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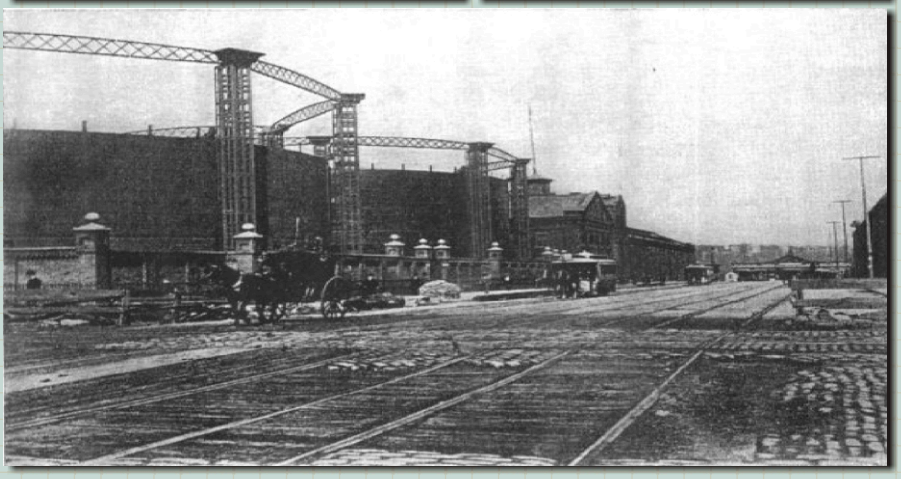
SILVERSTEIN PROPERTIES

Consolidated Edison Company of New York, Inc.

Remedial Work Plan

West 42nd Street
Former Manufactured Gas Plant Site
Brownfield Cleanup Program

Block 1089 Tax Lot 1-Site ID# C231024
Block 1089 Tax Lot 3-Site ID# C231012



March 2005

DVIRKA AND BARTILUCCI
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

RLA/JOBS/CNED2085(03/03/05)

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Consolidated Edison Company
of New York, Inc.
31-01 20th Avenue
Long Island City, NY 11105-2048
www.conEd.com

March 4, 2005

Joseph Moloughney
Project Engineer
New York State Department of Environmental Conservation
625 Broadway
Albany, N.Y. 12233-7017

Re: West 42nd Street Works Site
Remedial Work Plan
Brownfield Cleanup Program
Agreement Nos. W2-1017-04-09 and W2-1018-04-09
Site IDs C231024 and C231012

Dear Mr. Moloughney:

Enclosed please find two copies of the Remedial Work Plan which addresses the subject sites. This Remedial Work Plan has been revised based on your comments received on November 29, 2004.

If you have any questions or comments about this submittal please contact me at (718) 204-4288, or via e-mail at rienzor@coned.com.

Very truly yours,

Richard Rienzo, P.E.
Project Manager

RR/TPF/ld,tp
Enclosure
cc/encl.:
D.J. D'Ambrosio, NYSDEC (1 copy)
G. Lacetti, NYSDOH (2 copies)
J. O'Connell, NYSDEC, Region 2 (1 copy)
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WEST 42ND STREET
FORMER MANUFACTURED GAS PLANT SITE
MANHATTAN, NEW YORK
BROWNFIELD CLEANUP PROGRAM

BLOCK 1089 TAX LOT 1 - SITE ID #C231024
BLOCK 1089 TAX LOT 3 - SITE ID #C231012
REMEDIAL WORK PLAN

Prepared For:

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
IN CONJUNCTION WITH
SILVERSTEIN PROPERTIES, INC.

By:

DVIRKA AND BARTILUCCI CONSULTING ENGINEERS
330 Crossways Park Drive
Woodbury, New York

MARCH 2005

WEST 42ND STREET
FORMER MANUFACTURED GAS PLANT SITE
BROWNFIELD CLEANUP PROGRAM
REMEDIAL WORK PLAN

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

List of Appendices

TABLE OF CONTENTS (continued)

List of Figures

List of Tables

1.0 INTRODUCTION

The Consolidated Edison Company of New York, Inc. (Con Edison) has entered into a Voluntary Cleanup Agreement (VCA) with the New York State Department of Environmental Conservation (NYSDEC) to investigate and remediate potential contamination at a number of former manufactured gas plant (MGP) properties. One of these properties is known as the West 42nd Street Former MGP site (VCA Index No. D2-003-02-08, signed in August 2002, Site 1DV00531) which is located between West 41st Street and West 42nd Street and 11th Avenue and 12th Avenue on the west side of Manhattan, New York. The site includes Tax Block 1107, a stretch of 12th Avenue and both lots of Tax Block 1089, Tax Lots 1 and 3. The owners of Tax Lots 1 and 3, River Place I LLC and River Place II LLC, respectively, and Con Edison have applied to NYSDEC to transfer the Block 1089 tax lots into the Brownfield Cleanup Program (BCP) from the existing VCA. The remaining portion of the West 42nd Street Former MGP site, including potential off-site issues, would remain in the VCA. This Remedial Work Plan addresses the tax lots of Block 1089 and has been prepared in accordance with the BCP guidelines. River Place I, LLC and River Place II, LLC will be conducting the remediation of Tax Lots 1 and 3, respectively, pursuant to this remedial work plan.

A Site Characterization Study (SCS) was completed by Dvirka and Bartilucci Consulting Engineers (D&B) at the site in accordance with the Scope of Work presented in the NYSDEC-approved Site Characterization Study Work Plan, dated June 2003. The findings of the SCS were presented in the final Site Characterization Study Report (SCS Report), dated April 2004. The SCS, completed in the fall of 2003, focused on the tax lots of Block 1089 located to the east of 12th Avenue. The research of historical records performed as part of this SCS confirmed the presence of several former MGP structures located to the west of 12th Avenue. Supplemental investigation activities to address remaining portions of the site will be conducted under the VCA.

This Remedial Work Plan (RWP) has been prepared to address subsurface contamination present within the Block 1089 property associated with the historic operations of the West 42nd

Street Former MGP Site. For purposes of this document, the term "site" refers to both tax lots of the Block 1089 property.

1.1 Site Description

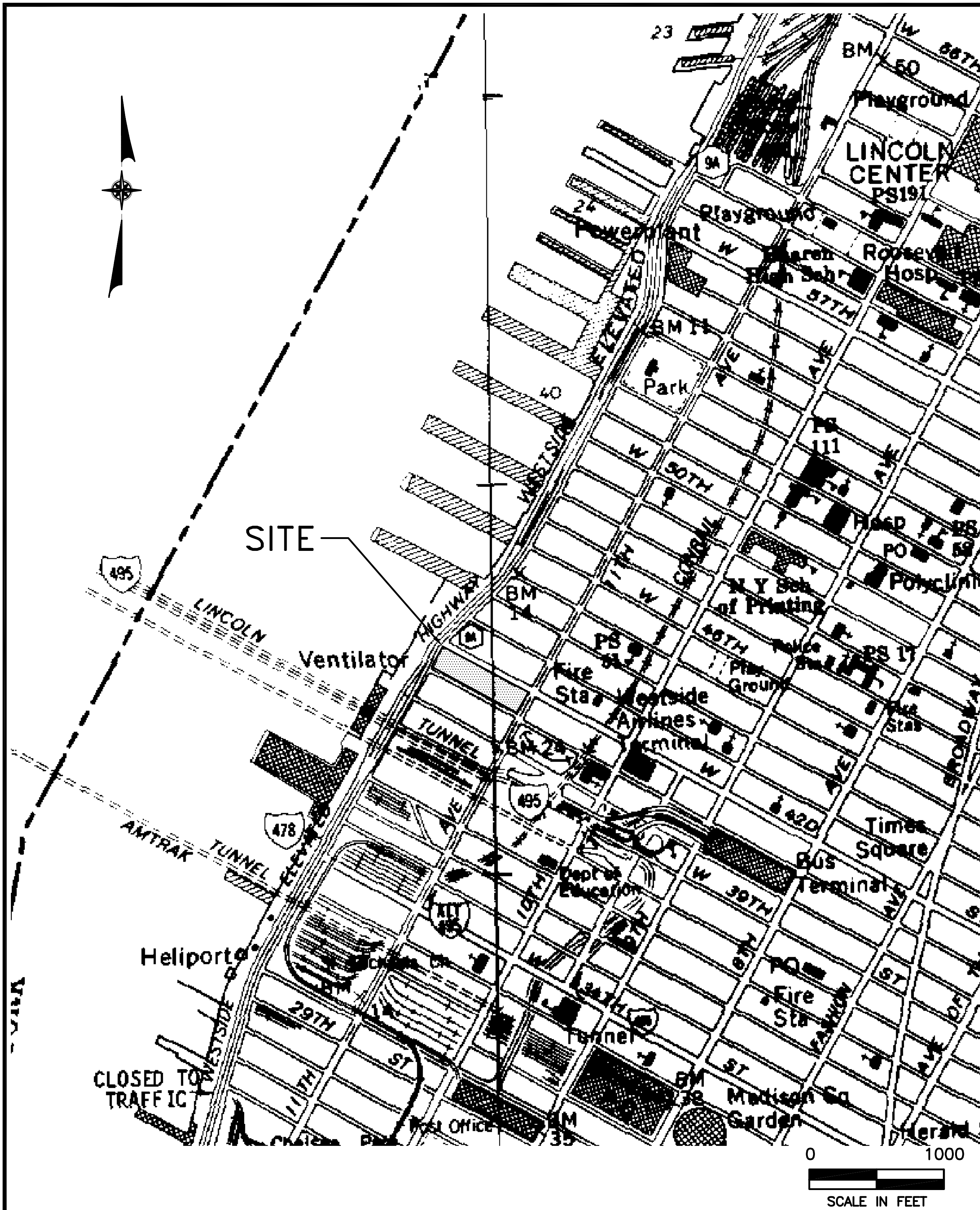
The site is located in the Borough of Manhattan, New York City, New York (see Figure 1-1). The area in which the site is located maintains a high population density due to the presence of residential high-rises, office buildings, local attractions, and retail facilities as well as the influx of the workforce population on any given day of the workweek.

