July 11, 2008

Mr. Edward Hampson, P.E.
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau D – 12th Floor
625 Broadway
Albany, NY 12233-7013

Re: 100-120 Apollo Street Property
Greenpoint, Brooklyn, New York
Remedial Options Assessment

Dear Mr. Hampson:

Science Applications International Corporation (SAIC), on behalf of Texaco Inc. (Texaco), respectfully submits this Remedial Options Assessment (ROA) to evaluate options for abating the phase-separated hydrocarbons (PSH) seep into Newtown Creek from the 100-120 Apollo Street property (the Apollo Street property). This ROA was prepared by SAIC for Texaco under the existing order on consent No. D2-1111-01-05 between Texaco and New York State Department of Environmental Conservation (NYSDEC) for the adjacent Peerless Importers (Peerless) property on which the former Paragon Oil Company operated a terminal (Texaco Facility # 304209). ExxonMobil provided technical input throughout the completion of the ROA. Texaco neither owned nor maintained operations on the Apollo Street property and is not accepting responsibility for the impacts on the property, but has completed this work in an effort to continue to work cooperatively with the NYSDEC and further improve the quality of Newtown Creek.

If you have any questions concerning the information presented in ROA, please do not hesitate to contact either Mr. Pete Cagnetta at 717-901-8841 or Ms. Gesele Harris of Texaco at 770-984-4190.

Sincerely,

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Peter J. Cagnetta, CPSSc
Project Manager/Soil Scientist

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1.0 INTRODUCTION

Science Applications International Corporation (SAIC), on behalf of Texaco Inc. (Texaco), respectfully submits this Remedial Options Assessment (ROA) to evaluate options for abating the phase separated hydrocarbons (PSH) seep into Newtown Creek from 100-120 Apollo Street (the Apollo Street property). This ROA was prepared by SAIC for Texaco under the existing Order on Consent no. D2-1111-01-05 between Texaco and NYSDEC for the adjacent Peerless Importers (Peerless) property on which the former Paragon Oil Company operated a terminal. Texaco neither owned nor maintained operations on the Apollo Street property and is not responsible for the impacts to the property.

1.1 Purpose and Organization of the ROA Report

The purpose of the ROA is to identify and evaluate the most appropriate remedial action for abating the PSH seep into Newtown Creek from the Apollo Street property. After a brief site history, a summary of the remedial investigation is provided, detailing the nature and extent of PSH contamination on the Apollo Street property. Remedial Action Objectives (RAO) are established to guide the development and analysis of potential remedial options. Following the ROA, the selected remedial option and conceptual approach which best satisfy all applicable criteria are presented.

1.2 Project Objectives and Scope

The project objective for the Apollo Street property is to stop the migration of PSH through the timber crib section of the bulkhead into Newtown Creek. This broad objective will streamline the potential remedial technologies and provide guidance throughout the ROA.

2.0 SITE BACKGROUND

The site description and history presented below provides a brief background for the Apollo Street property, including past site activities and characterization efforts.

2.1 Site Description and History

The Apollo Street property occupies current Block 2666, Lots 101 and 201 in the Greenpoint section, Brooklyn, NY, east of Apollo Street and north of Bridgewater Street. The Apollo Street property has never been used for refinery or petroleum terminal operations. To the west across Apollo Street is a fuel terminal operated by BP and to the east is the Peerless warehouse facility, site of the former Paragon Oil terminal. Newtown Creek forms the border of the Apollo Street property to the north. Currently the Apollo Street property is owned by Apollo Steel, LLC, and occupied by a tenant (Peerless). A site vicinity map is presented as Figure 1.

Historical property information has been obtained from a variety of sources including title searches, Sanborn fire insurance maps, and sources including maps and aerial photos. According to available historical sources, several private citizens owned the property from 1856 until 1926. Property usage included fertilizer and ash removal companies. The City of New York obtained the property in 1933 and operated a trash incinerator until sometime before 1965.
In 1968, Lots 101 and 201 were sold to the Bridge-Apollo Company. By the mid-1980s the lots came under separate ownership, and in 2000 Apollo Steel, LLC (Steel Equities) purchased both Lots 101 and 201. The property was not used for refinery or petroleum terminal operations. However, four fuel oil USTs were located on the property and then removed by BBL for McKesson Corporation in 1995.

A containment and absorption boom system is currently in place on Newtown Creek along 360 linear feet of shoreline of the former Paragon Oil terminal property. In addition, 80 linear feet of boom is present along the shoreline fronting the Apollo Street property. This 80 foot section of boom fronts the timber crib section of the Apollo Street Property. Soft absorbent booms are present immediately parallel to the bulkhead and contained by a hard shell globe boom (primary containment). A secondary containment fence boom is the outermost component of the system. Between the globe boom and the fence boom are solidification booms that are placed perpendicular to the flow of water in Newtown Creek.

