALE AS NOTED

P:/GIS/CRANE_NSWC/MAPDOCS/APR/SWMU09_TAGMAPS.APR FIRE TRAINING AERIAL AND LOCATION LAYOUT 7/05/07 JEE



Notes

1) Side walls will be sloped at a minimum of 2-Foot horizontal to 1-Foot vertical.

2) Surface excavation extends to 2 feet BGS. Subsurface excavation extends to 7 feet BGS.

CONTRACT NO. CTO 0367

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 3 - 2

REV 0

FORMER FIRE FIGHTING TRAINING AREA EXCAVATION
SWMU 9 INTERIM MEASURES WORK PLAN
NSWC CRANE
CRANE, INDIANA

NAVFAC

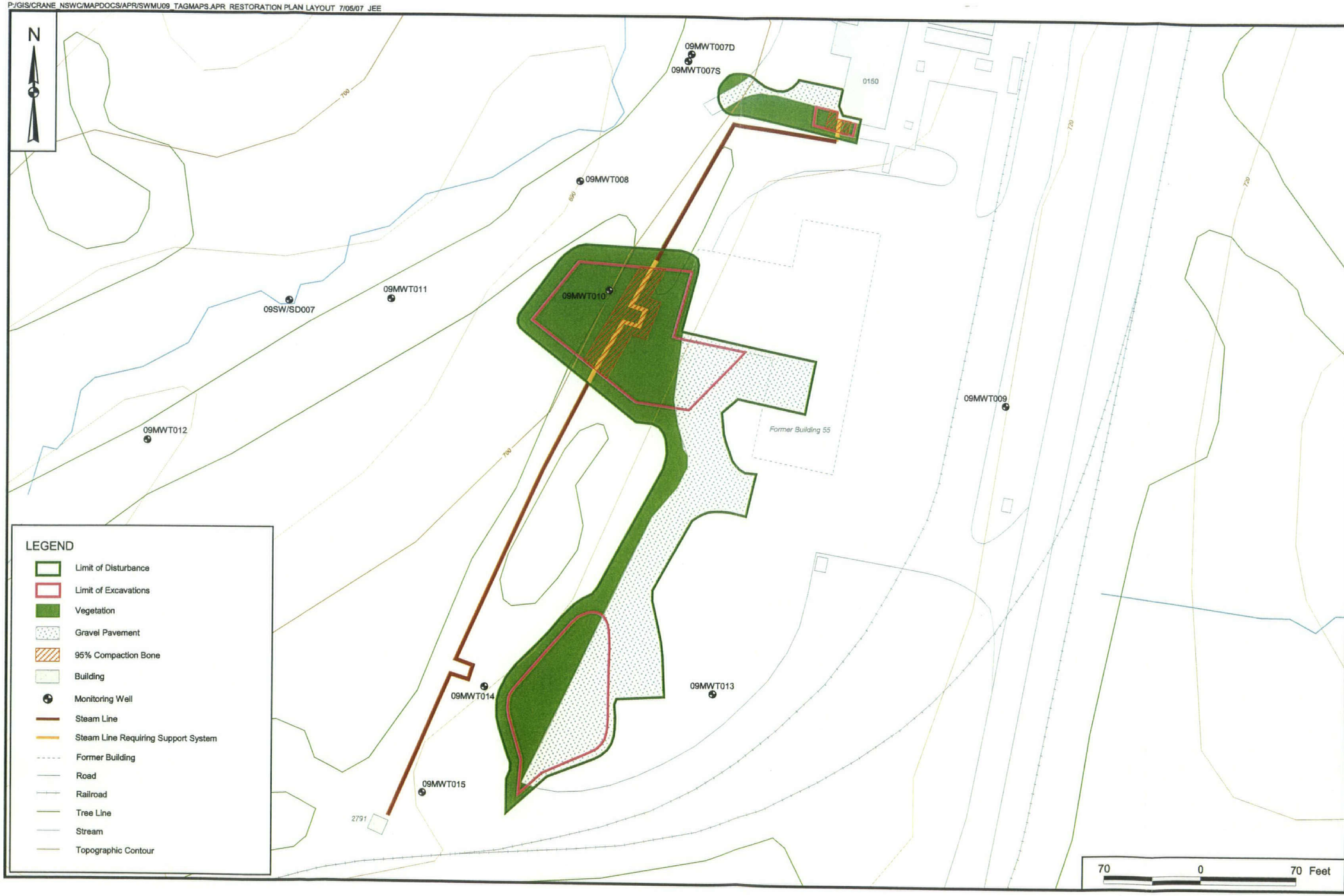
DRAWN BY S. STROZ DATE 3/29/07

CHECKED BY T. SMITH DATE 7/05/07

COST/SCHED-AREA

SCALE AS NOTED

P:/GIS/CRANE_NSWC/MAPDOCS/APR/SWMU09_TAGMAPS.APR RESTORATION PLAN LAYOUT 7/05/07 JEE



CONTRACT NO. CTO 0367

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 3 - 3

REV 0

RESTORATION PLAN
SWMU 9 INTERIM MEASURES WORK PLAN
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY A. JANOCHA DATE 5/25/07

CHECKED BY T. SMITH DATE 7/05/07

COST/SCHED-AREA

SCALE AS NOTED

5.0 VERIFICATION SAMPLING PLAN

5.1 PURPOSE

The purpose of this section is to present the two types of verification samples to be collected during and following implementation of the SWMU 9 IMWP. The two types of verification samples include the samples collected from within the excavation areas to verify the removal of soil with COCs at concentrations causing unacceptable human health and ecological risks, and the samples collected from surface soils located beneath the support facilities (i.e., decontamination pad, dewatering pad(s), material storage areas, construction entrances, and access trails). The verification samples collected to confirm the removal of unacceptable contamination will be collected following excavation. The verification samples collected to confirm that there were no contamination impacts to surface soils located below the footprints of the support facilities will be collected after IMWP implementation is complete. This section also presents criteria and procedures used to evaluate verification sample data. Verification samples will be collected by TtNUS. The sampling procedures, sample locations, and fixed-base laboratory analytical methods will be addressed in the QAPP (to be provided under separate cover).

5.2 VERFICATION SAMPLING OF EXCAVATION AREAS

IMWP implementation activities include the excavation and off-site disposal of surface and subsurface soil containing contaminants at concentrations causing unacceptable human health and ecological risks. These excavation areas are shown on Figures 3-1 and 3-2. Verification samples will be collected from the excavation floors and sidewalls to determine if all the IMWP soil cleanup goals have been reached. In general, as indicated in the QAPP, excavation floor samples will be collected at a rate of one composite sample for every 1,000 square feet of exposed surface area and excavation side wall samples will be collected at a rate of one composite sample for every 100 square feet of exposed side wall. Samples collected for DRO analysis will be collected at a rate of one grab sample per 1,000 square feet of excavation and one grab sample per 100 square feet of exposed sidewall. The following paragraphs describe the verification sampling procedures to be performed for each of the excavation area.

- Soil Excavation Areas - Verification samples will be collected from the excavation side walls and excavation floor in the three soil excavation areas. Based on the estimated extent of excavation at the former Building 55 area, ten excavation floor samples will be collected and eleven excavation side wall samples will be collected. From the excavation area on the southern end of Building 150, one excavation floor sample and four excavation side wall samples will be collected. Lastly, at the former fire training area, two excavation floor samples and six excavation side wall samples will be collected.

The verification samples will be analyzed for the COCs (i.e., pesticides, PCBs, and/or DRO) at each excavation area. The following is a listing of the COCs that area present at each of the three excavation areas.

Excavation Area	Applicable COCs
Former Fire Training Area	PCBs
Former Building 55 Area	Pesticides and DRO
Building 150 Area	DRO

In the event that verification sample results indicate that COC concentrations remaining in an excavated area still pose unacceptable human health or ecological risks, the Navy may direct the EMAC contractor to extend the excavation in the appropriate direction(s). The extent of additional excavation will depend on the location and concentrations of the COCs that still pose risks to human or ecological receptors. Following the additional excavation effort, additional verification samples will be collected by TtNUS. Excavation expansion may continue, at the discretion of the Contracting Officer, until all verification sample results indicate that all the COC concentrations within the excavated area fall within acceptable human health and ecological risks. The acceptable COC concentrations are as follows;

- Support Facility Areas - The frequency of verification sampling collected from the soils located beneath the support facilities after IMWP implementation has been completed, is the same as that for excavation samples (i.e., one verification sample for every 1,000 square feet of area disturbed). Side wall samples are not included in the support facility verification sampling program because no excavation will occur at the support facility areas. Based on the anticipated footprints of the support facilities, it is estimated that seven verification samples will be collected from the support facility areas (minimum of 1 sample from each support facility). The verification samples will be analyzed for the COCs (i.e., pesticides, PCBs, and DRO). As with the excavation areas samples to be analyzed for DRO will be collected at a rate of one grab sample per 1,000 square feet of area. In the event that a verification sample result exceeds the acceptable risk levels (see previous paragraph), six inches of soil will be removed from the impacted support facility footprint (the support facility footprint equals the actual footprint plus an additional 10 feet in all directions). Following the additional excavation activities, additional verification samples will be collected by TtNUS. Excavation expansion may continue until no unacceptable risks remain in the surface soil at the site.