The entire former MGP site occupied approximately 5 acres, including all of modern-day Block 1089, the Hudson River waterfront property immediately west of Block 1089 (now designated modern-day Block 1107), and the stretch of 12th Avenue currently separating Blocks 1089 and 1107 (see Figure 1-2). Block 1089 is further divided into Tax Lots 1 and 3. Currently, on Tax Lot 1, a high-rise apartment building occupies approximately 90 percent of the lot. The remaining portion of the lot consists of a landscaped, park-like area and sidewalks. The apartment building is referred to as River Place I and was built in 2000 with construction "at grade" and no below ground basement or garage areas. The ground level is used for retail space on the western side of the building while the eastern side is occupied by a small café and flower shop. Additionally, an elevated parking garage is located within the second floor of the building.

Tax Lot 3 is currently used as a parking lot open to the public. Surface structures on Tax Lot 3 include a small wooden kiosk located in the central portion of the site to house the parking attendant and a series of hydraulic lifts used to store cars along the eastern and southern property boundaries.

1.2 Site History

Historical records indicate that the land encompassing the former MGP site was originally part of the Hudson River and likely consisted of a shallow embayment, a tidal creek



CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
WEST 42nd STREET FORMER MANUFACTURED GAS PLANT SITE

SITE LOCATION MAP

FIGURE 1-1

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

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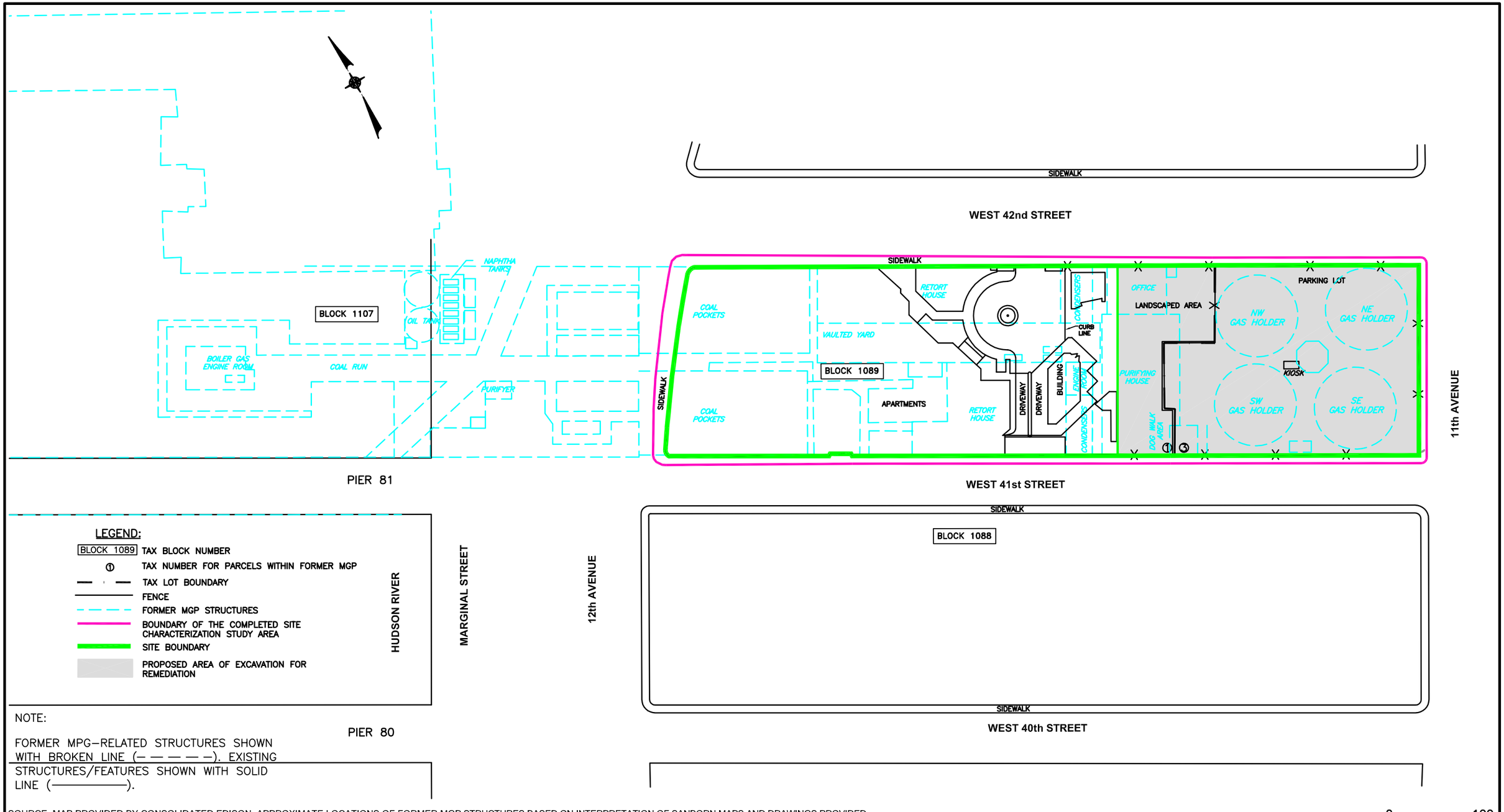

SOURCE: MAP PROVIDED BY CONSOLIDATED EDISON. APPROXIMATE LOCATIONS OF FORMER MGP STRUCTURES BASED ON INTERPRETATION OF SANBORN MAPS AND DRAWINGS PROVIDED BY CONSOLIDATED EDISON CONTAINED WITHIN THE WEST 42nd STREET MANUFACTURED GAS PLANT SITE HISTORY REPORT BY PARSONS, DATED AUGUST 2002 AND THE RIVER PLACE PHASE II, 42nd. STREET AND ELEVENTH AVENUE, GEOTECHNICAL ENGINEERING STUDY BY LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES, P.C., DATED JULY 2000.

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SCALE IN FEET

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
WEST 42ND STREET
FORMER MANUFACTURED GAS PLANT SITE

SITE MAP

FIGURE 1-2

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running through present day Block 1089, and associated tidal wetlands. By 1850, this portion of the Hudson River and associated wetlands have been filled.

The construction of the Metropolitan Gas Light Company's West 42nd Street plant began in 1860. The plant operated as a coal gasification plant from 1863 into the early 1920s and was likely demolished in approximately 1925. In 1932 the New York Central Railroad Company acquired the Block 1089 portion of the former MGP site and constructed a railroad yard with several small associated buildings and a gasoline service station. By the 1980s, this property was being utilized as a parking lot. In 2000 a high-rise apartment building was erected on Tax Lot 1.

1.3 Summary of Environmental Conditions at the Site

Previously Completed Investigations

Starting in 1995, a number of environmental investigations and remediations were completed at the site by the property owner. In 1995, 18 underground storage tanks (USTs) were removed from the eastern side of Tax Lot 3. The USTs were assumed to be associated with the historical use of the site by the New York Central Railroad Company. Several subsurface investigations were completed subsequent to the removal of the USTs and petroleum-related compounds were identified in on-site soil and groundwater within Tax Lot 3. Starting in 1996, several additional subsurface investigations within Tax Lots 1 and 3 were performed by the property owner. These investigations identified petroleum and MGP-related contaminants present in subsurface soil and groundwater in both tax lots. A transport and fate analysis performed by Woodward-Clyde Associates, L.P. concluded that site-related contaminants are not likely impacting the Hudson River. A human health risk assessment performed by Woodward-Clyde Associates, L.P. concluded that significant exposures to site-related contamination would not be expected after construction of the apartment complex on Tax Lot 1. A detailed description of each of these previous investigations is presented in Section 1.4 of the April 2004 SCS Report.

Site Characterization Study Findings

The following discussion presents a summary of findings related to the SCS, which are discussed in greater detail in the April 2004 SCS Report.

