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DEPARTMENT OF THE NAVY
NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
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IN REPLY REFER TO

1823/PO
28 January 1997

Ms. Christine A.P. Williams
U.S. Environmental Protection Agency
Region 1
J.F Kennedy Building HBT
Boston, MA 02203-2211

Mr. Richard Gottlieb
Office of Waste Management
Rhode Island Department of Environmental Management
235 Promenade Street
Providence, RI 02908-5767

Kenneth Finkelstein, Ph.D.
NOAA Office of Ocean Resource Conservation and Assessment
C/O EPA Waste Management Division HEE-6
J.F. Kennedy Federal Building
Boston, MA 02203

Re: RESPONSE TO COMMENTS ON THE CONSOLIDATED RESPONSE TO COMMENTS ON THE RI/FS/PRAP FOR SITE 09 ALLEN HARBOR LANDFILL, NAVAL CONSTRUCTION BATTALION CENTER (NCBC) DAVISVILLE, RI

Dear Ms. Williams, Mr. Gottlieb and Dr. Finkelstein,

Enclosed please find responses to comments provided by Environmental Protection Agency Region 1 letter of 11 December 1996, Rhode Island Department of Environmental Management letter of 11 December 1996 and National Oceanic and Atmospheric Administration letter of 9 December 1996.

If there are any questions on this matter, I can be reached at (610) 595-0567 ext 155.

Sincerely,

P. S. OTIS, P.E.
Remedial Project Manager
by direction of the Commanding Officer

Copy to:
RIEDC - H. Cohen
TONK - S. Licardi
CSO Davisville, RI

1. INTRODUCTION

In response to comments of the Environmental Protection Agency (EPA) Region I and the Rhode Island Department of Environmental Management (RIDEM) on the Draft-Final Phase III Remedial Investigation (RI) Report and Draft-Final Feasibility Study (FS), the Navy issued a document titled: "Consolidated Response to EPA/RIDEM Comments on RI/FS/PP, Site 09-Allen Harbor Landfill" on October 31, 1996. This document is hereinafter referred to as the "Consolidated Response." The Consolidated Response was presented at a BCT meeting on December 6, 1996 at RIDEM headquarters in Providence, RI.

EPA, RIDEM and National Oceanic and Atmospheric Agency (NOAA) submitted their comments to the Consolidated Response, as provided in Appendices 1 through 3 of this response document, respectively. These comments were thoroughly reviewed. The results of this review confirm the key conclusions of the Consolidated Response, as listed below:

1) Infiltration-induced risk to the Harbor has been non-existent due to the following facts:
   - Infiltration, as a component of the Landfill groundwater, has not posed a threat to the Harbor sediment.
   - There is sufficient soil/groundwater/sediment data to support the incompleteness of the Landfill groundwater risk pathway to the Harbor sediment.
2) Construction of an impermeable RCRA Subtitle C cap for meeting ARARs is unnecessary due to the following facts:
   - RCRA Subtitle C is not applicable to the Landfill due to the placement of waste material before 1972.
   - RCRA Subtitle C is not relevant and appropriate to the Landfill, given site specific limitations and the characteristics of present and future infiltration-induced risks.
3) With respect to management of future releases (e.g., potential corrosion of buried drums), construction of an impermeable RCRA C cap is inappropriate for the Landfill due to the following facts:
   - An impermeable RCRA C cap restricts response flexibility to manage future releases.
   - Elimination of freshwater infiltration by an impermeable RCRA C cap would increase the salinity and the associated corrosion potential within the saturated and capillary zones of the Landfill.
4) Consideration of vertical barriers as a contingency plan against a non-existing risk is inappropriate for the Landfill due to the following facts:

- The Landfill groundwater risk pathway has not been complete, and thus, has not posed a threat to the Harbor sediment.
- There is sufficient soil/groundwater/sediment data to support the absence of a complete Landfill groundwater risk pathway.
- Construction of vertical barriers will not satisfy the statutory mandate to address the source of any future release which poses a risk to human health and the environment[1].

The following subsections provide detailed responses to comments raised by EPA, RIDEM and NOAA. To avoid redundancy and for the sake of brevity, all these latter comments are numbered as indicated in Appendices 1 through 3, respectively. The following responses are provided with respect to the enumerated comments.

2. RESPONSE TO COMMENTS

2.1 Response to EPA Comments

Response to Comment 1:

General Response: The Consolidated Response (Attachment A, Section 4, p. A-5) clearly states that the presented analysis neither uses nor relies on the EA groundwater flow/transport model. Therefore, EPA's comments about this latter model and its perceived deficiencies are not relevant to the Consolidated Response. The following responses are provided for the sake of completeness.

The Consolidated Response provided qualitative and quantitative proofs that the groundwater at the Landfill does not pose a risk to the Harbor sediment. This report did not dispute the fact that the groundwater flux from the Landfill into the Harbor is occurring. Instead, it proves quantitatively that the available data do not support the presence of contaminated sediments due to groundwater transport of contaminants. The EPA's speculations about the presence of an alleged groundwater impact are inconsistent with the available data, and therefore, cannot be viewed as valid for the Allen Harbor Landfill.

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[1] Rhode Island Rules and Regulations for Solid Waste Management Facilities, Appendix K, Section II paragraph (b) (3): *"Control the source(s) of releases so as to reduce or eliminate, to the maximum extent practicable, further releases of Appendix B constituents into the environment that may pose a threat to human health or the environment."*

Response to Comments 2-5 (Groundwater Flux)

Under long-term, steady-state conditions, the groundwater flux at the Landfill Harbor is mainly driven by the vertical infiltration flow into the Landfill. This is due to the following facts:

1. The boundary conditions at the Landfill are: (1) no-flow along its eastern boundary (delineated by the mound) and (2) constant fluctuating head along its shoreline boundary. Therefore, the main inflow into the Landfill is infiltration which flows out through the boundary delineated by its shoreline.