Current bulkhead construction at the Apollo Street property consists of a timber crib platform bulkhead (80 feet) and an adjacent relieving platform bulkhead (220 feet). A modern steel bulkhead is present at the former Paragon Oil terminal. The containment boom system that fronts the Apollo Street property and the former Paragon Oil terminal property is divided into five watertight compartments. Compartment 5 in front of the Apollo Street property timber crib section has historically demonstrated more petroleum staining on absorbent booms relative to the compartments fronting the former Paragon Oil terminal property, which have also contained staining. A single containment boom with a single row of absorbent boom fronts the 220 feet of relieving platform bulkhead. Regarding the Apollo Street property, PSH has historically only been visible within the timber crib section and not the relieving platform section.

SAIC, on behalf of Texaco, currently operates a total fluids recovery system on the former Paragon Oil terminal. CMW-43R, located at the northeast corner of the Apollo Street property functions as a recovery well for the total fluids system. Site characterization has determined that PSH is likely present under a large portion of the Apollo Street property.

3.0 SUMMARY OF REMEDIAL INVESTIGATION

SAIC and Texaco initiated a construction and engineering evaluation of the Apollo Street bulkhead with the use an underwater diver from Atlantic Response Inc. and contracted by Mueser Rutledge Consulting Engineers (MRCE). A structural evaluation was required in order to select a seep abatement technology that would not compromise the structural integrity of the existing concrete and timber bulkhead. Initial evaluation activities were completed on February 19-20, 2008.

The evaluation area was defined and stationed during pre-dive activities on February 19, 2008. The 780 foot evaluation area extended from 10 feet beyond the grout wall extent to the east (Station 0) on the Peerless property to the junction of the BP property and the north side of Apollo Street (Station 780). Although the study area included a portion of the Peerless bulkhead, the primary focus was the Apollo Street property bulkhead.
The Apollo Street property dive commenced during the afternoon of February 20, 2008 to coincide with an extreme low tide associated with a lunar eclipse. The inspection began at the westernmost station (the junction of Apollo Street and the BP terminal) and was completed at the junction of the Peerless and the Apollo Street properties.

3.1 Description of Existing Bulkhead

The bulkhead on the Apollo Street property consists of an 8' high concrete gravity wall on both the timber relieving platform and a timber crib wall retaining inboard fill. Additional fill exists an estimated 6-8' above the top of the gravity wall. The thickness of the gravity wall is unknown but the wall is effectively retaining the inboard earth fill. The bottom of the concrete gravity wall and the top of the timber substructure are at approximately mean low water.

All but the easternmost 80 feet of the Apollo Street bulkhead consists of a timber pile supported, timber relieving platform (timber decking) situated atop a series of 12" x 12" timber "headers," which in turn rest atop bents of timber pilings. The remaining eastern portion of the bulkhead consists of a timber crib platform bulkhead. A site map is presented as Figure 2. Diagrams illustrating the typical construction of timber crib section and relieving platform section of the bulkhead are presented as Figures 3, 4, and 5.

At lowest tide, approximately 2 to 3 feet of space was exposed beneath the timber relieving platform. Under these conditions, the diver could assess the exposed area beneath the relieving platform. The exposed area within this section ranged from approximately 5' to 35' from the creekside edge of the bulkhead inland. In certain areas, the diver noted exposures that extend from the bulkhead to beneath the Apollo Street property warehouse.

The timber cribbing section of the bulkhead extends from the western edge of the steel Peerless bulkhead, westwards approximately 80'. In most of this area, horizontal timbers were noted extending from above the waterline to the mudline. In this area of intact timber cribbing, the diver had no method to assess the foundation inland of the horizontal timbers. At the western edge of the timber crib bulkhead, an exposed area was noted beneath the concrete gravity wall where horizontal timbers were absent. In this area the diver noted exposures extending inland from the bulkhead and abundant concrete breakdown and debris. This "corner" of the timber crib bulkhead could have been previously damaged by a barge or boat impact.

3.2 Performance of Existing Bulkhead as a Barrier to Contaminant Migration

Based on visual observations documented on February 20, 2008, PSH was noted seeping through the timber crib bulkhead at the Apollo Street property into Newtown Creek. Seepage was observed and is believed to migrate through at least three distinct areas of the timber cribbing: 1) from the rectangular wooden breaches within the horizontal timbers (potential historic joints between crib sections); 2) from the junction between the horizontal timbers and the overlying concrete gravity wall; and 3) from cracks within the concrete gravity wall. Photographs and videos were taken of these seepage points.

