DEPARTMENT OF THE NAVY
CRANE DIVISION
NAVAL SURFACE WARFARE CENTER
300 HIGHWAY 361
CRANE INDIANA 47522 5001

N00164.AR.000909
NSWC CRANE
5090.3a

IN REPLY REFER TO
5090/S4.7.5
Ser RP3/4335

4 NOV 2004

U.S. Environmental Protection Agency, Region V
Waste, Pesticides, & Toxics Division
Waste Management Branch
Corrective Action Section
77 West Jackson Blvd.
Chicago, IL 60604

Dear Mr. Ramanauskas:

Crane Division, Naval Surface Warfare Center submits the Final Corrective Measures Study (CMS) for the Dye Burial Ground, Solid Waste Management Unit (SWMU) 02. Enclosure (1) contains the CMS along with responses to comments. The permit required Certification Statement is provided as enclosure (2).

If you require any further information, my point of contact is Mr. Thomas J. Brent, Code RP3-TB, at 812-854-6160, email thomas.brent@navy.mil.

Sincerely,

Christine D. Freeman, for
JAMES M. HUNSICKER
Manager, Environmental Protection
By direction of the Commanding Officer

Enclosures: 1. Final DBG CMS and Response to Comments
2. Certification Statement

Copy to:
ADMINISTRATIVE RECORD
SOUTHNAVFACENGCOM (Code ES31) (w/o encl)
IDEM (Doug Griffin)
TTNUS (Ralph Basinski) (w/o encl)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Christian D. Freeman, for

SIGNATURE

Manager, Environmental Protection — 11/4/04

TITLE — DATE

5090
Ser RP3/4335

4 Nov 2004

The letter Ser RP3/4335 was for the Final Corrective Measures Study for the Dye Burial Ground, SWMU 02. Updated pages added to report dated 12/16/03 making it the final report.

October 28, 2004

RESPONSES TO USEPA COMMENTS DATED MARCH 19, 2004 ON CORRECTIVE MEASURES STUDY FOR SWMU 2 - DYE BURIAL GROUNDS NAVAL SURFACE WARFARE CENTER CRANE, INDIANA

United States Environmental Protection Agency Region 5 comments are shown in bold font. The response to each comment is shown in regular font. Text changes to the Corrective Measures Study are shown in italic font enclosed in quotation marks.

Comment 1:

Referring to the Clean Air Act section on page 3-4, NWIRP appears to be an undefined acronym.

The acronym "NWIRP" stands for a facility other than NSWC Crane and has been changed to "NSWC Crane".

Comment 2:

Section 3.4.2. refers to Table 3-4, which is missing.

Table 3-4 provides a list of media cleanup standards (MCSs). Copy of this table is attached to these responses and has been added to the CMS report.

Comment 3:

Section 4.2.4.2. under <u>Effectiveness</u> refers to Table 2-1, which is missing. On page 4-9, this same part refers to treatment by-products consisting of spent solvents. Would these be water based solvents, organic solvents, or both?

Table 2-1 provides physical/chemical characteristics of the dyes detected at SWMU 2, including water solubility. A copy of this table is attached to these responses and has been added to the CMS report.

Whenever possible soil washing is preferably performed with water based solvents, but under certain cases organic solvents can be used as well.

Comment 4:

Section 4.2.4.3., <u>Effectiveness,</u> refers to Table 2-1, which is missing. The <u>Implementability</u> part of this section discusses ex-situ bio-slurry reactor and bio-pile technology. These technologies are said to be implementable but are later eliminated from further consideration apparently because of the need to perform treatability testing and complexities in the sequence of operations (e.g. soil staging, treatment, and disposal). However, as stated earlier in this section, the Navy has utilized bio-pile technologies for explosives contaminated soils, the infrastructure to utilize this technology already exists on the base, and this sequence of operations has been successfully performed. As such, it seems inappropriate to discount bio-pile technology based on implementability during the preliminary screening. If proving the effectiveness of such technology through treatability testing would be more expensive and/or time consuming relative to other proposed remedies, this should be stated and a detailed basis provided.