The COC media cleanup goals for achieving acceptable human health risks in soil at SWMU 9 are listed in the following table:

Contaminant Group	COCs	Media Cleanup Goals
PCBs	Total PCBs (surface soil)	1 ppm(1)
	Total PCBs (subsurface soil)	25 ppm(1)
DRO	DRO	1,600 ppm(2)
Pesticides	4,4'-DDD	24,300 ppb(4)
	4,4'-DDE	17,150 ppb(4)
	4,4'-DDT	3,600 ppb(3)
	Dieldrin	300 ppb(4)
	Heptaclor	1,050 ppb(4)
	Alpha-chlordane	3,500 ppb(3)
	Gamma-chlordane	3,500 ppb(3)

1 Toxic Substances Control Act (TSCA) high occupancy areas standard of 1 ppm [40 CFR 761.61(a)(4)(i)(A)] and low occupancy areas standard of 25 ppm [40 CFR 761.61(a)(4)(i)(A)].
2 IDEM Default Closure Level for direct contact to soil under a residential scenario.
3 Risk-based concentration for residential exposures to soil based on a target hazard index (HI) of 0.1.
4 Risk based concentration for residential exposure to soil based on a 1E-05 cancer risk level.

Risks to ecological receptors are based on the evaluation of average chemical concentrations at a particular site. Based on the proposed excavation areas, risks to ecological receptors will be acceptable at SWMU 9 because the excavated areas will be backfilled with clean fill as detailed in Section 3.2.7 and the average concentrations of COCs left in place at SWMU 9 will not exceed remediation goals established for protection of ecological receptors.

In order to minimize EMAC contractor downtime associated with waiting for sampling results, verification samples will be analyzed with field test kits to guide the excavation. Due to the cost associated with using the test kits and the time associated with performing the test kit analysis, the samples will be analyzed in batches. Once the test kit analysis is complete, TtNUS will submit a select number of samples for analysis at a fixed-base laboratory. The EMAC contractor should note that although the field test kit analysis takes only 2 to 3 hours, because TtNUS has to report the results to the Navy and because the Navy needs to evaluate those results, the EMAC contractor should expect a 24 hour delay between TtNUS collecting the verification sample, the Navy reporting test kit results to the EMAC contractor, and the Navy's decision to extend the excavation or send samples to a fixed-base laboratory.

The turnaround time for receiving analytical results from the fixed-base laboratory is five days, which includes time for sample shipment and results evaluation.

In the event the fixed-base laboratory results exceed the site cleanup goals, the Navy may or may not direct the EMAC contractor to perform additional excavation. If the Navy directs the EMAC contractor to perform additional excavation, TtNUS will collect additional verification samples following that excavation and the analysis process starting with test kit analysis will be repeated.

5.3 SAMPLING LOCATIONS

The numbers and locations of verification samples for the excavation areas and support facilities will be identified in a QAPP Addendum that will be provided under separate cover.

APPENDIX A

A.1 SWMU 9 ANALYTICAL DATA
A.2 SWMU 9 ANALYTICAL TAG MAPS
A.3 GROUNDWATER MONITORING WELL CONSTRUCTION LOGS

A.3

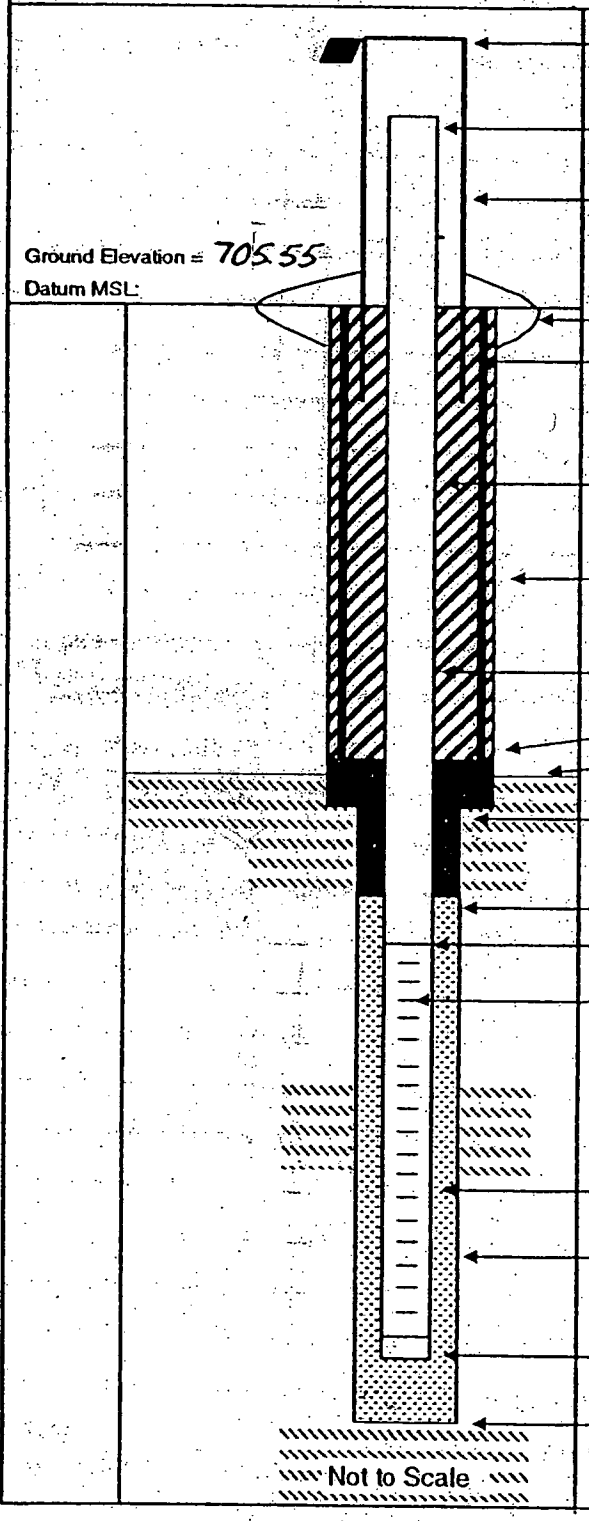
GROUNDWATER MONITORING WELL CONSTRUCTION LOGS

Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 09T03

PROJECT:	NSWC CRANE	DRILLING Co.:	BOWSER MORNER	BORING No.:	09T03
PROJECT No.:	7141 CTO 010	DRILLER:	A. WOLFE	DATE COMPLETED:	12-12-00
SITE:	SWMU 9	DRILLING METHOD:	AIR ROTARY	NORTHING:	1311791.416
GEOLOGIST:	M. G. COCHRAN	DEV. METHOD:	SURGE & WHALE PUMP	EASTING:	3025295.689



Elevation of Top of Casing: 708.56

Stick Up of Casing Above Ground Surface: 3.01'

Elevation of Top of Riser: 708.08

I.D. of Surface Casing: 4"

Type of Surface Casing: 4" STEEL SQUARE

Type of Surface Seal: CEMENT PAD

I.D. of Casing: 6"

Type of Casing: TEMPORARY STEEL FLUSH JOINT (REMOVED)

Casing Length: 9'

I.D. of Riser: 2"

Type of Riser: PVC SCH. 40

Borehole Diameter: 8 1/2

Type of Backfill: CEMENT-BENTONITE GROUT QUIKRETE + AMCOLLOID WYOMING BENTONITE

Elevation / Depth Top of Seal: 702.55' / 3'

Elevation / Depth Top Bedrock: 696.05' / 9.5'

Type of Seal: BENTONITE PELLETS COLLOID ENVIRONMENTAL

Elevation / Depth of Top of Filter Pack: 700.55' / 5

Elevation / Depth of Top of Screen: 698.55' / 7

Type of Screen: PVC

Slot Size x Length: .01" X 10'

I.D. of Screen: 2"

Type of Filter Pack: GLOBAL #6 19-6, #7 6-5'

Diameter of Hole in Bedrock: 5 5/8"

Elevation / Depth of Bottom of Screen: 688.55' / 17'

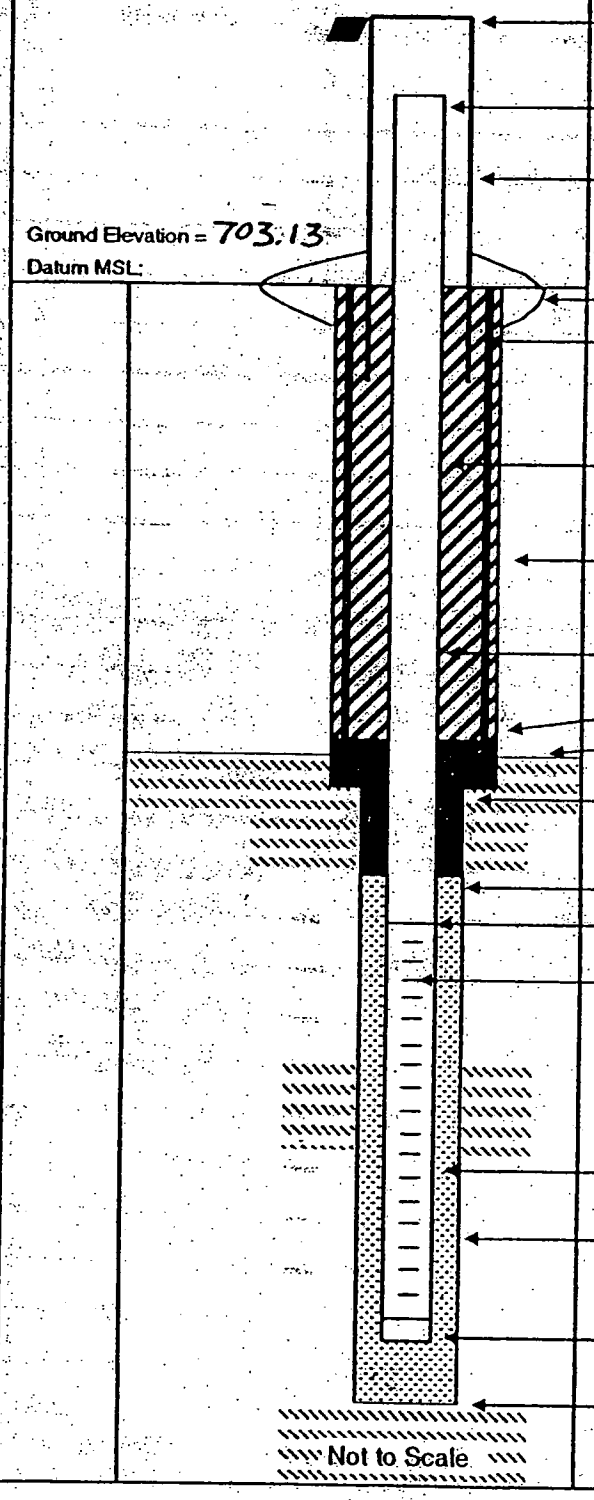
Elevation / Total Depth of Borehole: 686.55' / 19'

Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 09T04

PROJECT:	NSWC CRANE	DRILLING Co.:	BOWSER MORNER	BORING No.:	09T04
PROJECT No.:	7141 CTO 010	DRILLER:	A. WOLFE	DATE COMPLETED:	12-13-00
SITE:	SWMU 9	DRILLING METHOD:	AIR ROTARY	NORTHING:	1311679.977
GEOLOGIST:	M.G. COCHRAN	DEV. METHOD:	SURGE & WHALE PUMP	EASTING:	3025257.301



Elevation of Top of Casing: 706.53'

Stick Up of Casing Above Ground Surface: 3.40'

Elevation of Top of Riser: 705.70'

I.D. of Surface Casing: 4"

Type of Surface Casing: 4" STEEL SQUARE

Type of Surface Seal: CEMENT PAD

I.D. of Casing: 6"

Type of Casing: TEMPORARY STEEL FLUSH JOINT (REMOVED)

Casing Length: 10'

I.D. of Riser: 2"

Type of Riser: PVC SCH 40

Borehole Diameter: 8 1/2"

Type of Backfill: CEMENT-BENTONITE GROUT QUIKRETE + AM COLLOID WYOMING BENTONITE

Elevation / Depth Top of Seal: 700.13' / 3'

Elevation / Depth Top Bedrock: 693.13' / 10'

Type of Seal: BENTONITE PELLETS COLLOID ENVIRONMENTAL

Elevation / Depth of Top of Filter Pack: 699.13' / 4

Elevation / Depth of Top of Screen: 697.13' / 6

Type of Screen: PVC

Slot Size x Length: .01" X 10'

I.D. of Screen: 2"

Type of Filter Pack: GLOBAL #6 16-5', #7 5-4'

Diameter of Hole in Bedrock: 5 5/8"

Elevation / Depth of Bottom of Screen: 687.13' / 16'

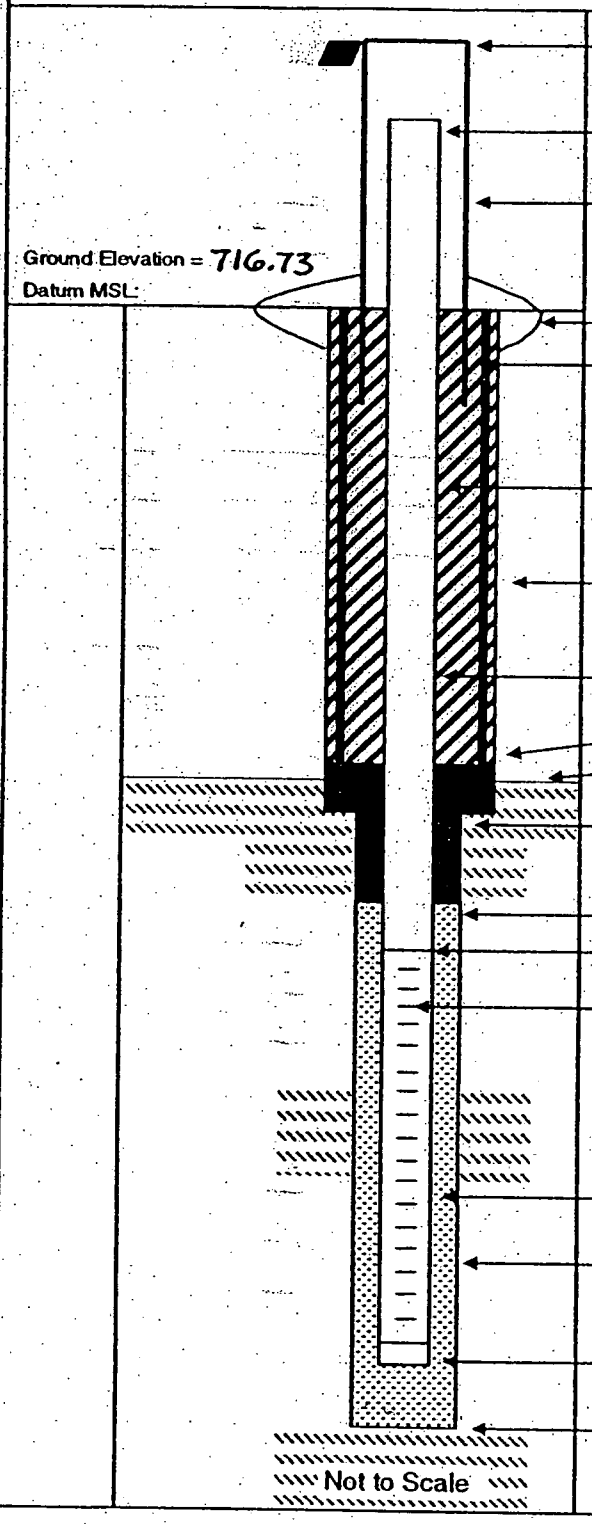
Elevation / Total Depth of Borehole: 687.13' / 16'

Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 09T05

PROJECT:	NSWC CRANE	DRILLING Co.:	BOWSER MORNER	BORING No.:	09T05
PROJECT No.:	7141 CTO 010	DRILLER:	A. WOLF	DATE COMPLETED:	12-4-00
SITE:	SWMU 9	DRILLING METHOD:	AIR ROTARY	NORTHING:	1311681.497
GEOLOGIST:	M.G. COCHRAN	DEV. METHOD:	SURGE & WHALE PUMP	EASTING:	3025540.482



Elevation of Top of Casing: 719.71

Stick Up of Casing Above Ground Surface: 2.98

Elevation of Top of Riser: 719.19

I.D. of Surface Casing: 4"

Type of Surface Casing: SQUARE STEEL

Type of Surface Seal: CEMENT PAD

I.D. of Casing:

Type of Casing: TEMPORARY STEEL FLUSH JOINT (REMOVED)

Casing Length: 9'

I.D. of Riser: 2"

Type of Riser: PVC SCHEDULE 40

Borehole Diameter: 8 1/2"

Type of Backfill: CEMENT-BENTONITE GROUT QUIKRETE + ARM. COLLOID WYOMING BENTONITE

Elevation / Depth Top of Seal: 713.73' / 3'

Elevation / Depth Top Bedrock: 707.73' / 9'

Type of Seal: BENTONITE PELLETS COLLOID ENVIRONMENTAL

Elevation / Depth of Top of Filter Pack: 711.73' / 5'

Elevation / Depth of Top of Screen: 709.73' / 7'

Type of Screen: PVC

Slot Size x Length: .01" X 10'

I.D. of Screen: 2"

Type of Filter Pack: GLOBAL #6 - 17'-6" #7 6-5'

Diameter of Hole in Bedrock: 5 5/8"

Elevation / Depth of Bottom of Screen: 699.73' / 17'