Sheens on the surface water were observed within the single containment boom fronting the relieving platform section (20 feet) of the bulkhead; however, the source of the sheens beneath the relieving platform was not discernable. However, it is possible that the source of the sheens is the section of timber crib bulkhead that is perpendicular to the creek where the two types of
bulkheads merge. Sheens and thin films of PSH were observed within the containment boom fronting the timber crib bulkhead section as well. The boom system fronting this section consists of the primary globe boom and the outer fence boom for secondary containment. This boom section has been identified as compartment 5 (C5) in previous Texaco reports. It should be noted that the extent of the staining of absorbent booms placed in compartment 5 has been decreasing. This indicates recovery well CMW-43R located immediately landside of compartment 5 has had a positive effect in slowing the seep on the Apollo Street property.

The conclusions of the bulkhead structural assessment indicate that the timber relieving platform and the concrete gravity wall fronting the Apollo Street property were structurally sound, showing no evidence of rotation, settlement, or marine borer infestation. The concrete gravity wall on the property was found to be heavily spalled within the tidal zone, exhibiting exposed and severely deteriorated reinforcing. The timber crib bulkhead does not provide a fully competent barrier to the migration of PSH into Newtown Creek.

4.0 REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES

The NYSDEC Division of Environmental Remediation has suggested that RAOS be established by:

1. Identifying all contaminants exceeding applicable Standards, Criteria and Guidance (SCGs) and the environmental media impacts by the contaminants,
2. Identifying applicable SCGs taking into consideration the current and, where applicable, future land use for the site,
3. Identifying all actual or potential public health and/or environmental exposures resulting from contaminants in environmental media at, or impacted by, the site, and
4. Identifying any site-specific cleanup levels developed appropriate for site contaminants of ecological concern.

The primary remedial goal and RAO for the Apollo Street site is to stop the migration of PSH through the timber crib bulkhead and into Newtown Creek. This broad objective will streamline the potential remedial technologies and provide guidance throughout the ROA.

5.0 DEVELOPMENT OF ALTERNATIVES

The development of remedial alternatives consists of a series of analytical steps designed to identify and evaluate potential remedial actions based on the nature and extent of site contamination. Based on NYSDEC DER-15, remedial technologies are to be evaluated based on effectiveness, implementability, and cost. For this ROA, remedial alternatives were developed that create a physical and/or hydraulic barrier to the migration of PSH through the Apollo Street property timber crib bulkhead and into Newtown Creek.

5.1 Description of Alternatives

The following remedial alternatives were developed for the purpose of preventing PSH migration through only the Apollo Street property timber crib bulkhead (80 feet) into Newtown Creek. A description of each proposed remedial alternative is presented in conjunction with constructability and permitting considerations.
5.1.1 Option A - No Further Action
Consideration of the No Further Action option is required by NCP (40 CFR Part 300.430) and NYSDEC DER-10. 40 CFR 300.430(c) (6) requires that the No Further Action option be considered at every site as a baseline for comparison with other options. This option involves taking no further action to remediate the site. Typically this option is unacceptable because the site would remain in its current condition, and public health and the environment would not be adequately protected. The recovery of total fluids from CMW-43R has had a positive effect in reducing the seep on the Apollo Street property as demonstrated by the decreased extent of absorbent boom staining in CS.

5.1.2 Option B - Containment Barrier
Option B involves the construction of a hydraulically competent coaksider containment barrier fronting the existing Apollo Street property timber crib bulkhead. This barrier may either be a non-structural containment wall or a structural bulkhead. Either structure would be designed to provide the hydraulic containment necessary to abate the areas of active seepage noted emanating from the timber crib bulkhead. Permits from NYSDEC and other agencies are required to implement this remedy. This option would also require the landslide recovery of fluids via existing wells and/or newly installed recovery points to remove PSH. The space between the existing bulkhead and the containment barrier would be filled after installation. The type and extent of the fill materials would be dependant on structural and permitting considerations. The joints between the steel sheets of either the nonstructural wall or structural bulkhead would also be sealed to prevent lateral PSH and groundwater migration.

5.1.3 Option C - Containment Barrier and Strategic Grouting
Option C involves the injection of grout as an additional component to the hydraulically competent barrier described in Option B. The injection of grout offers added protection from PSH migration along potential preferential pathways and/or along the up and down-creek extents of the containment barrier. This option would also require the landslide recovery of fluids via existing wells and/or newly installed recovery points. A survey would be required to identify potential grout injection locations, as above and below-grade infrastructure will limit the placement of injections points.