BCP Site ID No. C231024 (Tax Lot 1)

A total of 11 subsurface soil borings were advanced on or immediately adjacent to Tax Lot 1, and 22 soil samples were selected for chemical analysis. In general, MGP impacts were not observed in shallow subsurface soil of less than 4 feet in depth. The most significant MGP impacts, including the highest volatile organic compound (VOC), semivolatile organic compound (SVOC) and metal concentrations were most prevalent in the Fill Unit below a depth of 10 feet, which places the majority of the impacted soil below the water table. However, at most locations, contaminant concentrations decrease rapidly below a depth of 24 feet. This rapid decrease in contaminant concentrations is likely due to the confining ability of the underlying Clay Unit. Exceptions to this general trend include borings located along 12th Avenue where nonaqueous phase liquid (NAPL) or tar at saturated conditions was observed to a depth of up to 38 feet and within the Clay Unit. The Bedrock Unit within Tax Lot 1 was not observed to be impacted by MGP residuals.

Based on existing conditions and use of the site, direct exposure to MGP contaminants would not be expected for most on-site and off-site receptors. Currently, Tax Lot 1 contains a large apartment building and the remaining land is either paved or landscaped. An assessment of soil gas and indoor air quality at Tax Lot 1 has been conducted under a separate phase of investigation. The results of this assessment have been presented to the NYSDEC by Con Edison in a separate report and indicate that indoor air is not impacted by subsurface intrusion of vapors emanating from any MGP-related material.

Based on the completed SCS, the only potential for future exposure to MGP contamination at Tax Lot 1 is associated with utility/construction workers who may be involved

with on-site excavations in support of the installation or repair of subsurface utilities within or in the vicinity of Tax Lot 1.

BCP Site ID No. C231012 (Tax Lot 3)

A total of 18 soil borings and 9 test pits were advanced within Tax Lot 3 with a total of 39 subsurface soil samples selected for chemical analysis. Thirty-nine out of 39 samples exhibited detectable levels of VOCs with the maximum total VOC concentration of 865 mg/kg observed in a soil sample collected along the eastern edge of the site at a depth of 19 to 23 feet, between the northeast and southeast former gas holders. Thirty-nine out of 39 samples exhibited detectable levels of SVOCs with the maximum total SVOC concentration of 12,010 mg/kg observed in a soil sample collected within the footprint of the former Purifying House foundation walls at a depth of 9 to 9.5 feet.

Evidence of NAPL/tar at saturated levels was not observed in subsurface soil within Tax Lot 3. The most significant MGP impacts were observed in the Fill Unit at depths ranging from 17 to 23 feet below ground surface (bgs), and within and adjacent to the former gas holders. Soil below and adjacent to the northwest and northeast former gas holders exhibited sheens and odors to a depth of up to 31 feet bgs. In addition, evidence of MGP impacts, including light to moderate odors, was observed below the southwest former gas holder up to a depth of 31 feet bgs. The southeast former gas holder exhibited the least amount of MGP impacts with only light to moderate staining and odors observed to 22 feet bgs.

Twenty-nine out of 39 subsurface soil samples selected for analysis exhibited detectable levels of total cyanide. The maximum total cyanide concentration of 1,580 mg/kg was detected in a soil sample collected at a depth of 9 to 13 feet along the western portion of Tax Lot 3 within the vicinity of the former Purifying House.

In general, MGP impacts were not observed in shallow subsurface soil of less than 5 feet in depth throughout the majority of Tax Lot 3. In addition, the central portion of Tax Lot 3

surrounded by the four former gas holders exhibits little to no evidence of MGP impacts in subsurface soil throughout its vertical extent.

Four existing groundwater monitoring wells and six monitoring wells installed as part of the SCS field investigation were sampled in order to characterize site groundwater quality. Measurable separate-phase NAPL was not detected in any of the on-site monitoring wells.

The highest VOC and SVOC concentrations in on-site groundwater were detected in samples collected from existing wells LMW-04 and LMW-03. LMW-03 appears to be located within the northwest former gas holder. Similarly, LMW-04 appears to be located within the southwest former gas holder and both wells are screened well below the water table immediately above the Bedrock Unit. Due to their location and construction, the two existing wells may be serving as migration pathways for contaminants within and below the former holders. As a result, the high concentrations of VOCs and SVOCs detected at these wells may actually be associated with MGP-impacted soil present within and below the former holders and not representative of the actual groundwater quality above the bedrock unit.

Methyl tertiary-butyl ether (MTBE), a common gasoline additive, was detected at concentrations that exceed NYSDEC Class GA Groundwater Standards at monitoring well LMW-01 located directly downgradient of an Exxon/Mobil Service Station located at 553 Eleventh Avenue, New York City. Based on the review of NYSDEC records, there have been at least three petroleum spills that have occurred at this service station. In 2003, a subsurface investigation conducted at the service station on behalf of the Exxon/Mobil Refining and Supply Company identified up to 3 feet of free-phase petroleum in on-site monitoring wells, and an off-site BTEX groundwater plume migrating in a southerly direction towards Tax Lot 3. In addition, strong petroleum-like odors were detected emanating from the borehole during the completion of soil boring SB-15, also located downgradient of the service station. This information indicates that on-site groundwater, as well as soil vapor, is being impacted by a petroleum contaminant plume migrating from this Exxon/Mobil Service Station. However, once Tax Lot 3 and a portion of Tax Lot 1 is excavated, the sheet piling around the excavation would remain in place and prevent any additional product from migrating on-site.

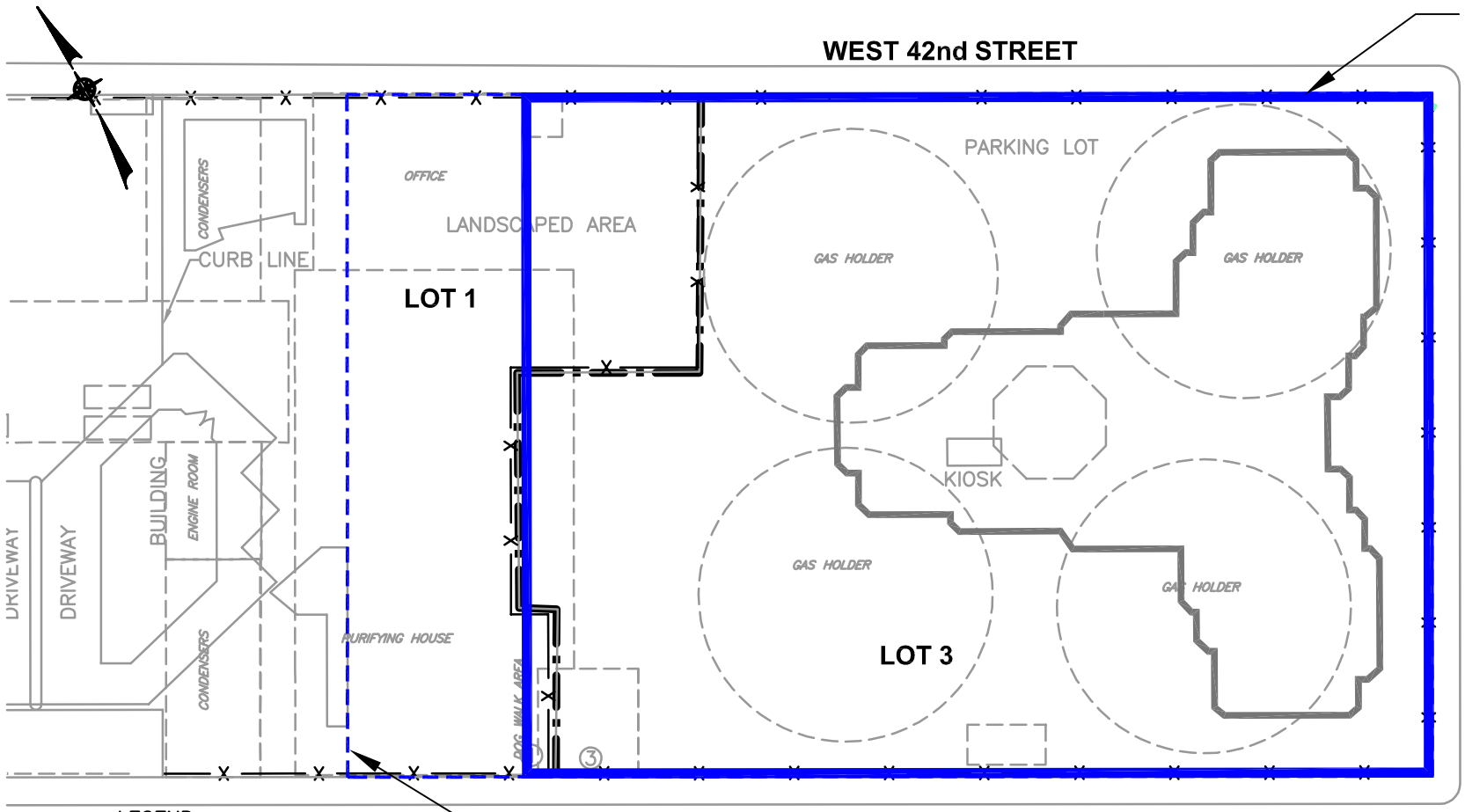
Currently, Tax Lot 3 is entirely paved and, therefore, direct exposure to MGP contaminants would not be expected under normal conditions. While groundwater contains MGP contaminants at concentrations in excess of NYSDEC Class GA Groundwater Standards, groundwater is not used for potable or non-potable uses.