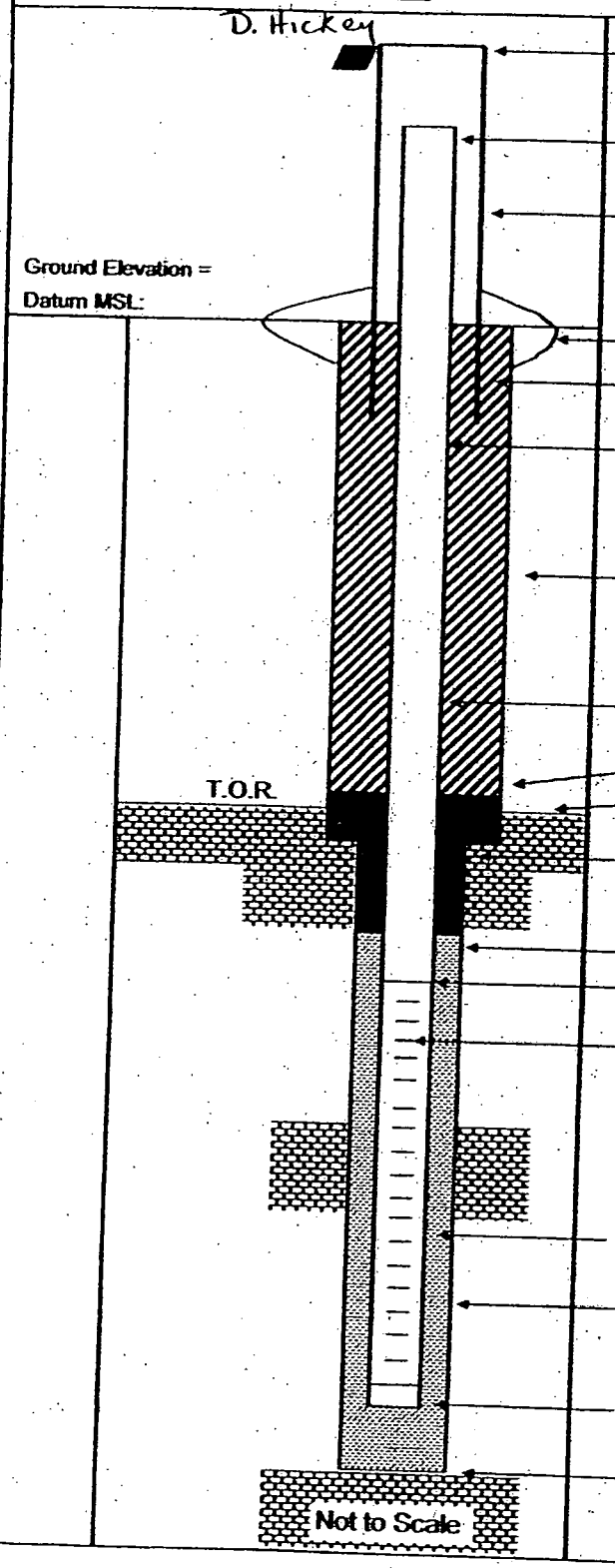
Elevation / Total Depth of Borehole: 699.73' / 17'

Tetra Tech NUS, Inc.

BEDROCK
MONITORING WELL SHEET

WELL No.: 09T06
PERMIT No.: 09MWT06

PROJECT:	NSW CRANE	DRILLING Co.:	Bowser Morner	BORING No.:	
PROJECT No.:	~~9080 CTO 0279~~ 00042	DRILLER:	J. Walsh	DATE COMPLETED:	10/20/05
SITE:	SWMU ~~18~~ 9	DRILLING METHOD:	Core	NORTHING:	
GEOLOGIST:	~~B. BAALKOVEG~~ D. Hickey	DEV. METHOD:		EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:

Elevation of Top of Riser:

I.D. of Surface Casing:

Type of Surface Casing:

Type of Surface Seal:

I.D. of Permanent Casing:

I.D. of Riser: 2"

Type of Riser: Sch 40 PVC

Borehole Diameter: 9.0"

Type of Backfill:

Elevation / Depth Top of Seal: 16.0'

Elevation / Depth Top of Bedrock: 10.0'

Type of Seal: Bentonite Chips (med)

Elevation / Depth of Top of Fine Sand: —1—

Elevation / Depth of Top of Filter Pack: 20.0'

Elevation / Depth of Top of Screen: 22.0'

Type of Screen: Sch 40 PVC

Slot Size x Length: 0.02" x 15'

I.D. of Screen: 2"

Type of Filter Pack: No. 10-20 SAND

Diameter of Hole in Bedrock Core / Ream: ~2.5"/~6" (NX Core)

Elevation / Depth of Bottom of Screen: 37.0'

Elevation / Total Depth of Borehole: 37.0'

Tetra Tech NUS, Inc. **OVERBURDEN MONITORING WELL SHEET**

BORING NO.: 09MWT075

PROJECT: ~~NIROP FRIDLEY~~ NSWC Crane
PROJECT No.: 00042 ~~7842 CTO 0057~~
SITE: SWMU9 ~~ANOKA PARK~~
GEOLOGIST: D. Hickey

DRILLING Co.: Bowser Morner
DRILLER: J. Walsh
DRILLING METHOD: HSA
DEV. METHOD:

BORING No.:
DATE COMPLETED: 10/31/05
NORTHING:
EASTING:

ELEVATION OF TOP OF SURFACE CASING:
STICK -UP TOP OF SURFACE CASING:
ELEVATION OF TOP OF RISER PIPE:
RISER STICK-UP ABOVE GROUND SURFACE:
I.D. OF SURFACE CASING:
TYPE OF SURFACE CASING:
GROUND ELEVATION:
TYPE OF SURFACE SEAL:
RISER PIPE I.D.: 2"
TYPE OF RISER PIPE: CARBON STEEL
BOREHOLE DIAMETER: 9"
TYPE OF SEAL:
ELEVATION / DEPTH OF SEAL: 1.2'
TYPE OF SEAL: BENTONITE CHIPS
ELEVATION / DEPTH TOP OF FILTER PACK: 1.4'
ELEVATION / DEPTH TOP OF SCREEN: 16.0'
TYPE OF SCREEN: CARBON STEEL
SLOT SIZE X LENGTH: 10 SLOT x 5'
I.D. OF SCREEN: 2"
TYPE OF FILTER PACK: SILICA SAND
(No. 10-20 U.S. STANDARD SEIVE SIZE)
ELEVATION / DEPTH BOTTOM OF SCREEN: 11.0
ELEVATION / DEPTH BOTTOM OF FILTER PACK: 11.0
TYPE OF BACKFILL BELOW WELL:
ELEVATION / DEPTH OF BOREHOLE: 11.0'

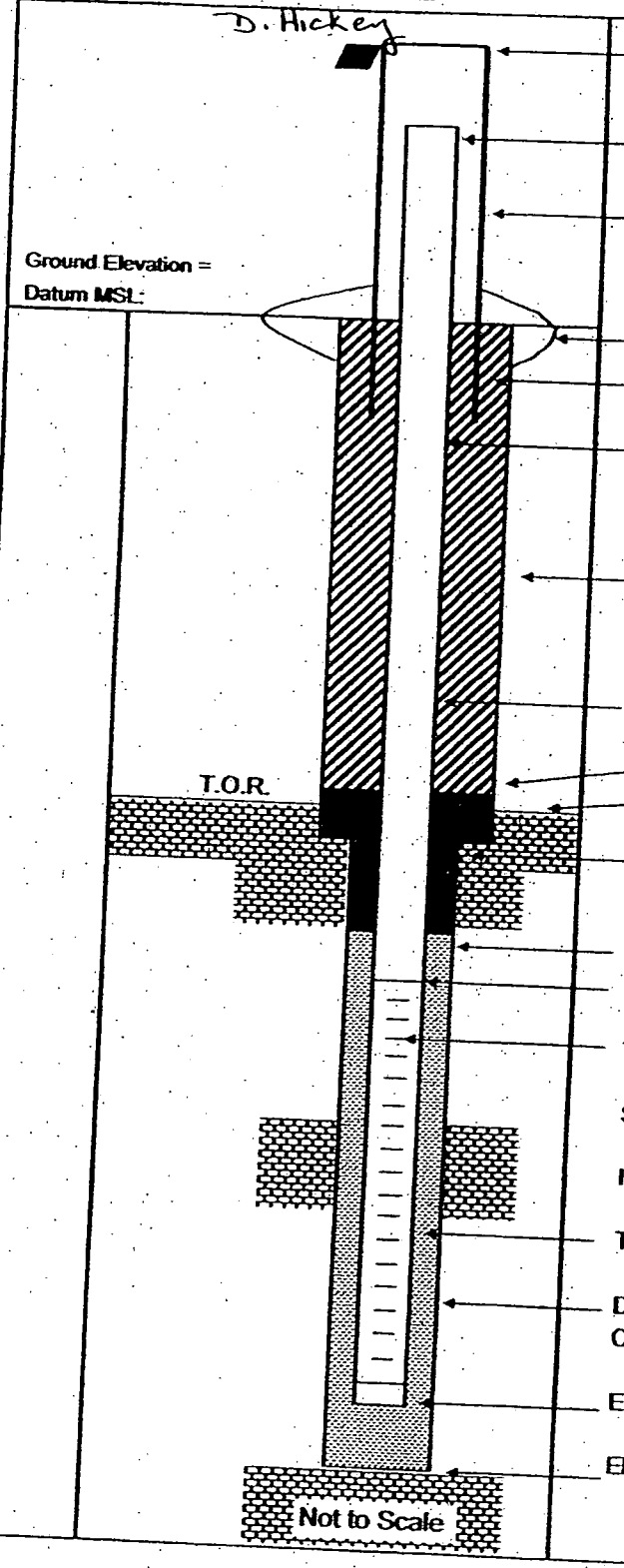
Tetra Tech NUS, Inc.