5.1.5 Option D - Strategic Grouting
This option involves strategic grout injection along potentially preferential PSH migration pathways. The options assessment would evaluate issues pertaining to grout injection and subsurface distribution within the fill materials comprising the timber crib structures and the areas underlying the relieving platform structure. This option would require landside fluids recovery via existing wells and/or newly installed recovery points to remove accumulated PSH in the vicinity of grout injection points and/or along preferential PSH migration pathways. No known NYSDEC or Army Corps of Engineers (ACE) permits would be required for this option.

A survey would be required to identify potential grout injection locations, as above and below-grade infrastructure will limit the placement of injections points. A post-installation assessment of the competency of the grout wall may be required to determine the mitigating effects of strategic grout injection.
5.1.6 **Option E - Outside Grout Wall**

This option would involve the construction of a competent grout wall in the area between the Apollo Street property warehouse and the timber crib bulkhead to prevent the migration of PSH into Newtown Creek. The options assessment would evaluate issues pertaining to grout injection and subsurface distribution within the fill materials comprising the timber crib structures and the open areas underlying the relieving platform structure. This option would require landside fluids recovery via existing wells and/or newly installed recovery points to remove accumulated PSH in the vicinity of grout injection points and/or along preferential PSH migration pathways. NYSDEC or USACE permits would not be required.

A survey would be required to identify potential grout injection locations, as above and below-grade infrastructure will limit the placement of injections points. A post-installation assessment of the competency of the grout wall may be required to determine the mitigating effects of the grout wall.

5.1.7 **Option F - Inside Grout Wall**

This option would involve the construction of a competent grout wall inside the Apollo Street property warehouse to prevent the migration of PSH into Newtown Creek. Due to the active nature of this warehouse, this option would be dependent on owner/tenant approval for the disruption of warehouse operations during the construction. The options assessment would evaluate issues pertaining to grout injection and subsurface distribution within the fill materials comprising the timber crib structures and the areas underlying the relieving platform structure. This option would also require fluids recovery via existing wells and/or newly installed recovery points to remove accumulated PSH in the vicinity of grout injection points and/or along preferential PSH migration pathways. NYSDOH or USACE permits would not be required.

A survey would be required to identify potential grout injection locations, as above and below-grade infrastructure will limit the placement of injections points. A post-installation assessment of the competency of the grout wall may be required to determine the mitigating effects of the grout wall.

6.0 **ASSESSMENT CRITERIA**

This ROA has been structured using assessment criteria presented in the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation and EPA’s Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. These documents provide evaluation guidelines for analyzing remedial alternatives through all stages of implementation and future operation. The assessment criteria utilized in this ROA are:

- Overall protection of public health and the environment
- Compliance with standards, criteria, and guidance (SCCs)
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility or volume with treatment
- Short-term effectiveness
- Implementability
- Cost
- Community acceptance
A description of all assessment criteria follows.

6.1 Overall Protection of Public Health and the Environment
This criterion evaluates the ability of the remedy to protect public health and the environment by assessing how the risks posed through each existing or potential exposure pathway are eliminated, reduced, or controlled through removal, treatment, engineering or institutional controls. This criterion also evaluates the ability of each remedy to achieve the remedial goals set forth in Section 4.0.

6.2 Compliance with Standards, Criteria, and Guidance (SCGs)
This criterion requires that each remedial option be evaluated on its ability to meet applicable environmental laws, regulations, standards, and guidance at all levels of government. A discussion of each option’s ability to achieve compliance is presented. For SCGs that will not be met, a discussion and an evaluation of the impacts of each is provided, as well as the need for any waivers or permits.

6.3 Long-term Effectiveness and Permanence
This criterion evaluates the long-term effectiveness of the remedy after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the selected items will be evaluated with respect to the magnitude of the remaining risks, the adequacy of the engineering and institutional controls intended to limit the risk, the reliability of those controls, and the ability of the remedy to continue to meet ROAs in the future.

6.4 Reduction of Toxicity, Mobility or Volume with Treatment
This criterion evaluates the remedy’s ability to reduce the toxicity, mobility, or volume of site contamination. Preference is given to remedies that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the site. According to the EPA’s Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, this evaluation focuses on the treatment processes and the materials they will treat, the amount of hazardous materials that will be destroyed or treated, the degree of expected reduction in toxicity, mobility, or volume, the degree to which the treatment will be irreversible, the type and quantity of treatment residuals that will remain following treatment, and if the treatment is a principal component in the remediation process.