1.4 Contemplated Use of the Site

The current property owner plans to construct an apartment building on Tax Lot 3. Figure 1-3 provides the approximate "footprint" of the proposed apartment building along with the limits of an associated below-grade parking garage and basement area. The proposed below-grade garage and foundation footings would require soil excavation to a depth of at least 15 feet below grade. Figure 1-3 also shows the approximate boundary of the proposed excavation for remediation. This boundary includes Tax Lot 3 and the landscaped portion of Tax Lot 1, and was developed based on the accessibility to the subsurface soil. The boundary of the proposed excavation was developed based on the minimum allowable distance for installation of sheet piling in close proximity to the residential tower on Tax Lot 1, River Place I. A minimum distance of 50 feet from the residential tower to the proposed sheet piling is necessary to protect the foundation support piles of the existing building from damage. Tax Lot 3 and the landscaped portion of Tax Lot 1 are not occupied by structures that would prevent excavation of subsurface soil. The remaining portion of Tax Lot 1 is considered not accessible for excavation due to the presence of buildings and active driveways. The future use of Tax Lot 1 would remain unchanged, with the existing residential apartment building, associated structures and driveway remaining. The landscaped area would be reconstructed after remediation is complete.

1.5 Remedial Action Objectives (RAOs)

Remedial action objectives are goals developed for the protection of human health and the environment. Definition of these objectives requires an assessment of the contaminants and media of concern, migration pathways, exposure routes and potential receptors. Typically, remediation goals are established based on standards, criteria and guidelines (SCGs) to protect



LEGEND:

- PROPOSED APARTMENT BUILDING FOOT PRINT
- PROPOSED BASEMENT/GARAGE FOOT PRINT
- TAX LOT BOUNDARY LINE

APPROXIMATE BOUNDARY OF PROPOSED EXCAVATION FOR REMEDIATION

NOTE:

FORMER MPG–RELATED STRUCTURES SHOWN WITH BROKEN LINE (– – – – – – –). EXISTING/PROPOSED STRUCTURES/FEATURES SHOWN WITH SOLID LINE (————————).

SOURCE: MAP PROVIDED BY CONSOLIDATED EDISON. APPROXIMATE LOCATIONS OF FORMER MGP STRUCTURES BASED ON INTERPRETATION OF SANBORN MAPS AND DRAWINGS PROVIDED BY CONSOLIDATED EDISON CONTAINED WITHIN THE WEST 42nd STREET MANUFACTURED GAS PLANT SITE HISTORY REPORT BY PARSONS, DATED AUGUST 2002 AND THE RIVER PLACE PHASE II, 42nd. STREET AND ELEVENTH AVENUE, GEOTECHNICAL ENGINEERING STUDY BY LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES, P.C., DATED JULY 2000. REFERENCED CELL PLAN BY COSTAS KONDYLIS AND PARTNERS, LLP, ARCHITECTS, FOUNDATION PLAN, DRAWING NO. FS-100, FS-300

SCALE: 1"=50'

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CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
WEST 42ND STREET
FORMER MANUFACTURED GAS PLANT SITE

PROPOSED TAX LOT 3 CONSTRUCTION FOOT PRINT FOR APARTMENT BUILDING

FIGURE 1-3

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human health and the environment. SCGs for the site, which were developed as part of the site characterization, include NYSDEC Technical and Administration Guidance Memorandum (TAGM) No. 4046, Determination of Soil Cleanup Objectives and Cleanup Levels (1994) and the NYSDEC Technical and Operational Guidance Series (TOGS) (1.1.1), Ambient Water Quality Standards and Guidance Values, and Groundwater Effluent Limitations (1998).

The RAOs of this Remedial Work Plan include the following:

- Reduce the contaminant mass through the removal of MGP-impacted soil and below-grade MGP structures.
- Protect on-site workers and the surrounding community from exposure to site-related contaminants during the implementation of the remedy.
- Establish general guidelines for the proper management and disposal of soil, water and other wastes that would be generated as part of the implementation of the remedy.
- Establish general guidelines associated with the operation and maintenance of the existing apartment building located at Tax Lot 1 and for the proposed apartment building to be constructed at Tax Lot 3 in order to reduce the potential for future exposure of workers and the community to site-related contaminants.

2.0 POTENTIAL REMEDIAL ALTERNATIVES EVALUATION

2.1 Introduction

The purpose of this section is to provide an engineering evaluation of potential remedial alternatives for both Tax Lot 1 and Tax Lot 3 of Block 1089 of the West 42nd Street Former MGP site. The goal of this evaluation is to demonstrate how the selected remedy would be protective of human health and the environment. For the purpose of completing this RWP, separate potential remedial alternatives were developed for Tax Lot 1 and Tax Lot 3.

Since Tax Lot 1 is currently developed with a high-rise apartment building occupying approximately 90 percent of the lot, remedial alternatives are limited. Therefore, for this lot, the following alternatives were developed for consideration:

- Alternative 1 - Excavation/Removal of Accessible Soil to Top of Clay Layer with Institutional Controls
- Alternative 2 - Excavation/Removal of Soil to NYSDEC TAGM 4046 Recommended Soil Cleanup Objectives (RSCOs)

Tax Lot 3 is currently undeveloped. Planned future use of the property includes the construction of an apartment building with a below-grade parking garage. For this tax lot, two remedial alternatives were developed for consideration:

- Alternative 1 - Excavation/Removal of Contaminated Soil with Engineering and Institutional Controls
- Alternative 2 - Excavation/Removal of Soil to NYSDEC TAGM 4046 RSCOs

The above alternatives have been evaluated against the following nine remedy selection factors in accordance with the NYSDEC BCP.

Conformance to Standards and Criteria

Conformance with applicable regulatory standards and criteria evaluates the alternatives against the federal and New York State standards and criteria identified for the site. This evaluation also considers the remedial action objectives developed for the site in Section 1.4. These standards are considered a minimum performance specification for each remedial alternative under consideration.

The following is a list of major SCGs that apply to the site:

- Technical and Administrative Guidance Memorandum (TAGM) 4046 - Determination of Soil Cleanup Objectives and Cleanup Levels
- Technical and Operational Guidance Series - New York State Ambient Water Quality Standards and Guidance Values
- 6 NYCRR Part 364 - Waste Transporter Permits
- 6 NYCRR Part 370 - Hazardous Waste Management System
- 6 NYCRR Part 376 - Land Disposal Restrictions
- 29 CFR Part 1910.120 - Hazardous Waste Operations and Emergency Response Standard
- 29 CFR Part 1926 - Safety and Health Regulations for Construction
- 6 NYCRR Part 750 through 758 - Implementation of NPDES Program in NYS (SPDES Regulations)
- TAGM 4031 - Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites
- TAGM 4061 - Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from former Manufactured Gas Plants (MGPs)
- New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan
- NYSDEC Air Guide 1 - Guidelines for the Control of Toxic Ambient Air Contaminants

- NYSDEC Draft Brownfield Cleanup Program Guide - May 2004
- New York City Department of Environmental Protection Limitations for Effluent to Sanitary or Combined Sewers

Overall Protectiveness of Public Health and the Environment

Protection of health and the environment is evaluated on the basis of estimated reductions in the potential for both human and environmental exposure to contaminants for each remedial alternative. The evaluation focuses on whether a specific alternative achieves adequate protection under the conditions of the site's future use and how site risks are eliminated, reduced or controlled through treatment, engineering or institutional controls. An integral part of this evaluation is an assessment of long-term residual risks to be expected after remediation has been completed. Evaluation of the human health and environmental protection factor is generally based, in part, on the findings of the exposure assessment.

Short-term Effectiveness and Impacts

Evaluation of short-term effectiveness and impacts of each alternative examines health and environmental risks likely to exist during the implementation of a particular remedial alternative. Principal factors for consideration include the expediency with which a particular alternative can be completed, potential impacts on the nearby community, on-site workers and environment, and mitigation measures for short-term risks required by a given alternative during the necessary implementation period.

Long-term Effectiveness and Permanence

Examination of long-term impacts and effectiveness for each alternative requires an estimation of the degree of permanence afforded by each alternative. To this end, the anticipated service life of each alternative must be estimated, together with the estimated quantity and characterization of residual contamination remaining on-site at the end of this service life. The magnitude of residual risks must also be considered in terms of the amount and concentrations of

contaminants remaining following implementation of a remedial action, considering the persistence, toxicity and mobility of these contaminants, and their propensity to bioaccumulate. This evaluation also includes the adequacy and reliability of controls required for the alternative, if required.