BEDROCK
MONITORING WELL SHEET

WELL No.: 09MWT07D

PERMIT No:

PROJECT:	NSW CRANE	DRILLING Co.:	Bowser Morner	BORING No.:	09T07
PROJECT No.:	~~0060 CTO 0279~~ 00042	DRILLER:	J. Walsh	DATE COMPLETED:	10/31/05
SITE:	SWMU ~~18~~ 9	DRILLING METHOD:	Core	NORTHING:	
GEOLOGIST:	~~B. BAALKOVEG~~ D. Hickey	DEV. METHOD:		EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:

Elevation of Top of Riser:

I.D. of Surface Casing:

Type of Surface Casing:

Type of Surface Seal:

I.D. of Permanent Casing:

I.D. of Riser: 2"

Type of Riser: Sch 40 PVC

Borehole Diameter: 9"

Type of Backfill:

Elevation / Depth Top of Seal: 13.0

Elevation / Depth Top of Bedrock: 11.0'

Type of Seal: Bentonite Chips

Elevation / Depth of Top of Fine Sand: —/—

Elevation / Depth of Top of Filter Pack: 12'

Elevation / Depth of Top of Screen: 13'

Type of Screen: Sch 40 PVC

Slot Size x Length: 0.020" X 10'

I.D. of Screen: 2"

Type of Filter Pack: No. 10-20 SAND

Diameter of Hole in Bedrock:
Core / Ream: 2.5" / 6"

Elevation / Depth of Bottom of Screen: 23'

Elevation / Total Depth of Borehole: 23'

Tetra Tech NUS, Inc.

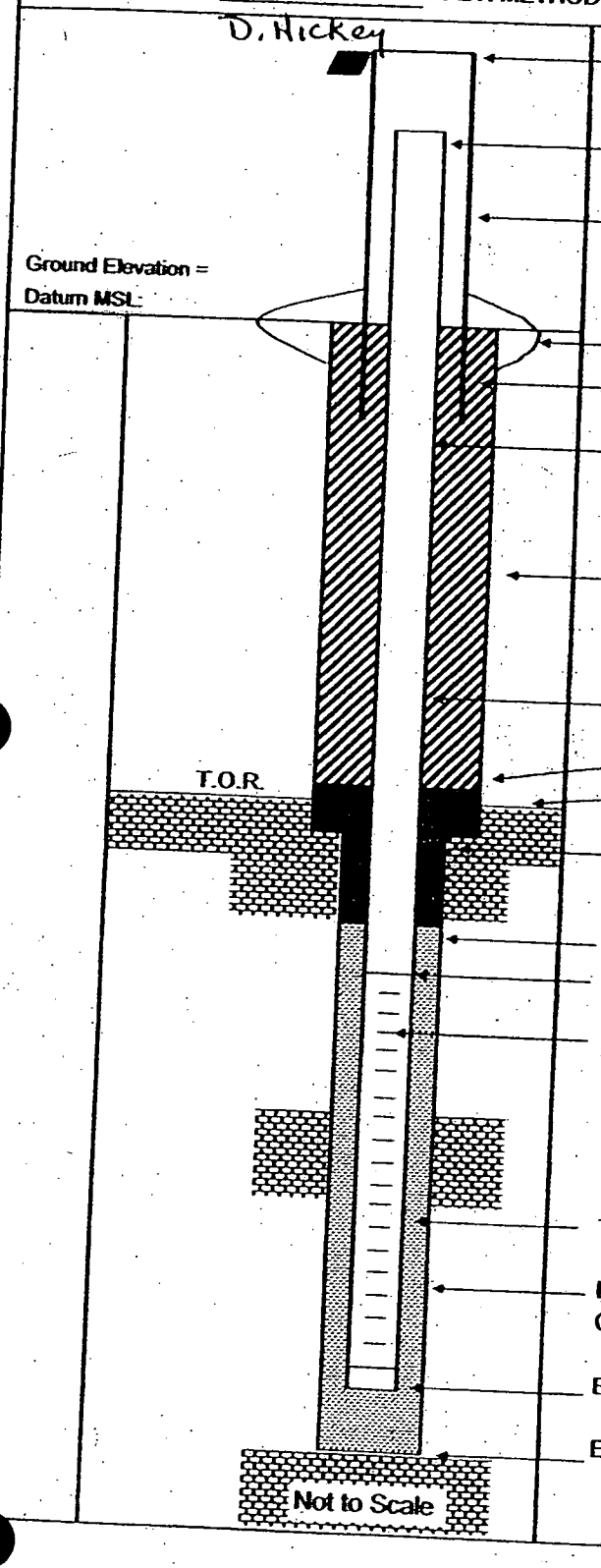
BEDROCK
MONITORING WELL SHEET

WELL No.: 09T08
PERMIT No.: 09MWT08

PROJECT: NSW CRANE
PROJECT No.: ~~0060 GTO 0270~~ 00042
SITE: SWMU ~~18~~ 9
GEOLOGIST: ~~B. BAALKOVEC~~ D. Hickey

DRILLING Co.: Bowser Morner
DRILLER: J. Walsh
DRILLING METHOD: Core
DEV. METHOD:

BORING No.: 09T08
DATE COMPLETED: 10-22-05
NORTHING:
EASTING:



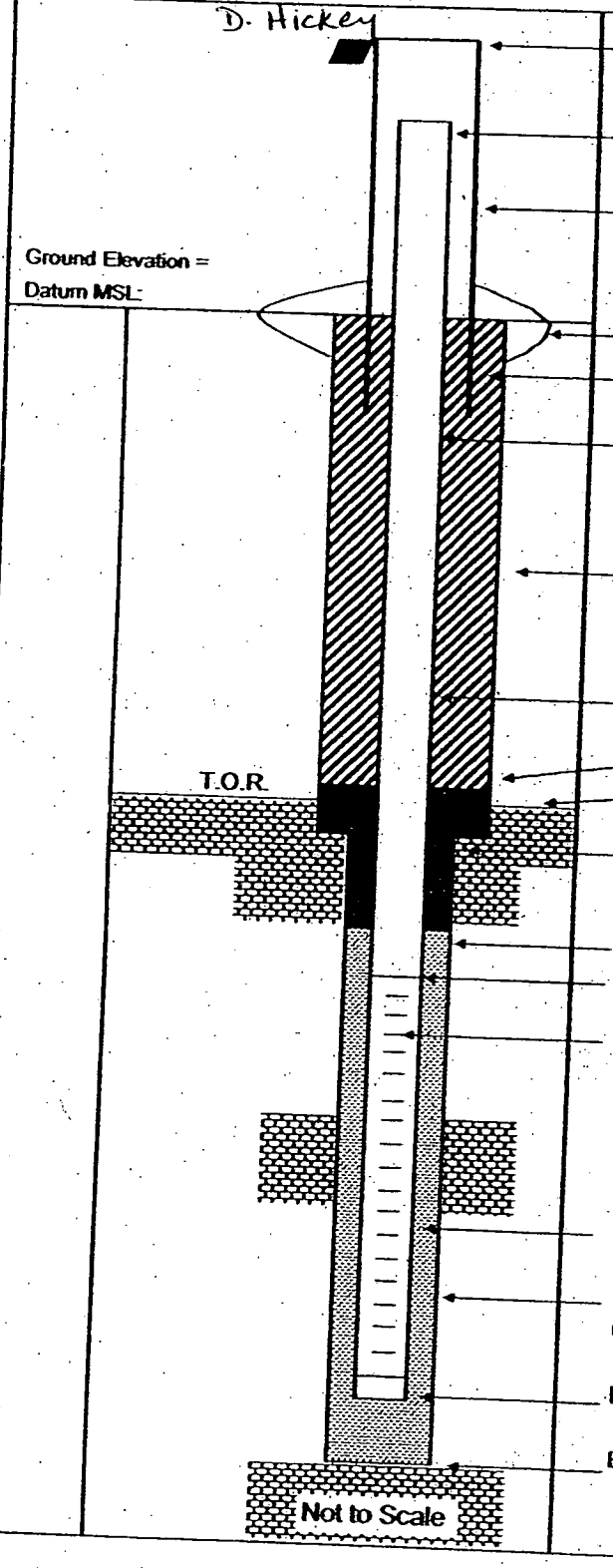
Elevation of Top of Casing:
Stick Up of Casing Above Ground Surface:
Elevation of Top of Riser:
I.D. of Surface Casing:
Type of Surface Casing:
Type of Surface Seal:
I.D. of Permanent Casing:
I.D. of Riser: 2"
Type of Riser: Sch 40 PVC
Borehole Diameter: ~9"
Type of Backfill:
Elevation / Depth Top of Seal: 13.0'
Elevation / Depth Top of Bedrock: 16.5'
Type of Seal: Bentonite Chips (med)
Elevation / Depth of Top of Fine Sand: — / —
Elevation / Depth of Top of Filter Pack: 11.0'
Elevation / Depth of Top of Screen: 13.0'
Type of Screen: Sch 40 PVC
Slot Size x Length: 0.02" X 10'
I.D. of Screen: 2"
Type of Filter Pack: No. 10-20 SAND
Diameter of Hole in Bedrock:
Core / Ream: ~2.5"/~6"
Elevation / Depth of Bottom of Screen: 23.0'
Elevation / Total Depth of Borehole: 23.0'

Tetra Tech NUS, Inc.