6.5 Short-term Effectiveness
This criterion evaluates the potential short-term adverse impacts and risks of the remedy upon the community, the workers, and the environment during the construction and/or implementation. A discussion of how the identified adverse impacts and health risks to the community or workers at the site will be controlled, and the effectiveness of the controls are discussed. This includes a discussion of engineering controls that will be used to mitigate short term impacts and an estimate of the length of time needed to achieve the remedial objectives.

6.6 Implementability
This criterion evaluates the technical and administrative feasibility of implementing the remedy. Technical feasibility includes the difficulties associated with the construction and the ability to
monitor the effectiveness of the remedy. Administrative feasibility includes the availability of the necessary personnel and materials, along with the potential difficulties in obtaining specific operating approvals, access for construction, etc.

This evaluation places greater emphasis on the institutional aspects of implementability, such as the ability to obtain necessary permits for offsite actions, the availability of treatment, storage, and disposal services (including capacity), and the availability of necessary equipment and skilled workers to implement the technology.

6.7 Cost
This criterion estimates capital, operation, maintenance and monitoring costs for the remedy. These estimates are expected to provide an accuracy of ±50 to -30 percent and are presented on a present worth basis. The overall cost-effectiveness of the remedy is also considered. A remedy that is compliant with the RAO and is evaluated favorably with respect to the other assessment criteria is identified in this document. However, costs for the selected remedy will be developed once additional testing and design work are completed.

Only alternatives that when completed will achieve the RAO are to be evaluated with respect to total costs. Therefore alternatives that are not compliant with achieving the RAO are not evaluated with respect to total costs.

6.8 Community Acceptance
This criterion provides a summary of any applicable public participation program that was followed for the project. The public’s comments, concerns, and overall perception of the remedy are evaluated in a format that responds to all questions that are raised (i.e. responsiveness summary).

7.0 DETAILED ANALYSIS OF ALTERNATIVES

In this section, each remedial alternative is evaluated against the eight criteria detailed in the DER-10 and Section 6.0. An analysis of alternatives provides decision-makers with the relevant information necessary to select the most appropriate, site-specific remedial action.

7.1 Option A – No Further Action
Consideration of the No Further Action option is required by NCP (40 CFR Part 300.430) and DER-10. 40 CFR 300.430(e) (6) requires that the No Further Action option be considered at every site as a baseline for comparison with other options. This option involves taking no further action to remediate the site. Typically, this option is unacceptable because the site would remain in its current condition, and public health and the environment would not be adequately protected. This option would include continued total fluids recovery from CMW-43R, which has had a positive effect in reducing the seep on the Apollo Street property.

7.1.1 Overall Protection of Public Health and the Environment
No Further Action option would include continued total fluids recovery from CMW-43R, which has had a positive effect in reducing the seep on the Apollo Street property. This alternative would not address the source pathway, and so the potential would remain for PSH to migrate through
the existing timber crib bulkhead and into Newtown Creek. This option does not satisfy the RAO established for the Apollo Street property.

7.1.2 Compliance with Standards, Criteria, and Guidance (SCGs)
The No Further Action option would not satisfy applicable SCGs. This option would not address the source pathway for PSH migration into Newtown Creek. The RAO would not be satisfied.

7.1.3 Long-term Effectiveness and Permanence
The No Further Action option would not address the long-term impacts of PSH migration into Newtown Creek since no remedial activity would occur. The RAO would not be satisfied.

7.1.4 Reduction of Toxicity, Mobility, or Volume with Treatment
The No Further Action option would not address the potential toxicity, mobility, or volume of PSH on the Apollo Street Property. The pathway and potential would remain for PSH to migrate through the existing timber crib bulkhead and into Newtown Creek. The RAO would not be satisfied.

7.1.5 Short-term Effectiveness
The No Further Action option would not address short-term impacts of PSH migration into Newtown Creek since no remedial activity would occur. The RAO would not be satisfied.

7.1.6 Implementability
There are no implementable actions for the No Further Action option.

7.1.7 Community Acceptance
Public comment has not been solicited. The document will be available for public review at the Brooklyn Public Library. Continued seepage of PSH into Newtown Creek is not acceptable to the community.

7.2 Option B – Containment Barrier
Option B involves the construction of a hydraulically competent, steel containment barrier designed to provide hydraulic containment fronting the existing creekside Apollo Street property timber crib bulkhead. The space between the existing bulkhead and the containment barrier would be filled after installation, dependent on structural and permitting considerations.

7.2.1 Overall Protection of Public Health and the Environment
In combination with a landslide recovery well system, this option provides a high probability of abating the migration of PSH from the Apollo Street property into Newtown Creek. A hydraulically competent barrier would prevent PSH migration into Newtown Creek while landslide total fluids recovery wells would extract accumulated PSH and groundwater from the subsurface. The installation of a hydraulically competent barrier would benefit the environment and satisfy the RAO.