Reduction in Toxicity, Mobility and/or Volume of Contamination

Reduction in toxicity, mobility and/or volume of contamination is evaluated on the basis of the estimated quantity of contamination treated or destroyed, together with the estimated quantity of waste materials produced by the treatment process itself. Furthermore, this evaluation considers whether a particular alternative would achieve the irreversible destruction of contaminants, treatment of the contaminants or merely removal of contaminants for disposal elsewhere. Reduction of the mobility of the contaminants at the site is also considered in this evaluation.

Implementability

Evaluation of implementability examines the difficulty associated with the installation and/or operation of each alternative on-site and the proven or perceived reliability with which an alternative can achieve performance goals. The evaluation examines the potential need for future remedial action, the level of oversight required by regulatory agencies, the availability of certain technology resources required by each alternative and community acceptance of the alternative.

Cost Effectiveness

Cost evaluations presented in this document estimate the capital, and operation, monitoring and maintenance (OM&M) costs associated with each remedial alternative. From these estimates, a total present worth for each option is determined.

Community Acceptance

Community acceptance evaluates the technical and administrative issues and concerns that the community may have regarding each of the alternatives.

Land Use

Evaluation of land use examines whether the alternative is suitable for the site, based on current and future use of the site and its surrounding factors, such as:

- zoning;
- any applicable comprehensive community master plans or land use plans;
- surrounding property uses;
- citizen participation;
- environmental justice concerns;
- land use designations;
- population growth patterns;
- accessibility to existing infrastructure;
- proximity to cultural resources;
- proximity to natural resources;
- off-site groundwater impacts;
- proximity to floodplains;
- geography and geology of the site; and
- current institutional controls.

The following sections provide a more detailed description of the remedial alternatives.

2.2 Description of Remedial Alternatives

Excavation and off-site disposal alternatives have been evaluated for Tax Lot 1 and Tax Lot 3. The following discussion demonstrates that the selected alternatives meet the remedy selection factors listed above.

Regarding the alternatives selected for evaluation, it should be noted that various in situ treatment technologies requiring longer timeframes and offering less certain degrees of effectiveness were not considered applicable due to plans to construct an apartment building on the site in the near future. Although none of the alternatives include separate remedial actions for groundwater impacts, groundwater extraction and treatment would be performed to dewater soil as necessary during excavation. Post-remediation groundwater monitoring is included in alternatives where contaminated soil would remain.

2.2.1 Tax Lot 1 Alternative 1 – Excavation/Removal of Accessible Soil to Top of Clay Layer with Institutional Controls

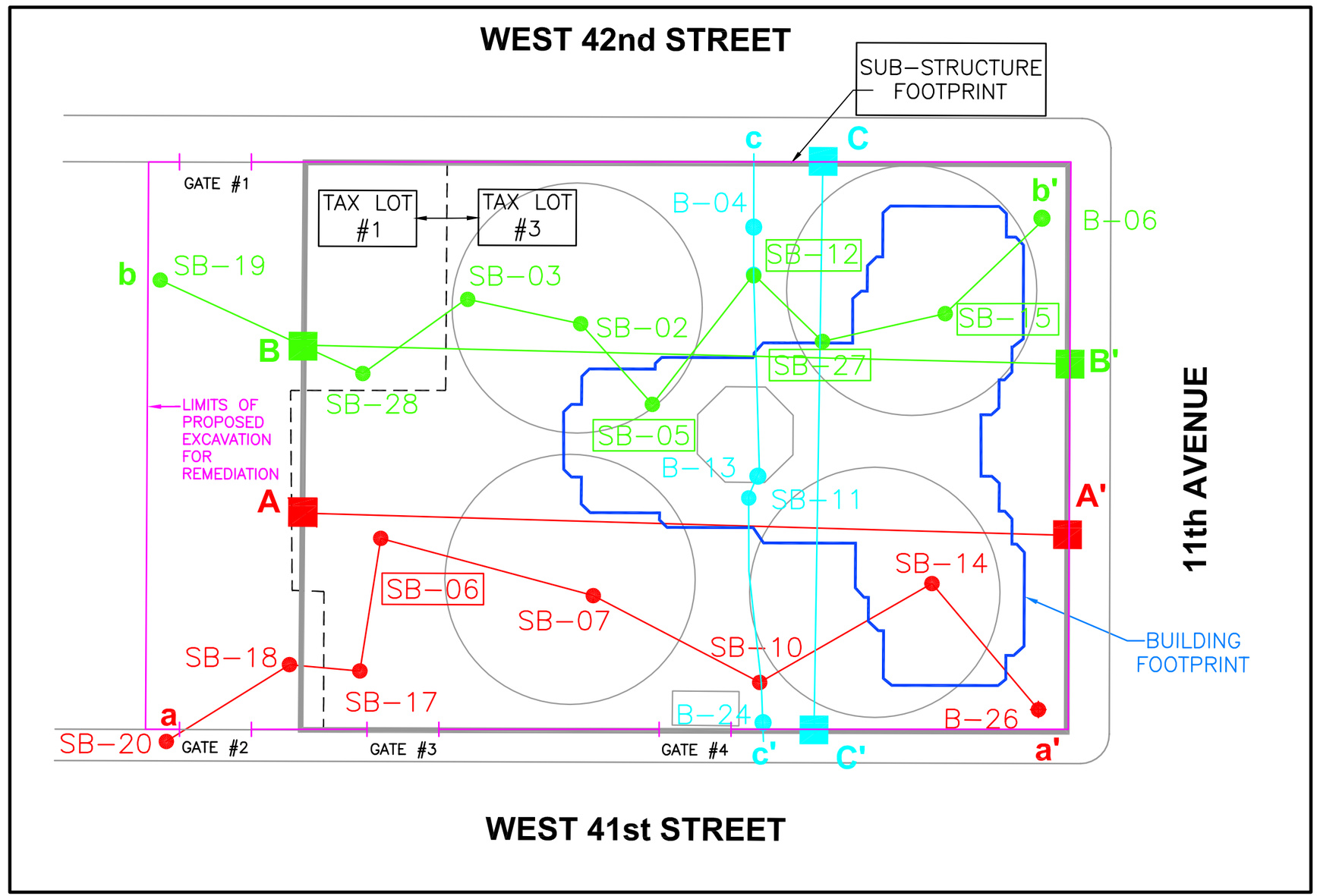
This alternative includes the excavation of soil above the clay layer from the accessible portion of Tax Lot 1. Access to contaminated soil on this tax lot is limited to the landscaped area, as shown on Figure 1-3. Based on geologic data obtained during the Site Characterization Study (SCS), it is anticipated that the depth of the excavation would range between approximately 15 and 25 feet below ground surface. The estimated volume of contaminated soil requiring off-site disposal is approximately 12,000 cubic yards (in-place volume). The estimated excavation depths for this alternative are shown on Figures 2-1 through 2-4.

Clean fill from an off-site approved source would be used for backfilling the excavation. Fill would be approved by NYSDEC prior to placement.

Sheet piling would be installed to stabilize the excavation as well as reduce the volume of groundwater entering the excavation. Groundwater extracted during the dewatering process would be treated to meet New York City Department of Environmental Protection limits prior to discharge to the sanitary sewer system. Sheeting would remain in-place and would be considered

LEGEND:

- TAX LOT BOUNDARY
- PROPOSED BASEMENT/GARAGE FOOTPRINT
- PROPOSED BUILDING FOOTPRINT
- FORMER MGP–RELATED STRUCTURE



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CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
WEST 42ND STREET FORMER MANUFACTURED GAS PLANT SITE