BEDROCK
MONITORING WELL SHEET

WELL No.: 09T09
PERMIT No.: 09MWT09

PROJECT:	NSW CRANE	DRILLING Co.:	Bowser Morner	BORING No.:	
PROJECT No.:	~~9060 GTO 0279~~ 00042	DRILLER:	J. Walsh	DATE COMPLETED:	10/19/05
SITE:	SWMU ~~13~~ 9	DRILLING METHOD:	Core	NORTHING:	
GEOLOGIST:	~~D. BAALKOVEC~~ D. Hickey	DEV. METHOD:		EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:

Elevation of Top of Riser:

I.D. of Surface Casing:

Type of Surface Casing:

Type of Surface Seal:

I.D. of Permanent Casing:

I.D. of Riser: 2"

Type of Riser: Sch 40 PVC

Borehole Diameter: 9.0"

Type of Backfill:

Elevation / Depth Top of Seal: 16.0'

Elevation / Depth Top of Bedrock: 19.5'

Type of Seal: Bentonite Chips (med)

Elevation / Depth of Top of Fine Sand: —/—

Elevation / Depth of Top of Filter Pack: 20.0

Elevation / Depth of Top of Screen: 22.0

Type of Screen: Sch 40 flush Thrd PVC

Slot Size x Length: 0.020" x 10'

I.D. of Screen: 2"

Type of Filter Pack: No. 10-20 SAND

Diameter of Hole in Bedrock:
Core / Ream: ~2.5"/~6" (NX Core)

Elevation / Depth of Bottom of Screen: 32.0'

Elevation / Total Depth of Borehole: 32.0'

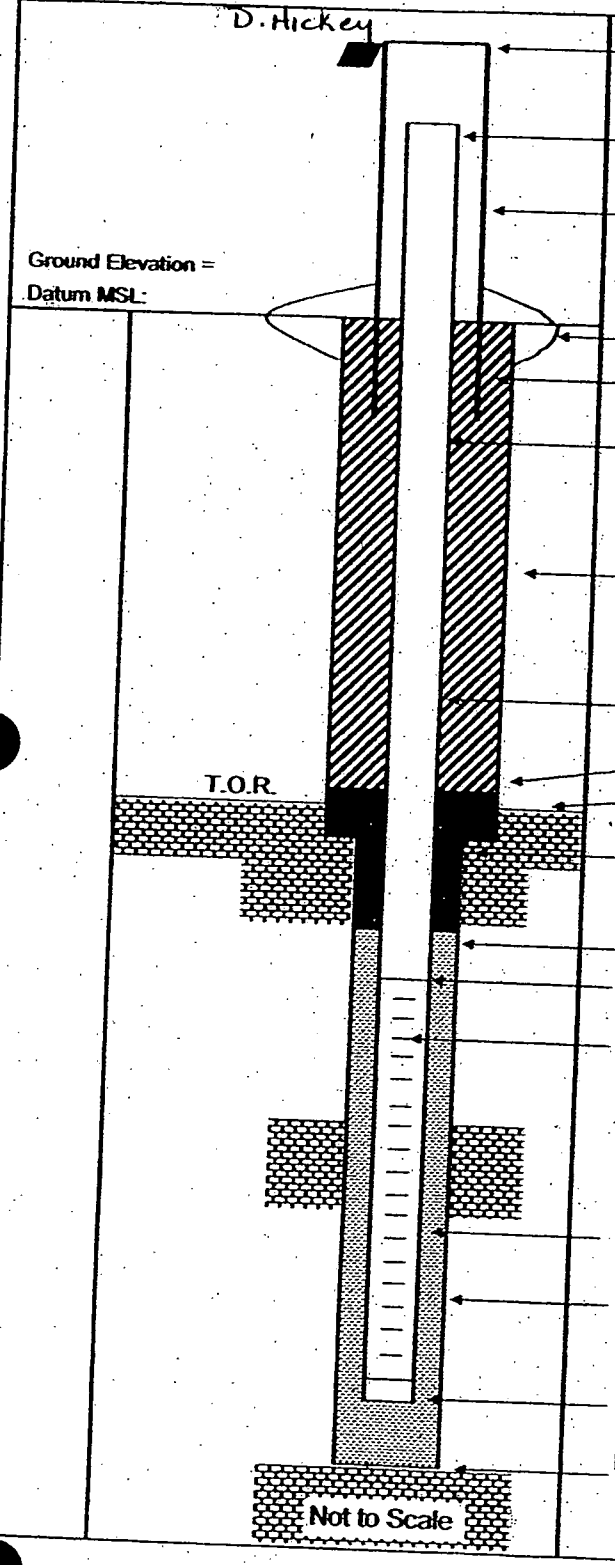
Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 09T10

PERMIT No.: 09MWT10

PROJECT:	NSW CRANE	DRILLING Co.:	Bowser Morner	BORING No.:	09T10
PROJECT No.:	~~9000 CTO 0279~~ 00047	DRILLER:	J. Walsh	DATE COMPLETED:	10/25/05
SITE:	SWMU 19	DRILLING METHOD:	Core	NORTHING:	
GEOLOGIST:	~~B. BAALKOVEG~~ D. Hickey	DEV. METHOD:		EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:

Elevation of Top of Riser:

I.D. of Surface Casing:

Type of Surface Casing:

Type of Surface Seal:

I.D. of Permanent Casing:

I.D. of Riser: 2"

Type of Riser: Sch 40 PVC

Borehole Diameter: ~9"

Type of Backfill:

Elevation / Depth Top of Seal: 1

Elevation / Depth Top of Bedrock: 16.0'

Type of Seal: Bentonite Chips

Elevation / Depth of Top of Fine Sand: — 1 —

Elevation / Depth of Top of Filter Pack: 10.0'

Elevation / Depth of Top of Screen: 12.0'

Type of Screen: Sch 40 PVC

Slot Size x Length: 0.02" x 10'

I.D. of Screen: 2"

Type of Filter Pack: No. 10-20 SAND

Diameter of Hole in Bedrock:
Core / Ream: ~2.5"/~6"

Elevation / Depth of Bottom of Screen: 22.0'

Elevation / Total Depth of Borehole: 22.0'

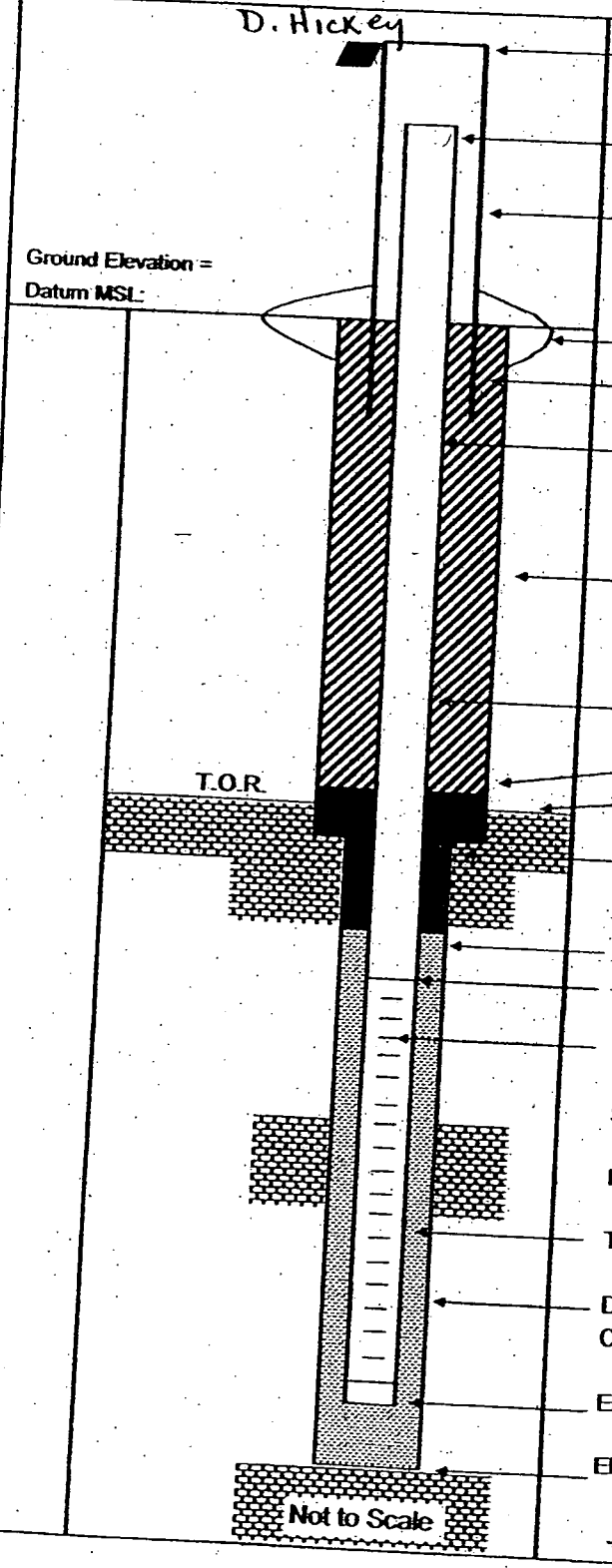
Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 09T11

PERMIT No.: 09MWT11

PROJECT:	NSW CRANE	DRILLING Co.:	Bowser Morner	BORING No.:	09T11
PROJECT No.:	~~9060 CTO 0270~~ 00092	DRILLER:	J. Walsh	DATE COMPLETED:	10-21-05
SITE:	SWMU 18 9	DRILLING METHOD:	Core	NORTHING:	
GEOLOGIST:	~~B. BAALKOVEG~~ D. Hickey	DEV. METHOD:		EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:

Elevation of Top of Riser:

I.D. of Surface Casing:

Type of Surface Casing:

Type of Surface Seal:

I.D. of Permanent Casing:

I.D. of Riser: 2"

Type of Riser: Sch 40 PVC

Borehole Diameter: ~9.0"

Type of Backfill:

Elevation / Depth Top of Seal: 13.0'

Elevation / Depth Top of Bedrock: 16.5'

Type of Seal: Bentonite Chips (med)

Elevation / Depth of Top of Fine Sand: — / —

Elevation / Depth of Top of Filter Pack: 10.5'