7.2.2 Compliance with Standards, Criteria, and Guidance (SCGs)
This option provides a high probability of stopping the migration of PSH from the Apollo Street property into Newtown Creek by installing a hydraulically competent containment barrier
7.3 Option C – Containment Barrier and Strategic Grouting

Option C involves the injection of grout as an additional component to the hydraulically competent steel containment barrier outlined in Option B. This option would also incorporate the landside recovery of fluids via existing wells and/or new recovery points.

7.3.1 Overall Protection of Public Health and the Environment

This option provides the same benefits as Option B. The injection of grout in strategic locations could provide enhancements to further halt the migration of PSH along barrier extents or through barrier interlocks.

7.3.2 Compliance with Standards, Criteria, and Guidance (SCGs)

This option provides a high probability of stopping the migration of PSH from the Apollo Street property into Newtown Creek by installing a hydraulically competent containment barrier between the PSH and Newtown Creek. The successful implementation of this option would satisfy applicable SCG’s and the RAO.

7.3.3 Long-term Effectiveness and Permanence

This option employs a conventional technology that has been effectively used in similar applications to prevent PSH seeps into surface water bodies. The installation of a hydraulically competent barrier would provide a long term remedy to the migration of PSH into Newtown Creek. If breaches emerge through the barrier, the strategic injection of grout could provide enhancements to further halt the migration of PSH along barrier extents or between sheeting interlocks.

7.3.4 Reduction of Toxicity, Mobility or Volume with Treatment

This option provides the same benefits as Option B. The strategic injection of grout would further fortify the barrier, as needed to reduce the mobility of subsurface PSH.

7.3.5 Short-term Effectiveness

This option provides the same benefits as Option B. Installation of a hydraulically competent barrier would provide both a short and long term solution to the migration of PSH into Newtown Creek. Total fluids recovery via landside recovery wells would extract accumulated PSH and groundwater from the subsurface and satisfy the RAO.

7.3.6 Implementability

As outlined in Option B, the installation of a hydraulically competent containment barrier is readily implementable. The injection of grout as a means of sealing preferential hydraulic pathways is a conventional remedial technique. The effectiveness of strategic grouting will be dependant on the ability to pinpoint and inject grout into specific preferential pathways. This could prove difficult in the irregular urban fill materials comprising the subsurface at the Apollo Street property.

A survey would be required to identify potential grout injection locations, as above and below-grade infrastructure may limit the placement of injections points. A post-installation assessment of the competency of the grout may be required to determine the mitigating effects of strategic grout injection.
7.3.7 Community Acceptance
Public comment has not been solicited, but the document will be available for public review at the Brooklyn Public Library. This option would stop the seep of PSH into the creek in a relatively short period of time and is therefore judged as acceptable to the community.

7.4 Option D - Strategic Grouting
This option involves strategic grout injection along pre-determined preferential PSH migration pathways. This option would also require landside fluids recovery via existing wells and/or newly installed recovery points to remove accumulated PSH in the vicinity of grout injection points and/or along preferential PSH migration pathways.

7.4.1 Overall Protection of Public Health and the Environment
In combination with a landside recovery well system, the strategic injection of grout into preferential PSH migration pathways could assist in halting the migration of PSH into Newtown Creek. The satisfaction of this criterion is dependent on the ability to stop the migration of PSH into Newtown Creek.

7.4.2 Compliance with Standards, Criteria, and Guidance (SCGs)
In combination with a landside recovery well system, the strategic injection of grout into preferential PSH migration pathways could potentially achieve compliance with applicable regulations under ideal conditions. The ability of Option C to satisfy this criterion is hinged upon stopping the seep of PSH into Newtown Creek.

7.4.3 Long-term Effectiveness and Permanence
The long-term effectiveness of strategic grouting is dependent on the ability to pinpoint and inject grout into specific preferential pathways and to recover accumulated PSH using existing or new recovery wells. This could prove difficult in the irregular and/or unknown urban fill materials comprising the timber crib structures at the Apollo Street property. Seeps may still occur after completion of strategic grouting and total fluids recovery due to unknown subsurface conditions. A survey would be required to identify potential grout injection locations, as above and below-grade infrastructure will limit the placement of injection points. A post-installation assessment of the competency of the grout would be required to determine the mitigating effects of strategic grout injection.

7.4.4 Reduction of Toxicity, Mobility, or Volume with Treatment
This option provides a low probability of stopping the migration of PSH from the Apollo Street property into Newtown Creek. Seeps may still occur after completion of strategic grouting and total fluids recovery due to unknown subsurface conditions.