See Response 3. A copy of Table 2-1 is attached to these responses and has been added to the CMS report. In addition to physical/chemical characteristics such as water solubility, Table 2-1 also provides environmental fate criteria of the dyes detected at SWMU 2 such as water/octanol partition coefficient (K_{OW}), organic carbon partition coefficient (K_{OC}), and bioconcentration factor (BCF) as well as an indication of known biodegradability. Table 2-1 data identifies the SWMU 2 military dyes as very persistent chemicals with few of them known to be

biodegradable. Accordingly, there are significant concerns about the site-specific effectiveness of the ex-situ bio-slurry reactor and bio-pile technology.

In addition, as mentioned in the discussion of the Implementability criterion, the ex-situ bio-slurry reactor and bio-pile technology would require a relatively complex sequence of operations. Although some elements of the existing biotreatment facility might be re-usable, this facility would have to be thoroughly modified because it was designed for the aerobic treatment of explosive-contaminated soil which is very different from the treatment of the SWMU 2 dye-contaminated soil that would require anaerobic conditions.

At this point, it is felt that the combination of significant effectiveness concerns and complexity of implementation should be sufficient to screen-out this technology. The discussion of the Effectiveness and Implementability criteria has been re-written as follows to clarify and reinforce the rationale for this choice:

"Effectiveness

Bio-slurry reactors and bio-piles have been proven effective for the treatment of soil contaminated with a wide range of organic compounds. Such a system has been operated at NSWC Crane for the treatment of explosive-contaminated soil but is currently idle. Typically, bio-slurry reactors or bio-piles can achieve close to 100 percent removal of these compounds. However, the effectiveness of these processes for the removal of the military dyes present in the SWMU 2 contaminated soil and landfill material is unproven. Only limited data is available about environmental fate criteria [water/octanol partition coefficient (K_{OW}), organic carbon partition coefficient (K_{OC}), and bioconcentration factor (BCF)] and biodegradability for the military dyes disposed at SWMU 2, but this data as presented in Table 2-1 indicates that these chemicals are very persistent, that biodegradation does not appear to be an important environmental fate process, and that only a few of the dyes might be amenable to anaerobic treatment. Therefore, this technology is not very likely to achieve the CAOs and meet the MCSs.

Implementability

Ex-situ bio-slurry reactor or bio-pile technologies would be implementable for SWMU 2, but each would require a relatively complex sequence of operations, including staging, treatment, and disposal of treated soil. In addition, treated soil from a bio-slurry reactor would also require dewatering and drying prior to disposal or re-use. The necessary equipment and resources are only available from a relatively limited number of contractors or off-base permitted TSDFs. The existing facility previously used for the biological treatment of explosive-contaminated soil could be considered for this application but it would have to be extensively modified because it was designed as an aerobic treatment system whereas the biodegradation of the SWMU 2 military dyes, if feasible, would almost certainly require anaerobic conditions. Treatability testing would be required to prove effectiveness and determine operating parameters."

Comment 5:

Section 4.2.4.4., Effectiveness, refers to an unknown "Table 2-". The Conclusions part of this section mentions pre-treatment of Dye Burial Grounds soil with LTTD. Why would this be considered pre-treatment instead of a final remedy for DBG if LTTD would likely be effective in producing a clean soil? Furthermore, if the treated soil is clean of contaminants and meets acceptable standards, it may be returned to the DBG site as backfill thereby saving on off-site disposal cost. This technology should be further considered in the CMS and evaluated in Section 5 as Alternative 4: Excavation, LTTD Treatment, Backfilling.

The unknown "Table 2-" is in fact Table 2-1, which is discussed in Responses 3 and 4. In addition to the environmental fate and biodegradability information mentioned in Response 4, Table 2-1 also provides an indication of the vapor pressure, melting point, and thermal properties of the SWMU 2 military dyes. Although relatively limited this additional information seems to indicate that an LTTD system designed to treat the SWMU 2 contaminated soil would have to be operated towards the upper temperature range of this technology (probably 800 to 1,000° F or 425 to 540° C).