KEYMAP SHOWING CROSS SECTION LINES

FIGURE 2-1

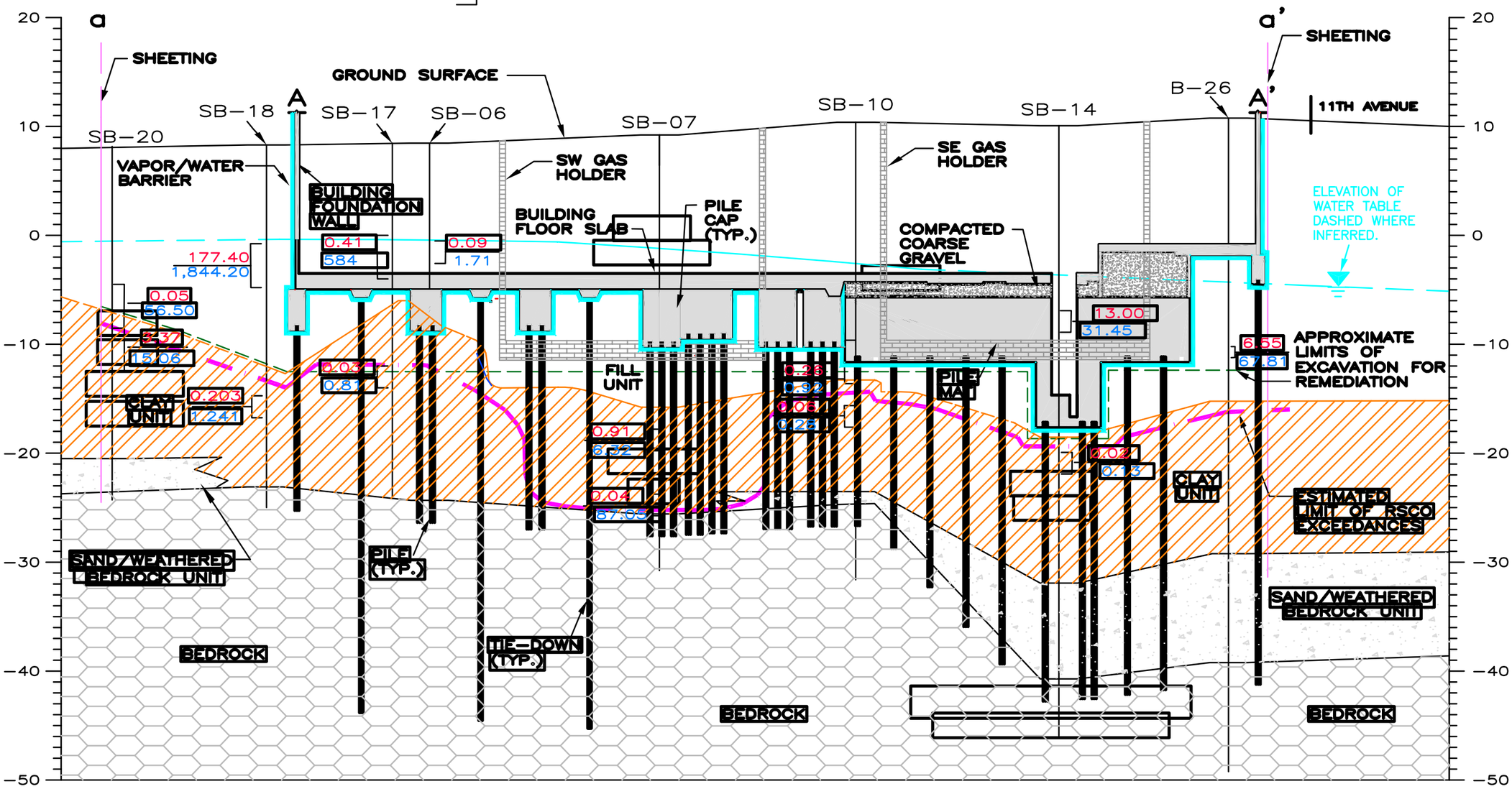
F:\2085\presentation\cross sections EW.dwg, 11/29/04 02:32:00 PM, d b, Dvirka and Bartilucci

LEGEND

0.41 TOTAL VOCs (mg/kg)
583.60 TOTAL SVOCs (mg/kg)
SOIL CONCENTRATIONS

WEST

EAST



NOTE:

1) STRUCTURAL ELEVATIONS (BUILDING FLOOR SLAB) SHOWN WITHIN THE CROSS–SECTION ARE AS PER FOUNDATION PLAN, DRAWING FS–100 TO FS–300, PROVIDED BY COSTAS KONDYLIS AND PARTNERS, LLP, ARCHITECTS.
2) ELEVATOR PIT PROJECTED. REPRESENTS DEEPEST CONSTRUCTION ELEVATION.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
WEST 42nd STREET FORMER MANUFACTURED GAS PLANT SITE

EAST-WEST CROSS SECTION A-A'

FIGURE 2-2

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

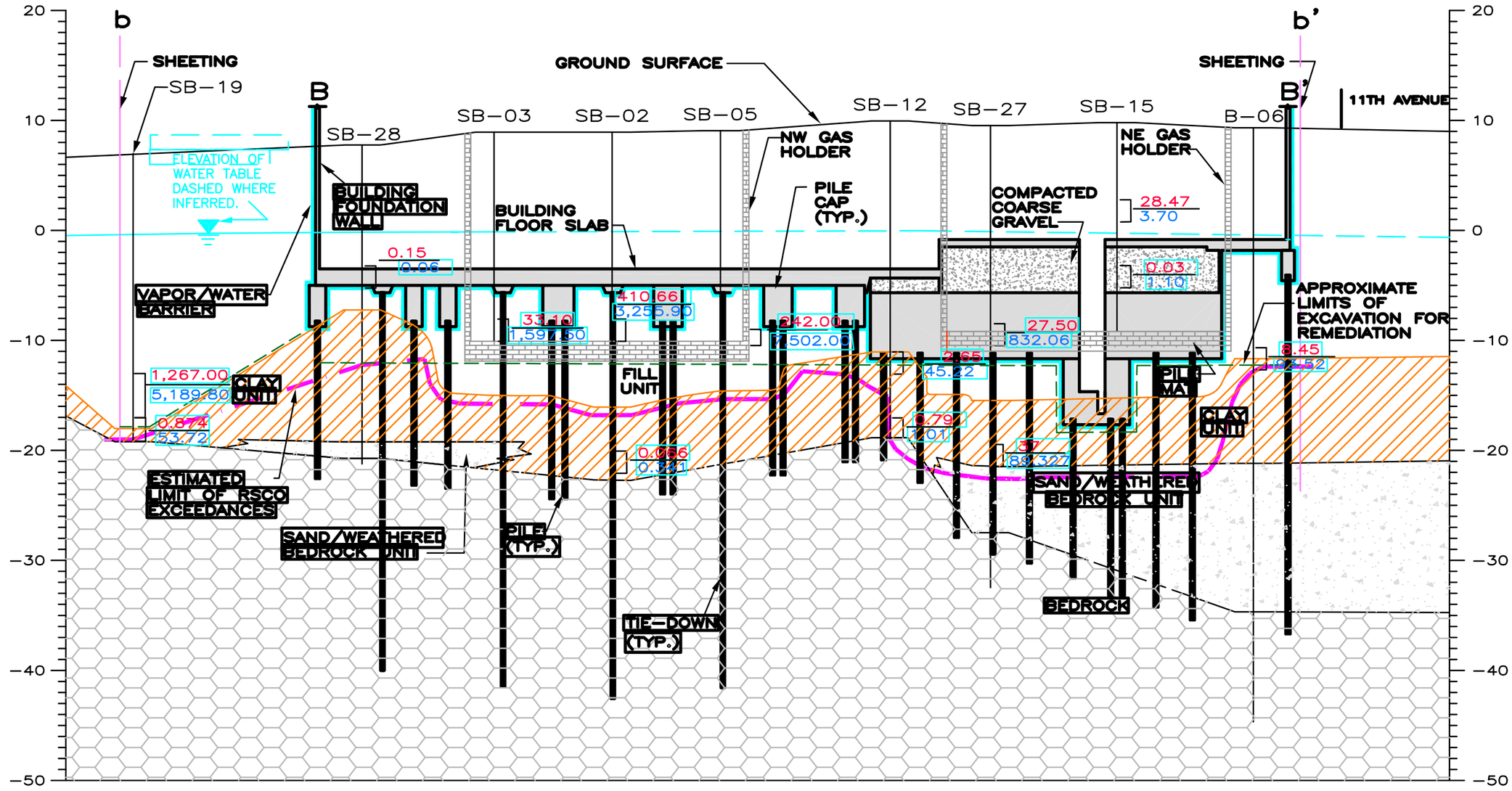
F:\2085\presentation\cross sections EW.dwg, 11/29/04 02:36:16 PM, d b, Dvirka and Bartilucci

LEGEND

0.03 TOTAL VOCs (mg/kg)
1.10 TOTAL SVOCs (mg/kg)
SOIL CONCENTRATIONS

WEST

EAST



10'
0
30'

NOTE:

1) STRUCTURAL ELEVATIONS (BUILDING FLOOR SLAB) SHOWN WITHIN THE CROSS–SECTION ARE AS PER FOUNDATION PLAN, DRAWING FS–100 TO FS–300, PROVIDED BY COSTAS KONDYLIS AND PARTNERS, LLP, ARCHITECTS.
2) ELEVATOR PIT PROJECTED. REPRESENTS DEEPEST CONSTRUCTION ELEVATION.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
WEST 42nd STREET FORMER MANUFACTURED GAS PLANT SITE

EAST-WEST CROSS SECTION B-B'