2. The groundwater at the Landfill displays neither a consistent increasing trend, nor a consistent decreasing trend. Therefore, on average, the infiltration must flow in and out of the Landfill aquifer system in order to preserve its long-term steady state condition.

The above indicates that the groundwater flux is governed by the infiltration rate. Therefore, given the more-or-less constant infiltration flux in the Landfill, if the hydraulic conductivity coefficients are higher or lower than expected, the hydraulic gradients must be lower or higher than expected, respectively. Measurement of hydraulic conductivity less than those used in the EA model, does not mean that the groundwater flux is lower. Such discovery simply implies that for preserving the steady state condition of the Landfill aquifer, hydraulic gradients must be higher. So if the hydraulic conductivity is one to two orders of magnitudes lower, then the hydraulic gradient of 0.002 must be one or two orders of magnitudes higher. EPA's use of the 0.002 hydraulic gradient in conjunction with the lower hydraulic conductivity is misleading and contrary to the conservation of mass at the Landfill.

The Navy agrees with EPA that despite the significant groundwater flow, the groundwater contaminants have not been transported into the Harbor. This is due to a number of factors, such as: natural attenuation processes at the Landfill, as well as the significant attenuation related to the diurnal tidal fluctuations along the shoreline of the Landfill. These natural, site-specific processes have created a barrier against the transport of groundwater contamination into the Harbor.

The analysis of groundwater salinity data may be supplemented by spatial analysis of metal ratios in groundwater. The Consolidated Response analyzed all metals of concern in groundwater, soil, seep and Harbor sediment. None of these analyses indicated that the groundwater risk pathway is complete.

EPA's preliminary calculations on the extent of seawater encroachment under an impermeable cap ignores the principal of conservation of mass. Heretofore, the main flux of freshwater into the Landfill Harbor have been infiltration and potential seepage

from an adjacent salt marsh. This freshwater influx will be significantly reduced by the construction of the impermeable cap and the repair of the connecting culvert between the salt marsh and the Harbor. These actions almost eliminates the freshwater influx into the Landfill. Under such a condition, the influx will be dominated by brackish water from the salt marsh and saline water from the Harbor. Therefore, sooner or later the entire surficial aquifer at the Landfill will become more saline than its present condition. EPA's preliminary calculations do not consider this very fundamental change in the mass balance of the Landfill aquifer, and therefore, cannot be viewed as valid.

The Consolidated Response neither relies nor uses the RI conceptual and numerical groundwater flow/transport models. Therefore, EPA's comments about its deficiency is not relevant to this discussion.

Response to Comment 6 (Additional Data Collection):

As demonstrated in the Consolidated Response (Attachment A, Section 5) the number of available samples for each media of concern is adequate for characterization of the relationship between the Landfill and the Harbor sediment. The accuracy of the proportions demonstrates that the conclusion regarding the Landfill groundwater risk pathway would not be altered by additional data. While remedial design may require additional data, the issue of groundwater risk pathway completeness does not require any additional sampling.

Response to Comment 7 (Statistical Correlation Analysis):

The Consolidated Response utilized the EPA's overly conservative "Guidance[2]" which requires that the null hypothesis be defined such that the groundwater pathway in the Landfill is impacting the Harbor. As noted in the EPA guidance document[3]: "*the null hypothesis is assumed to be true unless substantial evidence shows that it is false.*" Therefore, the main aim of the Consolidated Response was to find a shred of evidence which supports the groundwater pathway completeness.

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[2] EPA, "Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media," Statistical Policy Branch, Office of Policy, Planning and Education, Washington, DC, February 1989, page 2-3: "*When the results of the investigation are uncertain, the procedure in this guidance document favor protection of the environment and human health and conclude that the sample area does not attain the cleanup standard. In the statistical terminology applied in this document, the null hypothesis is that the site does not attain the cleanup standard. The null hypothesis is assumed to be true unless substantial evidence shows that it is false.*"

[3] Id.

Contrary to EPA's comments, the stated conditions for the above null hypothesis are not sub-hypotheses. Instead, these conditions, including correlation analyses, were defined in order to identify any statistically-significant evidence which support the completeness of the groundwater pathway. The individual conditions were assessed not to reject the null hypothesis, but to determine significant evidence that can be used to accept the null hypothesis.

The Navy believes that using the EPA's suggested null hypothesis and arbitrary definition of the statistical significance are inconsistent with EPA's own guidance documents and are not warranted.

The Navy agrees with the EPA that the power of many computed correlation tests are low due to the low number of pairs. However, in the presented analyses, this is not a critical issue. This is due to the fact that the objective of the tests was to identify any statistically-significant correlation that could uphold the null hypothesis. For this reason, numerous correlation tests for various media and contaminants were conducted. No such statistically-significant correlation could be found. This consistent absence of statistically-significant correlation, along with variogram analyses results and previous extensive deterministic studies, provide the substantial evidence that refutes the null hypothesis.

As stated in the Consolidated Response (Attachment A, Section 2.1, p. A-2), the Navy agrees with EPA that the groundwater migration pathway is influenced by numerous random-like factors. This is exactly the reason why deterministic approaches may fail to analyze such pathways. Therefore, to complement the RI investigations, statistical analyses were conducted to ensure that any statistically-decipherable pattern could be identified.