As to the implementability of LTTD at SWMU 2, it is generally assumed that such a relatively complex technology should not be implemented on site unless a sufficiently large volume of contaminated material is to be treated (typically at least 20,000 yd^3). For SWMU 2 the volume of contaminated soil is only approximately 19,000 yd^3 and, therefore, LTTD would probably best be implemented at a permitted off-base facility. This means that it would be impractical to transport the treated soil back to SWMU 2 for reuse as backfill material and that this treated soil would have to be disposed at the off-base facility, making the LTTD process a "pre-treatment" step. However, the SWMU 2 soil is not considered as hazardous and could be directly disposed at a number of off-base permitted facilities, without this "pre-treatment" step, hence the conclusion that LTTD should be eliminated as unnecessary. The discussion of the Implementability criterion and the Conclusion has been re-written as follows to clarify and reinforce the rationale for this choice:

"Implementability

Ex-situ LTTD would be implementable for SWMU 2. The quantity of contaminated material to be treated (less than 20,000 yd^3) would make it more practical and cost effective for this technology to be implemented at a fixed off-base permitted TSDF rather than on-site with a mobile treatment system. A number of qualified off-base permitted TSDFs are available to provide this service. Pre-treatment for size reduction would most likely be required and could be accomplished on site prior to off-base transportation. Off-gases from the thermal desorption unit would have to be treated. Although the treated material would meet the MCSs, it would probably still have to be disposed by non-hazardous landfill, unless an acceptable and practical application could be readily found for the re-use of this material. Treatability tests would have to be performed to verify effectiveness and determine operating parameters."

and

"Conclusion

Although ex-situ LTTD would likely be effective and could be readily implemented at an off-base permitted TSDF, non-hazardous landfilling of the treated material would probably still be required for ultimate disposal. Because it is assumed that the SWMU 2 contaminated soil is non-hazardous and that its disposal would not trigger LDRs, pre-treating this material with LTTD would not significantly improve disposal options and costs. Therefore, LTTD is eliminated from further consideration for this CMS as unnecessary."

Comment 6:

Section 4.3.2., Component 2, discusses groundwater flow velocity and dye transport velocities. Appendix C presents calculations for these velocities and estimates time travel for dye between the capped area and downgradient wells to be around 70 years.

The study from which the hydraulic conductivity value was obtained derived the value from slug testing. It is stated that the aquifer properties estimated from slug testing should be considered as bulk equivalent properties, appropriate for isotropic, homogeneous, fully-penetrated, and confined aquifers. The two wells for which the Appendix C calculations were done are for wells located in the Lower Pennsylvanian Sandstone aquifer which is unconfined and fractured.

Given the heterogeneous nature of the of the geology beneath the SWMU, present a discussion of the uncertainties associated with the parameters used in these calculations (e.g., hydraulic conductivities and retardation factors, etc). As contaminants frequently follow the course of least resistance, a worst-case (fracture flow, karst) scenario for water and dye transport should be prepared and travel times calculated. In addition, the Navy should re-evaluate the groundwater monitoring plan and the associated costs based on the worst-case scenario.

Uncertainties related to the ground water flow direction, hydraulic conductivity values, porosity, organic carbon content, overall ground water flow velocities, and dye transport velocities are now presented and discussed in Section 4.3.2 and Appendix C. The water and contaminant migration velocities and travel times have been calculated using worst-case and best-estimate conditions.

Irregardless of the results of the ground water flow and contaminant transport calculations above, the Navy believes that periodic sampling of the five monitoring wells (02-02, 02-05, 02-06, 02-07, and 02-08) closest to the capped landfill is sufficient to detect migrating contaminants at the earliest time. These wells are located either within or directly adjacent to the capped area and should show evidence of migration before any other wells. If a dye is detected in one of these wells, then the monitoring well network should be expanded to include additional wells located farther downgradient (e.g., 02C15P2, 02-04, 02C11P3).