7.4.5 Short-term Effectiveness
The short-term effectiveness of strategic grouting is dependent on the ability to pinpoint and inject grout into specific preferential pathways and to recover accumulated PSH using existing or new recovery wells. This could prove difficult in the irregular and/or unknown urban fill materials comprising the timber crib structures at the Apollo Street property. Seeps may still occur after completion of strategic grouting and total fluids recovery due to unknown subsurface conditions.
7.4.6 Implementability
The strategic injection of grout is implementable across portions of the Apollo Street property. A survey would be required to identify potential grout injection locations, as above and below-grade infrastructure may limit the placement of injection points. A post-installation assessment of the competency of the grout may be required to determine the mitigating effects of strategic grout injection.

7.4.7 Community Acceptance
Public comment has not been solicited, but this document will be available for public review at the Brooklyn Public Library.

7.5 Option E - Outside Grout Wall
This option would involve the construction of a hydraulically competent grout wall in the area between the Apollo Street property warehouse and the existing concrete and timber crib bulkhead to prevent the migration of PSH into Newtown Creek. This option would require landside fluids recovery via existing wells and/or newly installed recovery points to remove accumulated PSH in the vicinity of grout injection points and/or along preferential PSH migration pathways.

7.5.1 Overall Protection of Public Health and the Environment
In combination with a landside recovery well system, the construction of a hydraulically competent grout wall in the area between the Apollo Street property warehouse and the existing concrete and timber crib bulkhead could assist in halting the migration of PSH into Newtown Creek. The satisfaction of this criterion is dependent on the competence of the wall and the ability to stop the migration of PSH into Newtown Creek.

7.5.2 Compliance with Standards Criteria, and Guidance (SCGs)
Compliance with all applicable regulations could potentially be achieved under ideal conditions. Prevention of PSH migration into Newtown Creek will depend on the competency of the grout wall. The ability of Option E to satisfy this criterion is hinged upon stopping the seep of PSH into Newtown Creek.

7.5.3 Long-term Effectiveness and Permanence
The long-term effectiveness of a grout wall would be dependent on unknown surface conditions affecting the competence of the grout wall. Seeps may still occur after construction of a grout wall due to unknown subsurface conditions. Risks are reduced but not completely eliminated. The performance of the grout wall would determine if the RAO is met.

7.5.4 Reduction of Toxicity, Mobility or Volume with Treatment
In combination with landside total fluids recovery, this option may inhibit the migration of PSH into Newtown Creek under ideal conditions. Prevention of PSH migration will depend on the competence of the grout wall. Seeps may still occur after completion of strategic grouting and total fluids recovery due to unknown subsurface conditions.
7.5.5 Short-term Effectiveness

The short-term effectiveness of a grout wall is dependant on unknown surface conditions affecting the competence of the grout wall. Seeps may still occur after construction of a grout wall due to unknown subsurface conditions. Risks are reduced but not completely eliminated. The performance of the grout wall would determine if the RAO is met.

7.5.6 Implementability

The injection of grout in the area between the Apollo Street property warehouse and the existing concrete and timber crib bulkhead is potentially implementable, yet to be likely limited by the presence of above and below-grade infrastructure. The probability of completing a hydraulically competent grout wall in this area is unlikely due to spatial restrictions, above and below grade obstructions, and variability within the urban fill materials comprising the timber crib structures.

7.5.7 Community Acceptance

Public comment has not been solicited, but the document will be available for public review at the Brooklyn Public Library.

7.6 Option F - Inside Grout Wall

This option would involve the construction of a hydraulically competent grout wall inside the Apollo Street property warehouse to prevent the migration of PSH into Newtown Creek. This option would also require fluids recovery via existing wells and/or newly installed recovery points to remove accumulated PSH in the vicinity of great injection points and/or along preferential PSH migration pathways.

7.6.1 Overall Protection of Public Health and the Environment

In combination with a landslide recovery well system, the construction of a hydraulically competent grout wall inside the Apollo Street property warehouse could assist in halting the migration of PSH into Newtown Creek under ideal conditions. The satisfaction of this criterion is dependant on the competence of the wall and its ability to stop the migration of PSH into Newtown Creek.

7.6.2 Compliance with Standards Criteria, and Guidance (SCGs)

Compliance with all applicable regulations could potentially be achieved under ideal conditions. Prevention of PSH migration into Newtown Creek will depend on the competence of the grout wall. The ability of Option F to satisfy this criterion is hinged upon stopping the seep of PSH into Newtown Creek.