Deterministic and qualitative analyses of existing data have already proven that even under conservative hypothetical conditions the groundwater impact on the Harbor is insignificant. The statistical analyses simply verified and complemented the previous conclusions. EPA's recommendation for testing for correlation within the same media has already been conducted and presented in the Consolidated Response (e.g., Figures A-4-1 and A-4-2). EPA's suggestion of considerable subsurface variability was exactly the reason why statistical techniques were used in tandem with other procedures.

Absence of statistically-significant correlation did not only apply to metals, but also to other contaminants of concern. This consistent absence indicates that measured contaminants are not related to a subsurface source. This information, along with other statistical results and previous deterministic and qualitative analyses, constitute the substantial evidence that refutes the null hypothesis.

Response to Comment 8 (Geostatistical Analysis):

The Consolidated Response (Attachment A) provided the results of the variogram analyses consistent with ASTM D 5549-94: *Standard Guide for Content of Geostatistical Site Investigations.* During this process various parameters, including lag size and directional angles were assessed to avoid any error or misrepresentation in the analyses. Furthermore, electronic files of data, including the exact GEO-EAS files were provided to the EPA contractor for his own review to verify the results.

Similar to correlation analyses, the presented variogram analyses were not intended to reject the null hypothesis. Instead, they were performed to investigate whether any evidence could be found to support the null hypothesis. The absence of any variogram or trend which could be related to the Landfill, along with other statistical results and previous deterministic and qualitative analyses, constitute the substantial evidence that refutes the null hypothesis.

Response to Comment 9: (Sample Size Determination)

To quantitatively assess the data adequacy, the Consolidated Response utilized the EPA Guidance (230/02-89-042). The main objective of this assessment was to evaluate the chances of missing hot spots whose discovery may alter the conclusions of the Consolidated Response. The EPA Guidance offers the method of proportions, if the potential for missing hot spots is an issue. Based on this guidance, the Consolidated Response used the procedure to evaluate the adequacy of available data in order to ensure that there are no unidentified hot spots whose discovery may alter conclusions regarding the incomplete groundwater risk pathway.

The EPA comments offer two equations for determining adequate sample size. These equations are dependent on the sample variance. These type of equations are only used if the objective is to compute the mean concentration and its upper confidence limit. The assessment of data adequacy in the Consolidated Response was not driven by the mean concentrations. Instead, the main concern was whether there are unidentified hot spots whose discovery may alter the conclusions of the Consolidated Response. Therefore, the use of the suggested equations by the EPA is neither relevant nor appropriate.

EPA also raises an issue about the sediment VOC data. In the Consolidated Response, geostatistical methods were used solely for the variogram analysis, not "simulation" as suggested by the EPA. For all other contaminants of concern, such as metals and PAHs, 41 sediment measurements were available. The lower number of samples for VOC measurements can be attributed to the fact that these latter compounds have not been identified as contaminants of concern for the Harbor sediment. Furthermore, 18 samples are adequate to perform the variogram analysis.

Such a sample set yields 153 pairs, which would allow computing up to seven sample variograms over lags containing twenty or more pair-difference results. Therefore, even though VOCs are not considered as contaminants of concern in the Harbor, the results of their variogram analyses, along with other statistical analyses and previous deterministic studies, constitute the substantial evidence that refutes the null hypothesis.

Response to Comment 10:

EPA's comment is noted. The limitations associated with the interpretation of the infrared photographs are explained clearly in Attachment B. This infrared remote sensing investigation was not intended to quantify the level of groundwater discharge from the Landfill into the Harbor. The main objective of this investigation was to assess the relative significance of freshwater input from the Landfill into the Harbor when compared to input from other parts of the vast drainage basin of the Harbor.

Response to Comment 11:

EPA's comment is noted.

Response to Comment 12: (Specific p.1)

EPA's comment is noted.

Response to Comment 13: (Specific p. 1)

The statistical and geostatistical analyses performed on the site data indicate that the groundwater risk pathway is not complete and thus the discharge of groundwater from the Landfill does not pose a threat to human health or the environment. The potential impacts on the harbor are associated with surficial processes, such as Landfill face erosion and sediment transport, as demonstrated by the site data and statistical analyses. As addressed in the response to Comment 17, the construction of an impermeable cap may actually increase the potential for future releases.

Response to Comment 14: (Specific p. 2, Section 1.2)

As noted repeatedly above, the Consolidated Response (Attachment A, Section 4, p. A-5) neither uses nor relies on the EA groundwater flow/transport model. Therefore, EPA's comments about this latter model and its perceived deficiencies are not relevant to the Consolidated Response. Furthermore, contrary to EPA's speculation, the USGS findings do not contradict the previous groundwater flow modeling results concerning the groundwater flux (see Response to Comments 2-5).

Response to Comment 15: (Specific p. 4)

The Navy agrees with EPA that the sediment samples have been subjected to random-like influences due to dredging. This is exactly the reason that, in addition to pervious deterministic studies, the Consolidated Response provided the supplemental statistical analyses. These analyses further confirmed the RI key conclusion that the groundwater risk pathway is incomplete.

Response to Comment 16: (Specific p. 4)

The relative contribution of the groundwater to the total freshwater discharge to the harbor is relevant to the CERCLA investigation process when the objective of protecting human health and the environment is considered in the remedy selection process. CERCLA does not require one hundred percent reduction of potential risk. The relative contribution of groundwater to overall site risk should be considered when evaluating remedies according to the nine National Contingency Plan selection criteria.