Elevation / Depth of Top of Screen: 12.0'

Type of Screen: Sch 40 PVC

Slot Size x Length: 0.02" x 10'

I.D. of Screen: 2"

Type of Filter Pack: No. 10-20 SAND

Diameter of Hole in Bedrock:
Core / Ream: ~2.5" / ~6.0"

Elevation / Depth of Bottom of Screen: 22.0'

Elevation / Total Depth of Borehole: 22.0'

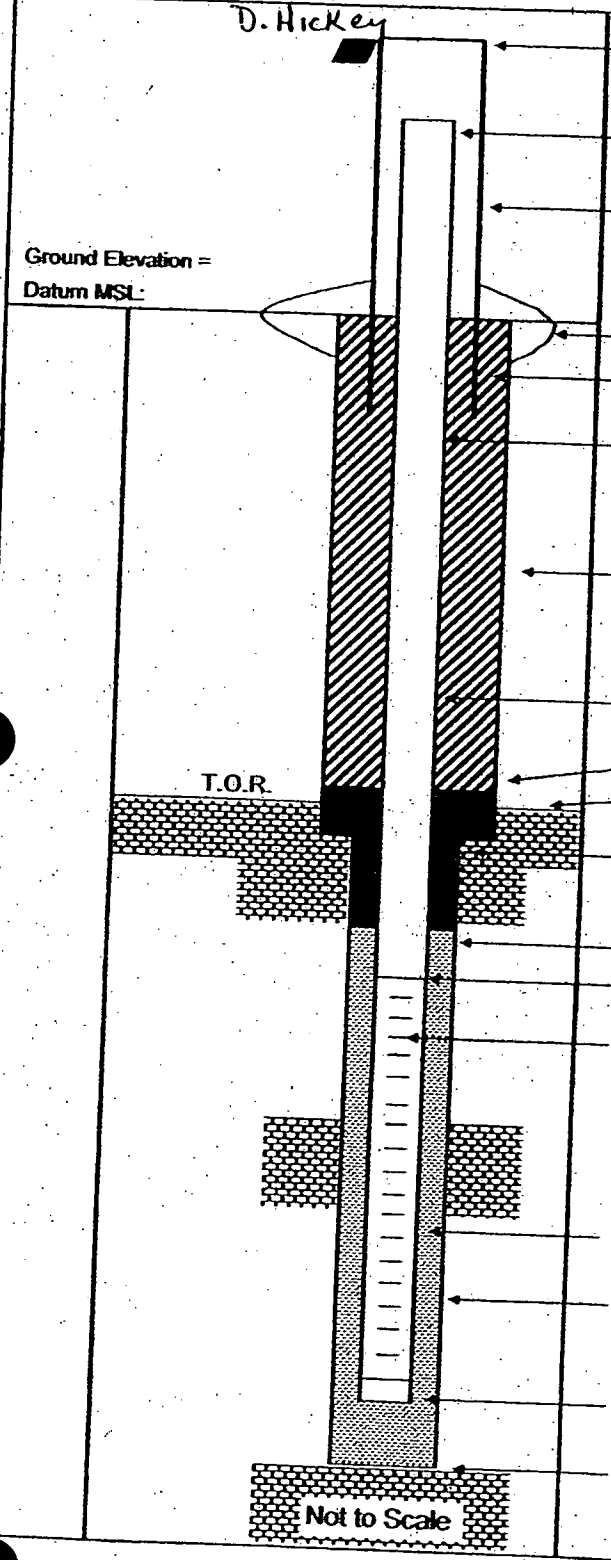
Temp Casing Set to 9.0' BGS

Tetra Tech NUS, Inc.

BEDROCK
MONITORING WELL SHEET

WELL No.: 09T12
PERMIT No.: 09MWT12

PROJECT:	NSW CRANE	DRILLING Co.:	Bowser Morner	BORING No.:	
PROJECT No.:	~~9060 GTO 0279~~ 60912	DRILLER:	J. Walsh	DATE COMPLETED:	10/21/05
SITE:	SWMU ~~18~~ 9	DRILLING METHOD:	Core	NORTHING:	
GEOLOGIST:	~~B. BAALKOVEG~~ D. Hickey	DEV. METHOD:		EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:
Elevation of Top of Riser:

I.D. of Surface Casing:

Type of Surface Casing:

Type of Surface Seal:

I.D. of Permanent Casing:

I.D. of Riser: 2"

Type of Riser: Sch 40 PVC

Borehole Diameter: ~9"

Type of Backfill:

Elevation / Depth Top of Seal: 13.0'
Elevation / Depth Top of Bedrock: 16.5'

Type of Seal: Bentonite Chips (med)

Elevation / Depth of Top of Fine Sand: —
Elevation / Depth of Top of Filter Pack: 10.8'
Elevation / Depth of Top of Screen: 12'

Type of Screen: Sch 40 PVC

Slot Size x Length: 0.02" x 30'

I.D. of Screen: 2"

Type of Filter Pack: No. 10-20 SAND

Diameter of Hole in Bedrock:
Core / Ream: ~7.5" / ~6"

Elevation / Depth of Bottom of Screen: 42'

Elevation / Total Depth of Borehole: 42'

* Temp Casing set to 9.0' BGS.

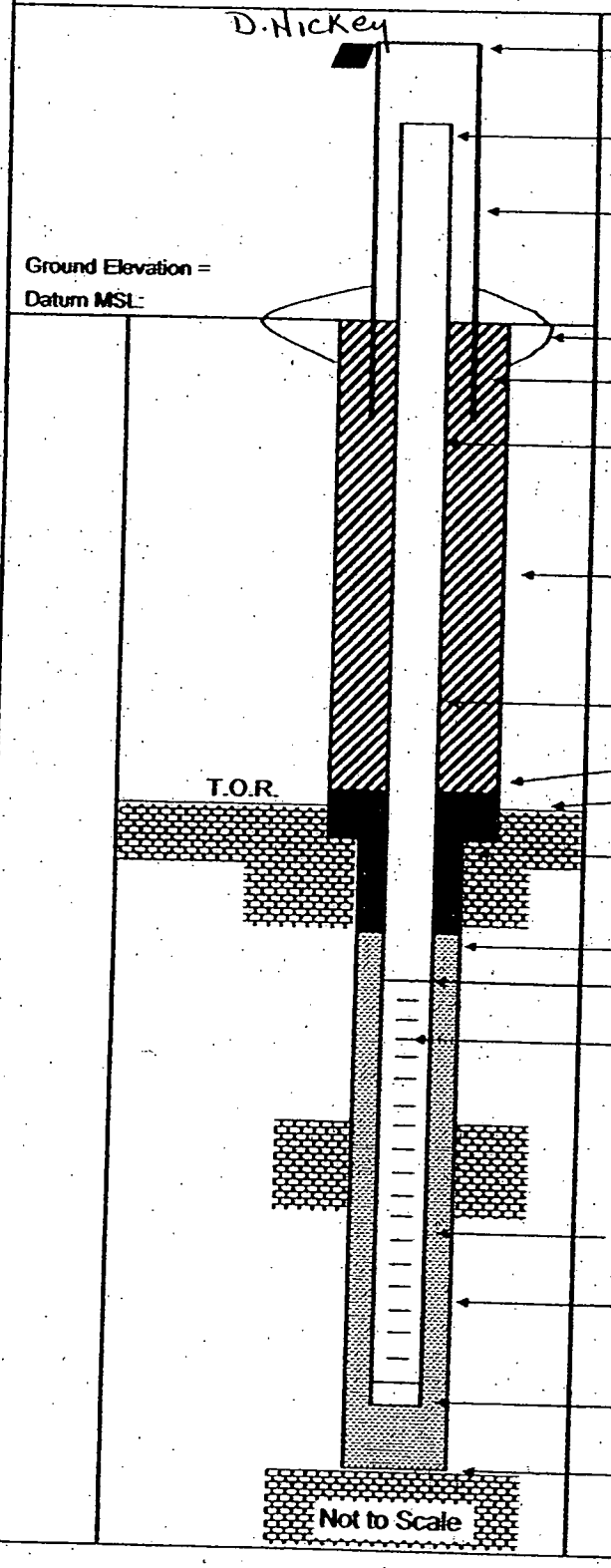
Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 09T13

PERMIT No.: 09MWT13

PROJECT:	NSW CRANE	DRILLING Co.:	Bowser Morner	BORING No.:	
PROJECT No.:	~~0060 CTO 0279~~ 00092	DRILLER:	J. Walsh	DATE COMPLETED:	10/19/05
SITE:	SWMU ~~18~~ 9	DRILLING METHOD:	Core	NORTHING:	
GEOLOGIST:	~~B. BAALKOVEC~~ D. Hickey	DEV. METHOD:		EASTING:	



Elevation of Top of Casing: _____

Stick Up of Casing Above Ground Surface: _____

Elevation of Top of Riser: _____

I.D. of Surface Casing: _____

Type of Surface Casing: _____

Type of Surface Seal: _____

I.D. of Permanent Casing: _____

I.D. of Riser: 2"

Type of Riser: Sch 40 flush Thread PVC

Borehole Diameter: 9"

Type of Backfill: _____

Elevation / Depth Top of Seal: 15.0'

Elevation / Depth Top of Bedrock: 19.0'

Type of Seal: Bentonit Chips (med)

Elevation / Depth of Top of Fine Sand: —/—

Elevation / Depth of Top of Filter Pack: 111.5'