The frequency of sampling was identified as every five years in the draft CMS. If the fastest ground water velocities (i.e., worst-case velocities have been calculated and are presented in Appendix C) are assumed to exist at the site, then the sampling frequency is lowered to once every two years instead of five years. If dyes are not detected in the five monitoring wells after five sampling rounds (i.e., 10 years), then the sampling frequency will be reduced to once every five years, as is the case in the draft CMS.

Comment 7:

Section 4.3.3., Component 1: Why would cross-sectional excavation of the DBG make it more difficult to segregate the non-contaminated cap material from the contaminated soil beneath the cap? Why would only one-third of the over-excavated soil and landfill cap material be used for backfilling versus the entire volume of clean material (24,000 yd^3)? This would leave only 15,000 yd^3 for off-site disposal.

Cross-sectional excavation of the DBG would make it more difficult to segregate the non-contaminated cap material from the contaminated soil beneath the cap because it would limit the surface area of the excavation zone and thus make it difficult or impossible to use earth moving equipment such as bulldozers, graders, or front-end loaders that could "peel-off" and segregate relatively accurately the various horizontal layers of the cover system. Therefore, it was originally assumed that excavation would have to be performed with such equipment as backhoes which would result in significant vertical mixing of the various layers, and thus cross-contamination of clean cap material. However, on closer analysis, it is now believed that it would be possible to use such specialized excavation equipment as a Gradall to achieve relatively effective segregation of the various layers of excavated material.

The assumption that only one third of clean cap material and over-excavated soil would be re-usable for backfilling was a very conservative estimate that reflected the high likeliness of significant cross-contamination during the excavation process. This assumption is now thought to be overly conservative and it is now assumed that only the bottom 6 inches of the landfill cap material, or approximately 1,300 yd^3, would be cross-contaminated during excavation. Similarly, it is also now assumed that only one third of the 8,000 yd^3 of over-excavated soil, or approximately 2,700 yd^3, would be cross-contaminated during excavation. Therefore, the total volume of contaminated material to be disposed off-site is now estimated at 19,000 yd^3 (15,000 + 1,300 + 2,700), instead of 31,000 yd^3.

The sentence "Such an approach would make it much more difficult to segregate the non-contaminated cap material from the contaminated soil beneath the cap." has been deleted from the second paragraph of the description of Component 1: Excavation in Section 4.3.3 and the next-to-last and last sentences of this paragraph has been modified to read as follows:

"For the purpose of this CMS, it is assumed that approximately 20,000 yd^3 of clean landfill cap material and over-excavated soil would be segregated and re-used to backfill the excavated areas. Therefore, the net volume of waste material to be disposed off-base would be approximately 19,000 yd^3."

Comment 8:

There are missing remedy evaluation criteria in Section 5.0 (e.g., public acceptance, state acceptance). See MGBG CMS Addendum #1 Comment 18 sent via email November 19, 2003.

State Acceptance and Public Acceptance has been added to the "other factors" in the list of alternative evaluation criteria presented in the introductory statement of Section 5.0 on page 5-1. The following new paragraph has been added at the end of this introductory statement and in a new Section 6.5.6, State and

Community Acceptance, to explain that that these two additional criteria will be evaluated at a later date:

"State acceptance will be evaluated after the State of Indiana has reviewed and commented on the CMS. Public acceptance will be evaluated after comments on the proposed corrective action have been received from the public."

Comment 9:

The Navy should include a discussion of the time frames required to implement the remedy under the Implementability parts of Section 5.0.

A discussion of the timeframe required to implement has been added to the discussion of the Implementability criterion for each alternative, as well as an indication of attainment or non-attainment of CAOs and MCSs.

The following sentence has been added to the end of the sub-section entitled "Implementability" in Section 5.1.5:

"Alternative 1 would be implemented immediately and would not meet CAOs or MCSs."

The following paragraph has been added at the end of the sub-section entitled "Implementability" in Section 5.2.5:

"Alternative 2 would be implemented within approximately 6 months and would meet CAOs upon implementation. However, Alternative 2 would not meet MCSs and would require on-going institutional controls and monitoring for an indeterminate period of time."

The last sentence of the sub-section entitled "Implementability" in Section 5.3.5 has been changed to read as follows:

"Alternative 3 would be implemented within approximately one year and would meet CAOs and MCSs at the completion of the corrective action."