Response to Comment 17: (Specific p.4, Section 2.1, Number 3)

The slope stability analyses performed for the construction of a RCRA C cap at the site were based upon the extensive experience of the Army Corps of Engineers rather than a modeling effort. Further information regarding the analyses is provided in Response to Comment 36.

The chlorides within the groundwater underlying the site will increase following placement of a cap based on simple mass balance. The groundwater is recharged by surface water bodies on both sides of the Landfill that have elevated levels of chlorides. The only source of freshwater to the groundwater is infiltration. Once this infiltration is eliminated, the chloride content of the groundwater must increase.

Response to Comment 18: (Specific p.5, Second bullet)

Corrosion is a function of moisture and the characteristics of the moisture. The major portion of the Landfill will be exposed to high moisture content with or without the cap. The fact has been ignored that capillarity will maintain near saturated conditions over much of the depth of the Landfill: The freshwater infiltration currently eliminates the negative pressures that draw water up from the water table. The installation of an impermeable cap will allow negative pressure to develop, draw water upward into the Landfill from the water table, and expose material in the Landfill to saturated conditions. In addition, as stated in the above Response to Comment 17, the salinity of the groundwater will increase following construction of a

RCRA cap based on simple mass balance. The geochemical characteristics of the groundwater will therefore be much more corrosive.

The RCRA cap will have its most serious negative impact on the waste above the current water table. Containers above the water table have been exposed to 40 years of significant freshwater infiltration. Whatever is left in the way of containers, if anything, would have to be quite resistant to attack under the current infiltration flow conditions. The cap will totally alter the current situation above the water table. The zone within 10 to 15 feet of the water table will acquire the characteristics of a water table that will steadily increase in chloride content over time. This is the major portion of the Landfill, definitely considerably more than is currently impacted by elevated chloride levels.

Response to Comment 19: (Specific p. 6 and p. 8)

Responses to Comments 7, 8, and 9 above address the evaluation of the existing data and the sufficiency of the data to make conclusions. Based upon the analyses performed, the Navy believes sufficient data has been collected to support the conclusion that the groundwater risk pathway is not complete and the impacts on the sediments are associated with surficial processes. Additional data is not required to assess the completeness of various migration pathways to the harbor.

Response to Comment 20: (Specific p. 8)

The relative contribution of the groundwater to the total freshwater discharge to the harbor is relevant when the objective of protecting human health and the environment is considered in the remedy selection process. The pathways responsible for the majority of the risk should be addressed in the remediation of a site: It is not necessary to address *all* risk pathways if substantial risk reduction is provided by the elimination of some risk pathways. Surficial processes account for the majority of the observed impact in the harbor sediments and thus the remediation should focus on elimination of these processes.

Response to Comment 21: (Specific p. 8)

The significant correlation between soil and Harbor sediment chlorobenzene shows an increasing trend away from the Landfill. Such a correlation is exactly opposite to the pattern expected under a groundwater risk pathway for an organic compound, i.e. soils closer to the alleged source, on average, have a higher concentration than those further down gradient. This further confirms that processes, other than groundwater migration pathway, are responsible for the impacted sediments.

Response to Comment 22: (Specific p.10)

As defined in EPA Guidance[4], RCRA Subtitle C requirements for the treatment, storage, and disposal of hazardous waste are applicable for a Superfund remedial action, if specific well-defined conditions are present. These conditions are defined by EPA[5], as:

1) The waste is a RCRA hazardous waste, **and** either:
2) The waste was initially treated, stored, or disposed of after the effective date of the particular RCRA requirement (i.e., 1980), or
3) The activity at the CERCLA site constitutes treatment, storage, or disposal, as defined by RCRA .

The relevancy of the requirements should be based on the applicability. The material disposed in the landfill are not classified as RCRA hazardous waste and are not known to exhibit characteristics of hazardous waste. Therefore, the requirements are not relevant to the Landfill.

Response to Comment 23: (Specific p. 10)

The "Risk Assessment Pilot Studies" collected data from Allen Harbor based on the hypothesis that the Landfill and Calf Pasture Point were sources of contamination to the harbor. The extremely conservative data evaluation techniques failed to find a significant impact in any harbor area with the majority of the harbor indicating slight or no impact. The moderate impacts noted adjacent to the Landfill are also areas where eddy currents are likely to concentrate any impacted sediments regardless of their source. These studies do not support the conclusion that Allen Harbor is at risk from Landfill activities.

Response to Comment 24: (Specific p.10)

EPA's response is noted. However, the culvert connecting the salt water marsh to the harbor is not intact and therefore is a source of saline water.

Response to Comment 25: (Specific p. 10, Section 4.2.1)

See Response to Comment 17.

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[4] EPA , 1991, *Design and Construction of RCRA/CERCLA Final Covers*, 625/4/91/025.

[5] EPA,, 1989, *RCRA ARARs: Focus on Closure Requirements*, Office of Solid Waste and Emergency Response Directive 9234.2-04FS, Office of Solid Waste and Emergency Response, Washington, DC.

Response to Comment 26: (Specific p. 11, Section 4.2.1)

The principle of conservation of mass indicates that elimination of freshwater input into the Landfill by a RCRA C impermeable cap would be compensated by a more aggressive sea water intrusion into the Landfill. This argument was presented to emphasize the fact that adverse impacts of an impermeable cap were overlooked in the previous investigations leading to the *de facto* selected remedy.

As the current data indicate, past storms have not impacted the status of the groundwater risk pathway. The fact remains that none of the previous investigations adequately addressed the negative impacts of an impermeable cap.