Elevation / Depth of Top of Screen: 112.5'

Type of Screen: Sch 40 flush Thread PVC

Slot Size x Length: 0.02" x 10'

I.D. of Screen: 2"

Type of Filter Pack: No. 10-20 SAND

Diameter of Hole in Bedrock:
Core / Ream: ~2.5" / ~6" (NX Core)

Elevation / Depth of Bottom of Screen: 132.5'

Elevation / Total Depth of Borehole: 132.5'

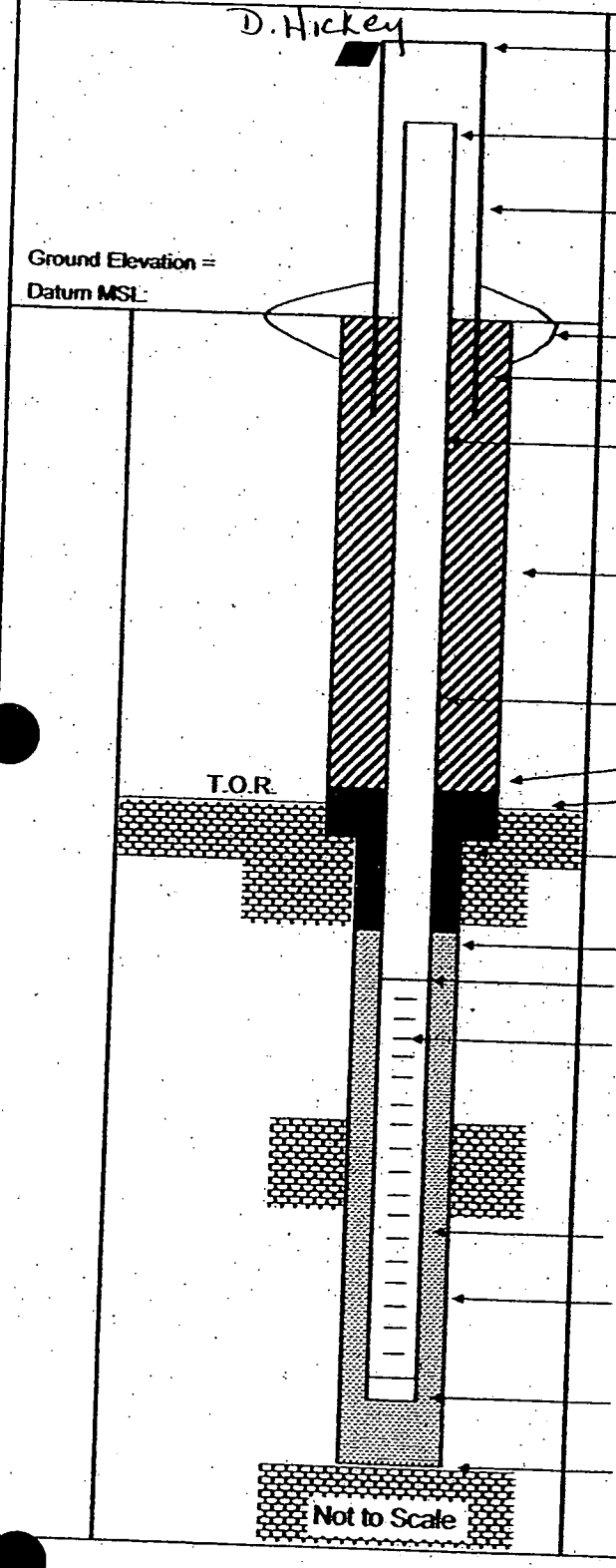
Tetra Tech NUS, Inc.

BEDROCK
MONITORING WELL SHEET

WELL No.: 09T14

PERMIT No: 09MWT14

PROJECT:	NSW CRANE	DRILLING Co.:	Bowser Morner	BORING No.:	09T14
PROJECT No.:	~~9000 CTO 0279~~ 00042	DRILLER:	J. Walsh	DATE COMPLETED:	10/18/05
SITE:	SWMU ~~15~~ 9	DRILLING METHOD:	Core	NORTHING:	
GEOLOGIST:	~~B. BAALKOVEC~~ D. Hickey	DEV. METHOD:		EASTING:	



Elevation of Top of Casing: _____

Stick Up of Casing Above Ground Surface: _____

Elevation of Top of Riser: _____

I.D. of Surface Casing: _____

Type of Surface Casing: _____

Type of Surface Seal: _____

I.D. of Permanent Casing: _____

I.D. of Riser: 2"

Type of Riser: Sch 40, flush thread PVC

Borehole Diameter: ~9.0"

Type of Backfill: _____

Elevation / Depth Top of Seal: 1 6.0'

Elevation / Depth Top of Bedrock: 1 10'

Type of Seal: Bentonite Chips (med)

Elevation / Depth of Top of Fine Sand: — / —

Elevation / Depth of Top of Filter Pack: 1 15.0

Elevation / Depth of Top of Screen: 1 17.0

Type of Screen: Sch 40, flush thread PVC

Slot Size x Length: 0.02" / 10'

I.D. of Screen: 2"

Type of Filter Pack: No. 10-20 SAND

Diameter of Hole in Bedrock:
Core / Ream: ~2.5 / 6.0

Elevation / Depth of Bottom of Screen: 1 27.0

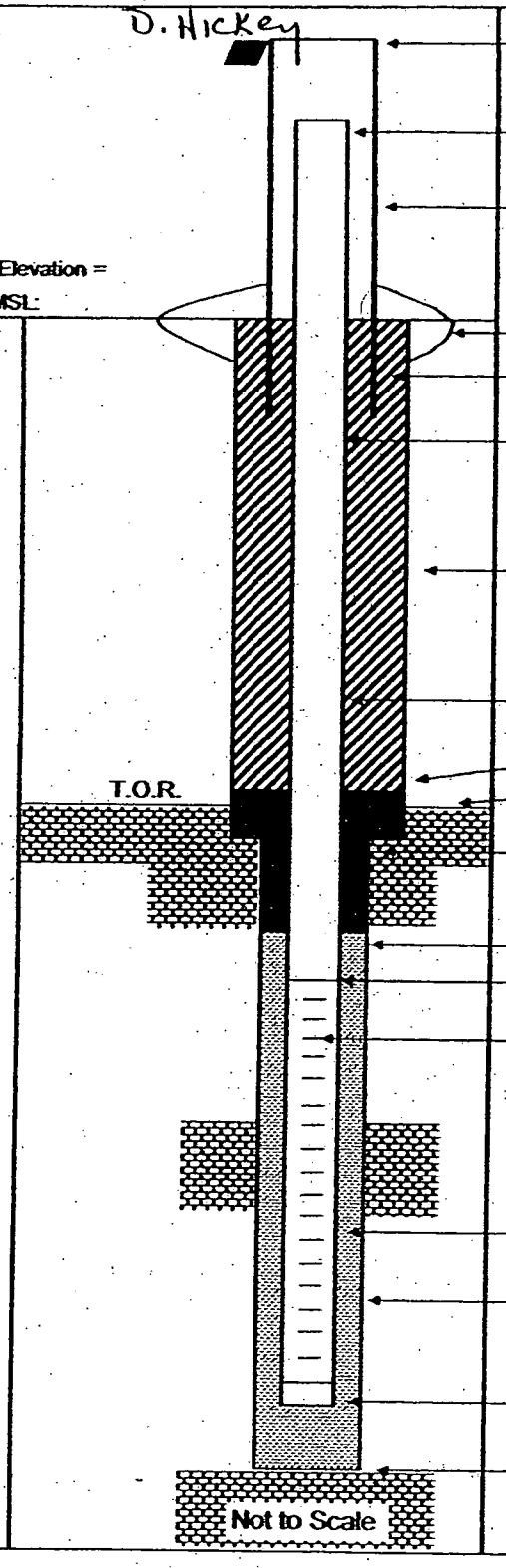
Elevation / Total Depth of Borehole: 1 32.5

Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 09T15
PERMIT No.: 09MWT15

PROJECT:	NSW CRANE	DRILLING Co.:	Bowser Morner	BORING No.:	09T15
PROJECT No.:	~~9060 GTO 0279~~ 2094Z	DRILLER:	J. Walsh	DATE COMPLETED:	10/18/05
SITE:	SWMU ~~13~~ 9	DRILLING METHOD:	Core	NORTHING:	
GEOLOGIST:	~~B. BAALKOVEG~~ D. Hickey	DEV. METHOD:		EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:

Elevation of Top of Riser:

I.D. of Surface Casing:

Type of Surface Casing:

Type of Surface Seal:

I.D. of Permanent Casing:

I.D. of Riser: 2"

Type of Riser: Sch 40 PVC

Borehole Diameter: 9-inch

Type of Backfill:

Elevation / Depth Top of Seal: 15.0

Elevation / Depth Top of Bedrock: 19.0

Type of Seal: Bentonite Chips (med)

Elevation / Depth of Top of Fine Sand: —/—

Elevation / Depth of Top of Filter Pack: 19.0

Elevation / Depth of Top of Screen: 21.0

Type of Screen: Sch 40 PVC

Slot Size x Length: 10-Slot / 10'

I.D. of Screen: 2"

Type of Filter Pack: No. 10-20 SAND

Diameter of Hole in Bedrock:
Core / Ream: ~2.5"/6" (NX Core)

Elevation / Depth of Bottom of Screen: 31.0

Elevation / Total Depth of Borehole: 32.5