FIGURE 2-3

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

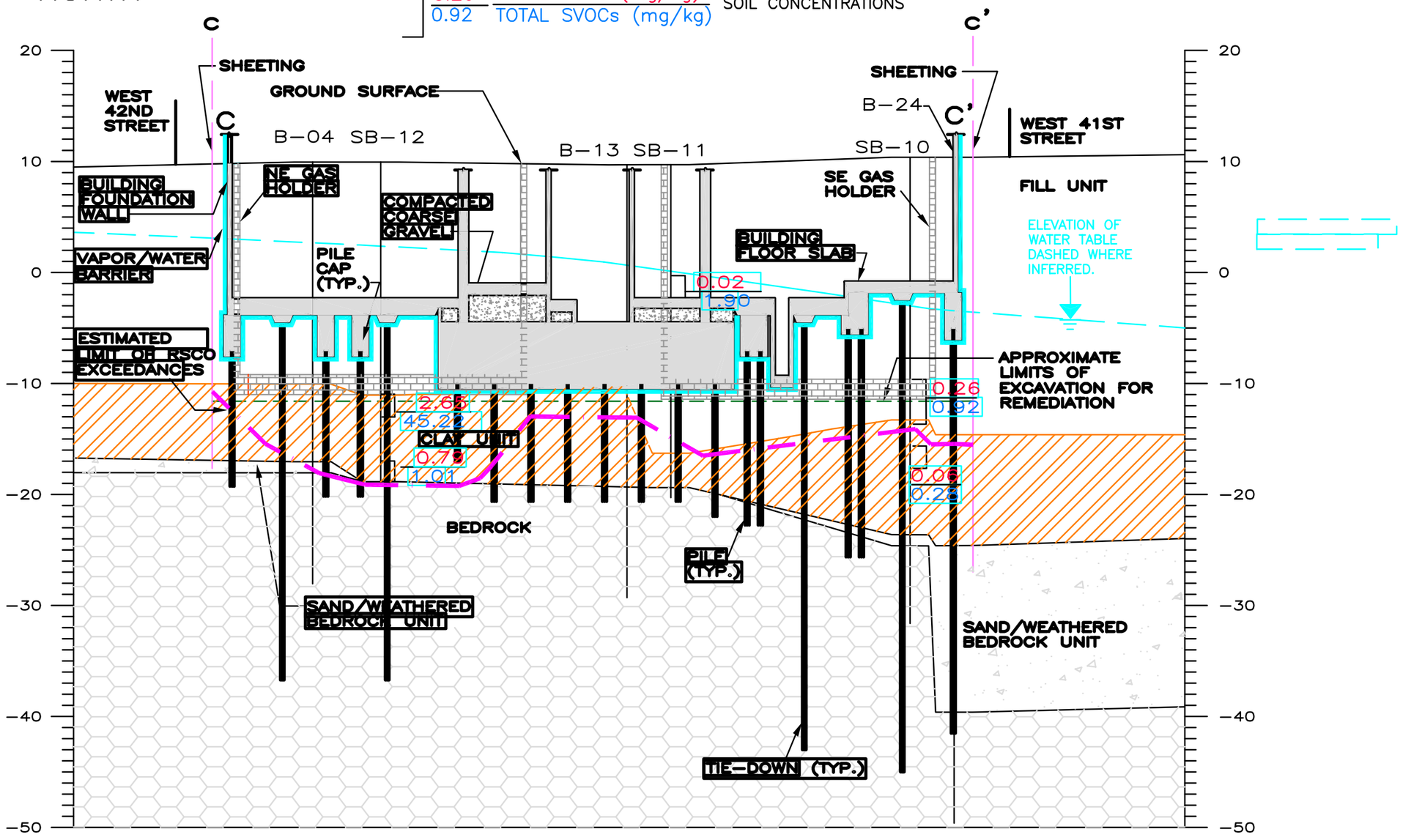
F:\2085\presentation\cross sections EW.dwg, 11/29/04 02:37:08 PM, d b, Dvirka and Bartilucci

LEGEND

0.26 TOTAL VOCs (mg/kg)
0.92 TOTAL SVOCs (mg/kg)
SOIL CONCENTRATIONS

NORTH

SOUTH



10' 0 30'

NOTE:

1) STRUCTURAL ELEVATIONS (BUILDING FLOOR SLAB) SHOWN WITHIN THE CROSS-SECTION ARE AS PER FOUNDATION PLAN, DRAWING FS-100 TO FS-300, PROVIDED BY COSTAS KONDYLIS AND PARTNERS, LLP, ARCHITECTS.

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
WEST 42nd STREET FORMER MANUFACTURED GAS PLANT SITE

NORTH-SOUTH CROSS SECTION C-C'

FIGURE 2-4

F:\2085\presentation\cross sections EW.dwg, 11/29/04 02:38:06 PM, d b, Dvirka and Bartilucci

permanent. Sheeting installed on the western edge of the landscaped area on Tax Lot 1 would be cut off approximately 6 feet below ground surface and would remain in place with the intention of minimizing the potential for migration of contamination from the inaccessible portions of Tax Lot 1 to the remediated portion.

The potential for generation of vapors, odors and dust would exist during implementation of this alternative, and as a result, implementation of appropriate controls would be necessary. Air monitoring would be conducted during remediation activities in accordance with NYSDEC and NYSDOH requirements to protect the health and safety of on-site workers and the surrounding community. Odor/vapor and dust controls would be implemented in conformance with the construction contractor's Health and Safety Plan and Community Air Monitoring Plan. Standard emission control techniques include:

- Installing gravel pads at vehicle egress points;
- Application of wetting agents to soil;
- Tarping/covering containers;
- Restricting vehicle speeds to 10 miles per hour;
- Application of foam vapor suppressants to soil;
- Using spray misters; and
- Covering of stockpiled soil and inactive excavations.

Documentation soil samples would be collected at pre-established depths and locations from the bottom of the excavation. The purpose of the sampling is to document conditions existing after the remedial excavation is complete.

Since contaminated soil would not be removed from the inaccessible portion of Tax Lot 1, institutional controls would be required to restrict use of the property and disturbances of the subsurface soil. These institutional controls include establishment of an environmental easement, which would:

1. ensure appropriate future use/control of the site that would protect human health and the environment;

2. include a restriction prohibiting use of groundwater to ensure there would not be any future exposures to groundwater;

3. include required notifications prior to any ground-intrusive activities that may encounter contaminated materials (notification of NYSDEC and on-site workers would be required prior to excavating soil).

4. include a soil management plan identifying requirements in the event of excavation, which would be included as part of the Operations, Maintenance and Monitoring (OM&M) Plan;

5. include a health and safety plan and community air monitoring plan for use during future ground-intrusive activities, which would be described in the OM&M Plan;

6. include provision for continued periodic soil vapor intrusion monitoring on River Place I property which would be described in the OM&M Plan;

7. include provision for groundwater monitoring, as discussed below, which would be described in the OM&M Plan;

8. include an annual inspection program to ensure appropriate use of the site and minimize the potential for exposures, which would be included as part of the OM&M Plan; and

9. include an annual certification program requiring the owner to certify that the institutional and/or engineering controls are in place, have not been altered and are still effective, which would be described in the OM&M Plan.

Although groundwater quality is expected to improve through the removal of contaminated soil and dewatering, contaminated soil would remain on the developed portion of Tax Lot 1 and would continue to impact groundwater quality. Therefore, groundwater monitoring would also be included as part of this alternative. Monitoring would consist of periodic groundwater sampling to evaluate changes in groundwater contaminant concentrations and to ascertain the level of any natural attenuation which may occur. Groundwater monitoring would involve quarterly sampling of one upgradient well and two downgradient wells for 2 years. Subsequent to the first 2 years of monitoring, the groundwater data will be evaluated to determine future groundwater monitoring requirements. The first sampling round would be performed 6 months after remediation is completed. New groundwater monitoring wells would be installed, since there are no existing wells on Tax Lot 1. Groundwater samples would be

analyzed for VOCs, SVOCs, metals and cyanide. Further details such as the locations of the monitoring wells to be used for post remediation monitoring would be provided in the OM&M Plan. The OM&M Plan would be prepared and submitted to the NYSDEC at a later date and would be included in the environmental easement. The OM&M Plan would be maintained in the management office of the building.

2.2.2 Tax Lot 1 Alternative 2 – Excavation/Removal of Soil to NYSDEC TAGM 4046 RSCOs

This alternative includes excavation of all soil that exceeds NYSDEC RSCOs for VOCs and SVOCs within Tax Lot 1. This alternative would require demolition of the existing high-rise apartment building in order to remove all contaminated soil from Tax Lot 1. Based on a review of the available data from the SCS, the estimated volume of contaminated soil requiring off-site disposal for this alternative is approximately 101,000 cubic yards (in-place volume). The estimated volume is based on excavation of the entire lot to an average depth of approximately 25 feet below ground surface. An average excavation depth of 25 feet was selected based on the review of available subsurface soil data as well as information concerning the depth of bedrock. Based on soil borings SB-23 and SB-24 completed immediately west of Tax Lot 1, MGP impacts were observed as deep as 35 feet below grade. However, the depth of bedrock within the eastern portion of Tax Lot 1 was found to be less than 20 feet below grade. Therefore, an average excavation depth of 25 feet was selected for Alternative 2.

Clean fill from an off-site approved source would be used for backfilling the excavation. Fill would be approved by NYSDEC prior to placement.