Response to Comment 27: (Specific p. 12)

As noted in Response to Comment 2-5, arguments concerning a slower groundwater flow are not supported by the long-term steady state condition of the Landfill aquifer. Therefore, speculations about a slow-moving plume cannot be considered as valid.

Response to Comment 28: (Specific p. 12, Section 4.3)

The variance to the RCRA C cap requirements at McAllister Point was noted due to the similarities of the physical setting to the Allen Harbor Landfill. The inability to comply with strict RCRA C cap requirements at a site with similar limitations is a basis to evaluate and design a landfill cap that at variance with the requirements but addresses the site-specific concerns.

Response to Comment 29: (Specific Table 1)

EPA's comment is noted, however, the Navy believes that the previously submitted EPA comments on the draft final document have been addressed in the Consolidated Response document.

Response to Comment 30: (Attachment C, p. 3, Section 3.b)

The following table includes all soil parameters assumed for the modeling effort. All subsequent model runs were made with the same soils parameters; only the angle of the slope was changed in an effort to determine the slope geometry which would produce a satisfactory Factor of Safety.

TABLE 1

SOIL PARAMETERS UTILIZED FOR THE STABILITY ANALYSIS
of
THE SIDESLOPE FOR THE ALLEN HARBOR LANDFILL

Material	Unit Weight (lb/ft^3)	Internal Friction Angle (ϕ)	Cohesion (lb/ft^2)
Soil Cap	110	28	0
Moist Sand	110	28	0
Saturated Sand	134	30	0
Clayey Silt	125	27	622
Saturated Sand	180	30	0
Bedrock	165	45	0
Riprap	165	45	0

Response to Comment 31: (Attachment C, p. 3 Section 3.b)

The basis of the comment "...the existing slope does not appear to be moving at the current time" is based on visual inspection of the Landfill face by Corps of Engineers and Navy technical personnel, interviews with base maintenance personnel, and the age and nature of the debris in the slope.

The recommendation for placement of riprap over the shoreline is not based on protection of human health, but rather on the prevention of erosion to the face of the Landfill. The slope would remain stable if erosion was eliminated or reduced at the Landfill face. The presence of the riprap will protect human health by covering exposed debris at the face of the Landfill and preventing exposure of trespassers to physical safety hazards.

Response to Comment 32: (Attachment C, p. 3, Section 3.b)

For the normal tidal condition (5 ft. wave height), the slope was assumed to be regraded to 1V on 3H. Furthermore, to increase the stability of the slope as well as to decrease the chance of a "quick condition" occurring, it was assumed that a 3 ft. thick layer of riprap was placed on the slope. The resulting Factor of Safety was found to be 1.30. The Corps of Engineers normally assumes a Factor of Safety of 1.25 to be adequate for conditions similar to this. Based on this, a satisfactory

Factor of Safety was found. The attached Figure shows the assumed slope configuration as well as the results of the modeling effort.

Response to Comment 33: (Attachment C, p. 4, Section 3.b)

The Factor of Safety resulting from the rapid drawdown condition exerted by this wave height was 1.15. The Corps of Engineers recommends a Factor of Safety of at least 1.25 for this condition. Based on this, the Factor of Safety found was inadequate.

The Factor of Safety with the riprap in place was found to be 1.30. The attached figure shows the cross section analyzed as well as the results returned. The soils properties, including the unit weights and internal friction angles of the materials analyzed are shown in Table 1.

Response to Comment 34: (Attachment C, p.4, Section 3.b)

EPA's comment is noted.

Response to Comment 35: (Attachment C, p.4, Section 3.b, Cap Stability)

The Factor of Safety resulting from the cap analysis with a 1V on 4H side slope was 1.47. The material properties used for the effort are shown in Table 1. The attached drawing depicts the method and results of the modeling effort.

Response to Comment 36: (Attachment C, p.4, Section 4)

The slope stability was not modeled for a RCRA C cap covering the entire Landfill. However, the statement regarding the elimination of the impermeable liner and internal drainage system is based on extensive experience with similar situations The pressure buildup beneath the liner (hydrostatic uplift forces) during a sudden influx of water would make the impermeable liner slide. The movement of the liner will result in slope instability since the pressure and movement of the liner will tend toward the area of least resistance (the slope).

Response to Comments 37-41 (Additional Comments on the RI groundwater....)

The Consolidated Response neither relies upon nor uses the RI conceptual and numerical groundwater flow/transport models. Therefore, EPA's comments about its perceived deficiency are not relevant to this discussion.

2.2 Response to RIDEM Comments

Response to Comment 1:

The past disposal practices identified at the site included the burning of organic and flammable wastes prior to covering with soil. This practice would limit the number of intact, waste containing barrels disposed in the Landfill. The fact that only one barrel was discovered during the Remedial Investigations, which included the collection of 131 soil samples in approximately 45 locations, would indicate that there is a low probability of additional barrels being present in the Landfill. In addition, nine test pits were excavated as deep as 20 feet below grade and only one partially deteriorated drum was encountered which contained about one gallon of material.

Response to Comment 2:

RIDEM's comment is noted.

Response to Comment 3:

The regulatory agencies' position was that additional data regarding the potential threat posed by the Landfill to the environment should be further investigated during the design phase of the project. Sufficient information is currently available to evaluate the groundwater risk pathway and to conclude that this pathway is not complete. Any additional information collected regarding the completeness of the groundwater risk pathway or the potential impacts on the harbor would therefore be redundant.

Response to Comment 4:

Within the context of the cited section, site limitations associated with the RCRA C impermeable cap construction are: (1) occurrence of diurnal tidal fluctuations which inhibits construction of an impermeable cap along the inter-tidal face of the Landfill, and (2) RIDEM's desire to not construct a retaining structure (wall) along the shoreline of the Landfill.