Comment 10:

In order for EPA to fully evaluate the Alternative presented in Section 5.2.1, provide additional explanation of how the integrity and effectiveness of the cap will be determined and maintained along with the other inspection checks and requirements.

A paragraph describing the proposed inspections of the existing cap has been added to the end of the description of Component 1: Institutional Controls of Alternative 2 in Section 4.3.2. This paragraph will read as follows:

"Over the long term, the integrity and effectiveness of the cap will be evaluated during annual site inspections. The annual inspections are designed to fulfill inspection requirements, identify and take action to correct deficiencies, and promote the long term effectiveness of the cap. During the annual inspection, the follow items will be evaluated:

- *Security - Gates and fencing, as well as warning signs, will be checked for damage. Signs will be checked for legibility. Any damage to signs will be repaired.*
- *Erosion - The soil cover will be checked for erosion damage such as washouts. Any damage to the soil cover will be repaired and revegetated.*
- *Settlement - The soil cover will be inspected for indications of settlement, subsidence, or displacement. The natures of any repairs will depend on the extent of the settlement, subsidence, or displacement. Any deep-rooted vegetation will be manually removed.*

- *Monitoring Wells – The wells will be checked for operability of the locks, identification tags, compromised impingement protection, and general condition of the riser.*

- *Vegetative Cover - The condition of the vegetative cover will be inspected for adequacy.*

The various inspection findings and actions will be documented in the facility inspection logbook."

In addition, results of the groundwater monitoring as described under Component 2 of Alternative 2 would provide further evidence of the continued integrity and effectiveness of the existing cap.

Comment 11:

Alternative 3 cost estimates are not provided in Appendix B as stated on page 5-7.

A detailed cost estimate for Alternative 3 is attached to these responses and has been added in Appendix B of the CMS report. This cost estimate has been revised to reflect the reduction in the volume of contaminated material to be disposed from 31,000 yd^3 to 19,000 yd^3. The estimated capital cost and net present worth for Alternative 3 is now $2,609,000, instead of $4,083,000.

Comment 12:

Section 6.0 should be re-written as needed to address EPA comments on previous sections of the document.

Section 6.0 has been modified as needed to reflect the revisions made to Sections 4.0 and 5.0 as a result of the CMS review process.

ATTACHMENTS

TABLE 2-1

PHYSICAL/CHEMICAL CHARACTERISTICS OF ACID DYES, BASIC DYES, AND SOLVENT DYES SWMU 2 - DYE BURIAL GROUNDS NSWC CRANE CRANE, INDIANA