7.6.3 Long-term Effectiveness and Permanence

The long-term effectiveness of a grout wall is dependant on unknown surface conditions affecting the competence of the grout wall. Seeps may still occur after construction of a grout wall due to unknown subsurface conditions. Risks are reduced but not completely eliminated. The performance of the grout wall would determine if the RAO is met.

7.6.4 Reduction of Toxicity, Mobility or Volume with Treatment

In combination with landslide total fluids recovery, this option may inhibit the migration of PSH into Newtown Creek under ideal conditions. Prevention of PSH migration will depend on the
competence of the grout wall. Seeps may still occur after completion of strategic grouting and total fluids recovery due to unknown subsurface conditions.

7.6.5 Short-term Effectiveness
The short-term effectiveness of a grout wall would be dependant on unknown surface conditions affecting the competence of the grout wall. Seeps may still occur after construction of a grout wall due to unknown subsurface conditions. Risks are reduced but not completely eliminated. The performance of the grout wall would determine if the RAO is met.

7.6.6 Implementability
The injection of grout in the area between the Apollo Street property warehouse and the existing concrete and timber crib bulkhead is potentially implementable, yet likely limited by the presence of above and below-grade infrastructure. Due to the active nature of this warehouse, this option would be dependent on owner/tenant approval for the disruption of warehouse operations during the construction. The probability of completing a hydraulically competent grout wall in this area is unlikely due to spatial restrictions, above and below grade obstructions, and variability within the urban fill materials comprising the timber crib structures.

7.6.7 Community Acceptance
Public comment has not been solicited, but the document will be available for public review at the Brooklyn Public Library.

8.0 COMPARATIVE ANALYSIS
The detailed analysis of alternatives identified similarities and differences between each alternative. In the comparative analysis, the relative performance of each alternative is evaluated in relation to each criterion used in the detailed analysis. The purpose of this analysis is to identify the advantages and disadvantages of each alternative relative to one another so key trade-offs can be identified and balanced by decision makers. A summary of the comparative analysis is presented in Table 1.

9.0 RECOMMENDED REMEDY AND CONCEPTUAL APPROACH
The advantages and disadvantages of each alternative have been identified and evaluated in previous sections. This section presents the remedy selected that best achieves the project's remedial goal while protecting human health and the environment. A conceptual approach detailing remedy specifications is presented as well.

The selected remedy is the steel containment barrier with a landslide total fluids recovery system. The barrier may take the form of either a nonstructural wall or a structural bulkhead.

9.1 Recommended Remedy
SAIC has determined that the most effective means of preventing the migration of PSH through the Apollo Street property timber crib bulkhead into Newtown Creek is via Option B, the installation of a hydraulically competent creekside containment barrier coupled with a landslide total fluids recovery system. A hydraulically competent barrier would prevent PSH migration.
into Newtown Creek while landside total fluids recovery wells would extract accumulated PSH and groundwater from the subsurface.

9.2 Conceptual Approach

Based on observations and data collected in the field during the initial bulkhead assessment on February 19 and 20, 2008, a conceptual design is being developed for Option B, installation of a new hydraulically competent containment barrier in Newtown Creek fronting the existing timber crib bulkhead on the Apollo Street property. NYCE has assisted SACE in the development of this conceptual design. This option would also require the landside recovery of fluids via existing wells and/or newly installed recovery points to remove PSH.

This barrier may either be a non-structural containment wall or a structural bulkhead. The selection between these two options is dependent on factors including the projected lifespan of the existing timber crib bulkhead and acceptance by the property owner. Both options would be designed to provide the hydraulic containment necessary to abate the areas of active seepage noted emanating from the timber crib bulkhead. The space between the existing bulkhead and the containment barrier would be filled after installation. The type and extent of the fill materials will be dependent on structural and permitting considerations. Sheet piling construction options are being explored which can be installed within 18" of the face of the existing bulkhead and facilitate the acquisition of a joint NYSDEC and Army Corps of Engineers permit.

The conceptual approach includes the design of a coated steel sheet piling wall fronting the timber crib bulkhead in Newtown Creek. The interlocks of the sheet piles would be sealed, typically by seal welding the interlock of each pair of sheets and installation of a hydrophobic joint sealant between adjoining pairs of sheets. The vertical interlock would be sealed to prevent lateral PSH migration. The western edge of the new wall would be interlocked to the westernmost existing sheet pile of the Peerless bulkhead. The wall would continue west approximately 80' outboard of the existing timber cribbing bulkhead. The wall would then turn 90° and terminate approximately 17 feet inboard perpendicular to the face of the bulkhead at the west end of the crib. Several design options will be evaluated to determine the best method of constructing the downdrill sheeting wall return.