Response to Comment 5:

Response flexibility is a function of the objective of the response. The objective of a potential response is in turn a function of the nature of a potential release. Given that the site has been flushed for forty years and impact has not been identified, the concern at the site is not infiltration. Rather, the concern is the role of infiltration in enhancing the acceleration of a release from a buried container.

A buried container, if present in the Landfill, will eventually corrode and release its contents, regardless of the rate of infiltration. As pointed out in the Consolidated Response, the rate of corrosion affecting the eventual release may actually be increased by the elimination of infiltration, as the chloride content within the underlying groundwater must increase based on a simple mass balance consideration. Further, given the rise of groundwater associated with capillarity, the extent of increased chlorides will extend over a significant vertical portion of the Landfill.

Given the absence of impact associated with the Landfill groundwater, future releases from containers are not expected to occur, or if they do occur, to be of such insignificance that they will never be measured.

However, if a release should occur, it would be an event that would eventually occur with or without a landfill cap. If a release is sufficient to be noticeable at perimeter monitoring wells, the most effective management would be identification and management of the source. The only effective means of such source isolation is intrusive sampling. Extensive sampling through the cap is impractical unless either, 1) the maintenance of an impermeable layer is abandoned, or 2) significant cost is entailed in repairing the cap after each intrusive sample.

Further, the cap limits the potential remedial technologies. For example, given the nature of the potential contamination, in-situ technologies such as air sparging or enhanced biodegradation may be applicable. The presence of the cap complicates the implementation of such technologies.

Response to Comment 6:

The chlorides within the groundwater underlying the site will increase following placement of an impermeable cap based on simple mass balance. The groundwater is recharged by surface water bodies on both sides of the Landfill that have elevated levels of chlorides. The only source of freshwater is infiltration. Once the infiltration is eliminated, the chloride content must increase. Further, the increase of chlorides at the water table will extend up into the capillary zone once the gravity flow of freshwater through this zone is eliminated.

Response to Comment 7:

Section 3 and Attachment A of the Consolidated Response provide adequate explanation which support the fact that there are adequate data which indicate that the Landfill groundwater risk pathway is incomplete and does not pose a risk to the Harbor.

Response to Comment 8:

The variability in the groundwater table elevation throughout the year is not of a magnitude that would alter the conclusion that the groundwater discharge from the Allen Harbor Landfill is an insignificant component of the total freshwater flux from the vast drainage basin into the harbor.

Response to Comment 9:

The closing of Allen Harbor to shellfishing during the 1980's was premised on the protection of human health. Quantitative data on which the decision was based has not been located. The *concern* over the potential for releases and knowledge of the site activities appear to have been the focus of the closure decision rather than empirical data.

Response to Comment 10:

The RIDEM comment is noted. The text should read that: "Future leachate concentration is not expected to surpass past leachate concentrations at the Landfill. This is due to the aggressiveness of the environment in terms of corrosion potential, as well as, reported disposal practices."

Response to Comment 11:

The RCRA cap will have its most serious negative impact on the waste above the current water table. Containers above the water table have been exposed to 40 years of significant freshwater infiltration. Whatever is left in the way of containers, if anything, would have to be quite resistant to attack under the current infiltration flow conditions. The cap will totally alter the current situation above the water table. The zone within 10 to 15 feet of the water table will acquire the characteristics of a water table that will steadily increase in chloride content over time. This is the major portion of the Landfill, definitely considerably more than is currently impacted by elevated chloride levels.

Response to Comment 12:

The Navy agrees with RIDEM that impacted sediments are the result of the surficial processes, such as Landfill face erosion and sediment transport. The presented statistical analyses were not intended to be viewed as the sole source of information. These results simply supplemented the previous extensive deterministic studies which supported the fact that the role of the groundwater risk pathway is negligible, if any. The proposed remedy, therefore, must focus on the main risk pathways of concern. An impermeable cap neither addresses the main risk pathways nor provide

an improvement over existing conditions. In fact, such a cap in the long run creates more saline conditions at the Landfill surficial aquifer and its capillary zone. A saline condition can lead to further corrosion of any buried drums and thus future releases.

Response to Comment 13:

As no technology or source isolation technique has been identified that is not intrusive to some extent, a cap will complicate future release management. With respect to the second observation, as a cap would increase corrosion potential over the entire lateral extent of the Landfill, it would also increase the extent of potential impact.

Response to Comment 14:

This management concept refers to responding to a source or a release with a full arsenal of technologies that can be implemented and modified as needed to satisfy the governing objective; prevention of impact to the Harbor. Release management should consist of a combination of contaminant removal, contaminant migration retention, and contaminant degradation enhancement such that the environment is protected at a realistic point of compliance.

Response to Comment 15:

This statement by RIDEM is an assumption, not a fact. RIDEM has not produced any evidence that the mass balance modification associated with a cap will not significantly alter the geochemical conditions underlying the site.

A future release is associated with corrosion as much or more than infiltration. As such, the Navy's position as presented in the Consolidated Response, does not change.

Response to Comment 16:

The above statement is based on the unalterable fact that a decrease in freshwater under the Landfill will result in an increase in chlorides. The increase in chlorides will increase corrosion potential. Given the long-term past infiltration, remaining containers are likely resistant to status quo conditions. Such containers are likely to be less resistant to the unavoidable increase in chlorides that will accompany the installation of an impermeable cap.