Compound	CAS No.	Molecular Weight	Water Solubility	Specific Gravity	K_{ow}	K_{oc}	H atm/m3/mole	VP mm Hg	BCF	Subject to Biodegradation	Melting Point	Thermal Properties
ACID BLUE 1	129-17-9	566.67	30,000 mg/L	NA	NA	15 (but ionic)	non-volatile	NA	2	NA	NA	NA
ACID BLUE 9	2650-18-2	783.01	5% at 20°C	NA	NA	NA	NA	NA	NA	NA	NA	NA
ACID ORANGE 10	1936-15-8	452.38	80,000 mg/L	NA	0	0 (but ionic, therefore, resists leaching)	low	2.50E-20	low	anaerobic(yes); aerobic (no)	NA	NA
ACID VIOLET 49	1694-09-3	734.9	soluble	NA	NA	NA	NA	NA	NA	NA	NA	NA
ACID YELLOW 23	1934-21-0	534.37	200,000 mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA
ANTHRACENE	120-12-7	178.23	43 ug/L	1.25	28,184	16,032	4.88E-05	2.67E-06	891	no		Boiling Point = 342°C; heat of vap. = 294 kj/kg; heat of comb. = 40110 kj/kg
BASIC VIOLET 10	81-88-9	479	soluble	NA	NA	NA	NA	NA	NA	NA	NA	NA
BASIC YELLOW 2	2465-27-2	303.66	10,000 mg/L	NA	NA	50000	2.80E-16	1.70E-11	3.8 - 16	no	>250°C	NA
BENZANTHRONE	82-05-3	230.25		NA	NA	>10,000	6.61E-08	2.21E-07	61 - 181	yes	170°C	NA
SOLVENT ORANGE 3	532-82-1	248.71	20 mg/L	NA	NA	840	non-volatile		114	anaerobic(yes)	118°C, decomposes at 235°C	NA
SOLVENT ORANGE 7	3118-97-6	276.32	insoluble	NA	NA	NA	NA	NA	NA	NA	166°C	NA
SOLVENT YELLOW 14	842-07-9	248.3	insoluble	NA	NA	NA	NA	NA	NA	NA	134°C	NA
SOLVENT YELLOW 2	60-11-7	225.28	13.6 mg/L	NA	38,019	7390	7.10E-09	3.30E-07	1780	yes	114-117°C	NA
PIGMENT VIOLET 12	81-64-1	240.2	probably insoluble	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOLVENT RED 1	1229-55-6	278.3	3.3E-4 mg/L	NA	32,000,000	290000	1.10E-10	6.30E-09	290000	NA	183°C	NA
SOLVENT VIOLET 13	81-48-1	329.37		NA						NA	196°C	NA
SOLVENT YELLOW 3	97-56-3	225.28	7.64 mg/L	NA	8,318	1,426 - 3,236	2.91E-08	7.50E-07	196 - 562	NA	101-102°C	NA
VAT BLUE 1	482-89-3	262.26	insoluble	1.35	NA	NA	NA	NA	NA	NA	NA	Sublimes at about 300°C; decomposes at 390°C
VAT YELLOW 2	129-09-9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VAT YELLOW 4	128-66-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-AMINOANTHROQUINONE	117-79-3	223.24	160 ug/L	NA	1,995	1500	9.20E-11	5.00E-11	18 - 46	no	302°C	Sublimes; Heat of Sublimation = 32.7 kcal/mol

K_{ow} - Octanol/water partition coefficient.

K_{oc} - Organic carbon partition coefficient.

VP - Vapor Pressure.

H - Vapor pressure x molecular weight x water solubility.

BCF - Biocentration factor.

NA - Not available.

TABLE 3-4

MEDIA CLEANUP STANDARDS
FOR MILITARY DYES IN SOIL
SWMU 2 DYE BURIAL GROUNDS
NSWC CRANE
CRANE, INDIANA

Dye Name	Preliminary Risk-Based Target Levels - Human Health[1] (µg/kg)	Preliminary Risk-Based Target Levels - Ecological[2] (µg/kg)
Water Soluble Dyes		
Acid Blue 1	760,000	10,000
Acid Blue 9	380,000,000	1,630,000
Acid Blue 45	---	---
Acid Red 64	---	---
Acid Yellow 3	---	---
Acid Yellow 23	---	---
Acid Yellow 73	---	---
Acid Orange 10	150,000	6,460
Basic Violet 10	950,000	12,000
Basic Yellow 2	100,000	1,300
Organic Soluble Dyes		
1-Aminoanthraquinone	---	---
2-Aminoanthraquinone	14,700[3]	---
Disperse Blue 14	---	---
Disperse Red 9	---	---
Disperse Violet 1	---	---
Pigment Red 1	---	---
Smoke Dye	---	---
Solvent Green 3	---	---
Solvent Orange 3	1,000,000	129,000
Solvent Orange 7	1,200,000	52,000
Solvent Red 1	---	---
Solvent Red 24	---	---
Solvent Yellow 2	110[3]	26,000
Solvent Yellow 3	130[3]	---
Solvent Yellow 14	760,000	3,230
Solvent Yellow 33	---	---

1 Values calculated using U.S. EPA Region 9 Preliminary Remediation Goal (PRG) methodology and calculated reference doses (RfDs).
2 Values calculated using U.S. EPA Region 9 methodology as described in March 9, 1999 memorandum from Daniel Mazur to Carol Witt-Smith.
3 Value calculated using an available cancer slope factor (CSF).