Response to Comment 17:

The Navy desires a comprehensive solution to this site, not one that is a stop-gap measure. Therefore, the observation that the RCRA cap does not address the isolation of a release, of which the odds of occurring may actually be increased by the installation of an impermeable cap, is a pertinent consideration.

Response to Comment 18:

The entire premise for installation of an impermeable cap is that infiltration is the driving force behind a potential release. Yet a release has not created an impact, despite 40 years of infiltration. The potential impact of a major alteration of the geochemistry has not been adequately considered by RIDEM. The application of a RCRA cap must be based on the specific conditions of each site and the true objective of site remediation.

Response to Comment 19:

Corrosion is a function of moisture and the characteristics of the moisture. The major portion of the Landfill will be exposed to high moisture content with or without the cap. RIDEM has not considered the fact that capillarity will maintain near saturated conditions over much of the depth of the Landfill. With an impermeable cap, the geochemical characteristics will be much more corrosive.

Response to Comment 20:

See responses to Comments 5,6, and 11.

Response to Comment 21:

The RIDEM statement is based on an assumption that infiltration will be the dominant characteristic creating a future problem. There are 40 years of empirical data demonstrating that infiltration has not created a problem. The RCRA cap will increase chlorides by decreasing the dilution available from freshwater infiltration. The change in geochemistry, based on the characteristics of corrosion, will be unfavorable with respect to drum integrity.

Therefore the above statement by RIDEM is unsupported speculation.

Response to Comment 22:

The basis for NewFields' position is the presence of elevated chlorides on both sides of the Landfill and the universally recognized concept of mass balance. If the major source of freshwater is removed, the chlorides in the groundwater must increase.

With respect to the impact of capillarity, the freshwater infiltration currently eliminates the negative pressures that draw water up from the water table. The installation of an impermeable cap will allow the negative pressure to develop, draw water upward into the Landfill from the existing water table, and expose material in the Landfill to saturated conditions.

Response to Comment 23:

This statement is directed toward the management of future releases. A future release capable of producing a measurable impact in Allen Harbor should be managed at the source in order to eliminate the measurable impact. A wall has no beneficial impact on managing a contaminant source.

Response to Comment 24:

It is RIDEM's position that further testing is required to determine if groundwater flow poses a threat *or* containment of the groundwater is necessary in lieu of further testing. As stated in the Consolidated Response, adequate data is currently available to assess the completeness of the groundwater risk pathway and thus no further data collection is necessary. Based on the existing data, the groundwater risk pathway is not complete and containment of the site groundwater is not necessary to protect human health and the environment.

Response to Comment 25:

To quantitatively assess the data adequacy, the Consolidated Response utilized the EPA Guidance (230/02-89-042). The main objective of this assessment was to evaluate the chance that the discovery of previously unidentified hot spots may alter the conclusions of the Consolidated Response. If potential unidentified hot spots are an issue, the EPA Guidance offers the method of proportions. Based on this guidance, the Consolidated Response used the procedure to evaluate the adequacy of available data in order to ensure that there are no unidentified hot spots whose discovery may alter the conclusions regarding the incomplete groundwater risk pathway.

The chances of missing hot spots are related to the chances of exceedence. If the site is heavily impacted, then even a few samples are enough to confirm its impacted status. Under such a condition, the chances of missing impacted areas is low. So few samples are needed to declare the site impacted. On the other hand, if the site is really clean, then only few samples are needed to confirm its compliance. The most uncertain situation is the case when the chance of exceedence is 50/50. Under this condition, the highest number of samples are needed before the status of a site can be determined as clean or impacted. This is exactly the reason why the Consolidated Response computes the adequate number of samples based on this latter critical condition for which the procedure requires the highest number of samples.

2.3 Response to NOAA Comments

Response to Comment 1:

The Consolidated Response presented a number of correlation conditions for the support of the null hypothesis. These conditions, including correlation analyses, were defined in order to identify any statistically-significant evidence which could be used to support the completeness of the groundwater pathway. The individual conditions were assessed not to reject the null hypothesis, but to determine significant evidence that can be used to accept the null hypothesis. Instead, the Consolidated Response attempted to verify numerous correlation test results for statistical significance. Under this highly conservative approach, only one single statistically-significant correlation is sufficient to accept the null hypothesis. As can be seen, this methodology significantly differs from a classical statistical hypothesis testing when a single rejection is viewed as sufficient for the rejection of the null hypothesis.

The Navy agrees with NOAA that available data are influenced by a variety of random- like influences, such as tidal fluctuations and TOC distribution. This is exactly the reason that, in addition to pervious deterministic studies, the Consolidated Response provided the supplemental statistical analyses. These analyses further confirmed the RI key conclusion that the groundwater risk pathway is incomplete.

Response to Comment 2:

The impacted sediment samples, such as W1, are not related to the groundwater risk pathway due to a number of reasons:

1. Groundwater is a less likely source: An inspection of the Landfill shoreline slope in the vicinity of Station W1 demonstrates the presence of potential sources of PAH and metal contaminants.

2. Groundwater flow in a coastal environment is not a very efficient transport mechanism: Tidal fluctuation is by far more effective than the groundwater flow to erode the debris along the Landfill shoreline and release the contaminants into the Harbor.

3. Sediment transport is the likely source-receptor scenario: The erosion of contaminants is followed by sediment deposition along the less active portions of the Harbor. Station W1 is the primary locations for such deposition processes.

4. Previous deterministic studies discount the significant impact of groundwater: The RI extensive numerical modeling effort indicated that, even under highly conservative hypothetical conditions, the risk posed by groundwater to the Harbor is insignificant.

5. Previous empirical studies discount the significant impact of groundwater: The fact that the Landfill groundwater has consistently been shown to be impacted by VOCs, while the Harbor sediments are mainly impacted by metals, PAHs and PCBs, further supports the absence of a groundwater risk pathway.

6. Presented statistical analyses discount the significant impact of groundwater: The Consolidated Response has provided further supplemental results to confirm the absence of the groundwater risk pathway.

The above provides the substantial evidence that refutes the completeness of the groundwater risk pathway. The site information does not support the groundwater source-receptor hypothesis. Therefore, selection of a remedy based on an unsubstantiated speculation is not appropriate. Instead, the selected remedy must directly address risk pathways of concern.

The shoreline seep is mainly governed by diurnal tidal fluctuations which are orders of magnitude greater than the groundwater discharges. The impact of tidal fluctuations must be the focus of the selected remedy.

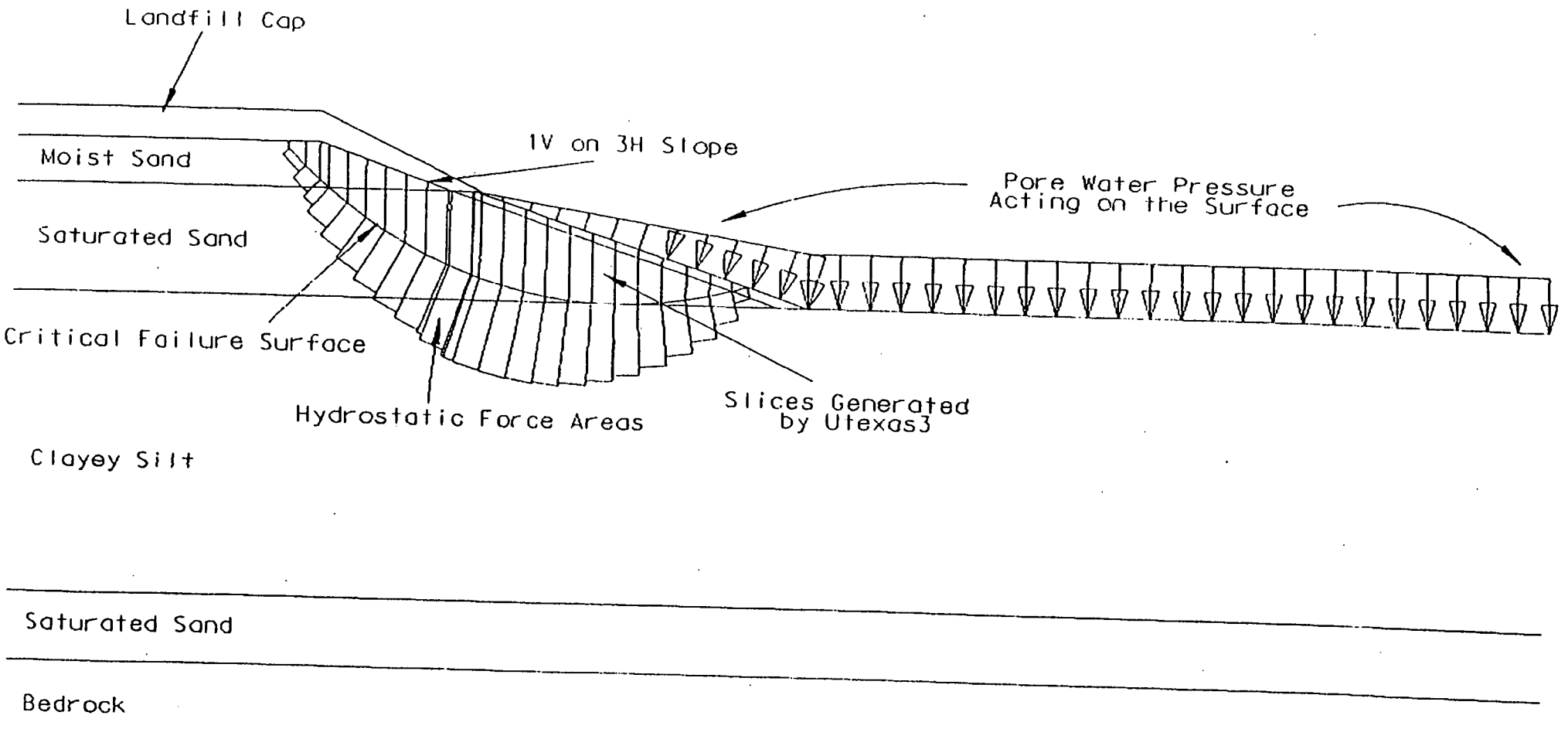
Response to Comment 3:

The Navy agrees with NOAA that the groundwater flux from the Landfill into the Harbor does occur. However, the substantial evidence listed above indicates that the groundwater contaminants have not impacted the Harbor sediment. This is due to a number of factors, such as: natural attenuation processes at the Landfill, as well as

the significant attenuation related to the diurnal tidal fluctuations along the shoreline of the Landfill. These natural, site-specific processes have created a barrier against the transport of groundwater contamination into the Harbor.

The selected remedy must focus on risk pathways of concern. An impermeable cap neither addresses the main risk pathways nor provide an improvement over the existing site conditions. In fact, such a cap in the long run creates more saline conditions at the Landfill surficial aquifer and its capillary zone. A saline condition can lead to further corrosion to buried drums and thus future releases.

STABILITY ANALYSIS WITH SOIL CAP



STABILITY ANALYSIS WITH 1V ON 3H SLOPE