Sheet piling would be installed around the entire tax lot, and dewatering would be performed. Vapor/odor emissions and dust controls would be employed, as necessary, based on the air monitoring program to protect the health and safety of workers and the surrounding community during remediation activities.

Since all soil exceeding RSCOs for VOCs and SVOCs would be removed from Tax Lot 1, engineering and institutional controls would not be necessary under Alternative 2. Groundwater monitoring would also not be included in this alternative.

2.2.3 Tax Lot 3 Alternative 1 - Excavation/Removal of Contaminated Soil with Engineering and Institutional Controls

This alternative includes the excavation of soil on Tax Lot 3 which contains the majority of the contamination. During soil excavation, the foundations of the existing gas holders and visibly heavily contaminated soil or nonaqueous phase liquid (NAPL), if present, at the predetermined bottom of the excavation, would also be removed. The estimated volume of contaminated soil requiring off-site disposal is approximately 41,000 cubic yards (in-place volume). The excavation depths for this alternative, which correspond with the bottoms of the former gas holders or development grade, whichever is deeper, are shown on Figures 2-1 through 2-4.

As discussed above, sheet piling would be installed to stabilize the excavation as well as to reduce the volume of groundwater entering the excavation. Extracted groundwater from the dewatering system would be treated to meet New York City Department of Environmental Protection limits for effluent to sewers.

At a minimum, a final 6-inch thick layer of RCA or clean fill would be placed to provide a barrier between the excavation bottom and construction workers who would be on-site after the remediation phase is complete. Fill would be approved by NYSDEC prior to placement. Additionally, as discussed in the description of the alternative for Tax Lot 1, vapor/odor emissions and dust controls would be employed and air monitoring would be conducted in accordance with NYSDEC and NYSDOH requirements to protect the health and safety of workers and the surrounding community during remediation activities.

As shown on Figures 2-2 through 2-4, a vapor/water barrier would be installed in accordance with manufacturer's recommendations to ensure the integrity of the barrier during building construction. The barrier would serve as an engineering control, separating the building

foundation from any contaminated soil and groundwater which remains after excavation is complete.

As part of building construction, the below grade parking garage would include a fresh air and mechanical exhaust ventilation system to meet the requirements of the NYC Building Code. The ventilation system would include four air changes per hour and would be designed to be completely separate from the apartment building so that there would be no possibility of impacting the apartments.

Institutional controls, as described for Tax Lot 1, would also be required for this alternative, since contaminated soil would remain on-site. Documentation soil sampling would be performed at pre-established excavation depths and locations to document conditions existing after the remedial excavation is completed. Additionally, as discussed for Tax Lot 1, groundwater monitoring would be performed for this alternative and would include sampling of one upgradient and two downgradient monitoring wells for VOCs, SVOCs, metals and cyanide quarterly for 2 years. Subsequent to the first 2 years of monitoring, the groundwater data will be evaluated to determine future groundwater monitoring requirements.. Sampling would commence 6 months after completion of remediation. New groundwater monitoring wells would be installed since existing wells would be destroyed during remedial activities. An OM&M plan that provides more detail regarding post-remediation monitoring would be prepared and submitted to NYSDEC for approval and would be included as part of the environmental easement for the site. The OM&M Plan would be maintained in the management office of the building.

2.2.4 Tax Lot 3 Alternative 2 - Excavation/Removal of Soil to NYSDEC TAGM 4046 RSCOs

This alternative would include the excavation of all soil that exceeds NYSDEC RSCOs for VOCs and SVOCs within Tax Lot 3. The estimated volume of contaminated soil requiring off-site disposal for this alternative is approximately 52,000 cubic yards (in-place volume). The horizontal limits of the area to be excavated are the same as Alternative 1; however, the depth of

the excavation, estimated based on existing soil characterization data, would increase as shown on Figures 2-2 through 2-4.

Similar to Tax Lot 3 Alternative 1, sheeting would be installed and dewatering, vapor and odor controls would be implemented. Air monitoring would be conducted to protect the health and safety of on-site workers, and the surrounding community.

Since excavation would extend below development grade, the excavation would be backfilled to the required depth for building construction with RCA or clean fill from an off-site approved source. Fill would be approved by the NYSDEC prior to placement.

Since all soil exceeding RSCOs for VOCs and SVOCs would be removed from Tax Lot 3, institutional controls would not be necessary under Alternative 2. Groundwater monitoring would also not be included in this alternative. As discussed above, a vapor/water barrier would be installed as part of construction and would serve as an engineering control.

2.3 Comparative Evaluation of Remedial Alternatives

Provided below is a comparative analysis of the remedial alternatives with respect to each of the evaluation criteria presented in Section 2.1. Evaluation of the alternatives developed for Tax Lot 1 is presented first, followed by the evaluation of the alternatives for Tax Lot 3. Based on this detailed evaluation, a remedial plan for the entire site (Tax Lot 1 and Tax Lot 3 of Block 1089) is selected.

2.3.1 Tax Lot 1 Comparative Evaluation

2.3.1.1 - Conformance to Standards and Criteria

Presented below is an evaluation of conformance of the proposed alternatives with the standards and criteria developed for the site.

Alternative 1 - Excavation/Removal of Accessible Soil to Top of Clay Layer with Institutional Controls, would meet, to the extent practicable, the Remedial Action Objectives (RAOs) developed for the site, identified in Section 1.4 of this RWP, as well as the SCGs listed in Section 2.1. All accessible soil above the clay layer would be removed from the accessible portion of Tax Lot 1 and groundwater would be treated during dewatering for excavation purposes. This would reduce the contaminant mass. Remaining on-site contaminated soil and groundwater that exceeds the SCGs, in the inaccessible part of the tax lot, would be isolated from contact due to the presence of existing structures and pavement.

During implementation of the alternative, on-site workers and the surrounding community would be protected from exposure to site-related contaminants through the implementation of health and safety measures that comply with the applicable SCGs, including those listed above. Disposal of contaminated material including soil, water and other wastes generated as part of implementation of the remedy would be completed in accordance with the RWP and in conformance with the applicable SCGs. Once implemented, the alternative would continue to conform with the RAOs and SCGs through the implementation of engineering and institutional controls that would protect potential future workers and the community.

Similar to the discussion provided for Alternative 1, Alternative 2 - Excavation/Removal of Soil to NYSDEC RSCOs, would meet the RAOs and SCGs for the site. All contaminated soil would be removed from Tax Lot 1, and groundwater would be extracted and treated during dewatering, as needed to perform excavation. Health and safety measures would be implemented during remedial activities to protect on-site workers and the surrounding community from exposure to site-related contaminants.

In summary, although both alternatives proposed for Tax Lot 1 conform to the standards and criteria established for the site, Alternative 2 would remove more contaminated soil from the site and, therefore, would be more compliant with RAOs and SCGs established for the site.

2.3.1.2 - Overall Protectiveness of Public Health and the Environment

Based on the completed SCS and the current and planned future use of the site, the only potential for future exposure to MGP contamination after implementation of Alternative 1 would be by utility/construction workers who could contact contaminated soil during excavation for installation or repair of subsurface utilities. Currently, there is no other exposure pathway for this tax lot which is complete. Implementation of this alternative is expected to reduce the potential for exposure of utility/construction workers to contaminated soil through the removal of contaminated soil from the accessible portion of Tax Lot 1. Extraction and treatment of groundwater during excavation would also reduce the potential for future exposure to contaminated groundwater. For the remaining portion of Tax Lot 1 where soil is not accessible and would not be removed, implementation of institutional controls would protect future workers by requiring monitoring and use of appropriate health and safety measures during any intrusive work.

Alternative 2 - Excavation/Removal of Soil to NYSDEC RSCOs, would be protective of public health and the environment through the removal of approximately 101,000 cubic yards of contaminated soil from Tax Lot 1. Groundwater would be extracted and treated during implementation of this alternative as part of a dewatering process. Through the removal of all contaminated soil from the site and treatment of contaminated groundwater, future exposures to site-related contaminants would be eliminated.

Both alternatives would provide overall protection of public health and the environment. Although contaminated soil exceeding NYSDEC RSCOs would remain under Alternative 1, the existence of a high-rise apartment building and associated structures and the implementation of institutional controls would preclude exposure to remaining contamination. Therefore, both alternatives would be equally protective of human health and the environment.

2.3.1.3 - Short-term Effectiveness and Impacts

It is estimated that excavation and removal of accessible contaminated soil above the clay layer from Tax Lot 1, under Alternative 1, could be completed in approximately 3 months. During implementation of the alternative, impacts to the community would include increased truck traffic in the vicinity of the site, as well as construction-related noise. Off-site migration of contaminated soil from soil erosion or construction and hauling vehicles could also be a short-term impact to the community, as well as generation of odors, vapors and/or dust during excavation activities. Potential short-term impacts to on-site workers include exposure to contaminated material, vapors and dust, as well as construction-related risks associated with working with heavy equipment and excavation at significant depths.

Alternative 1 includes measures that would be effective at reducing short-term exposure of the community and on-site workers to each of the above potential impacts. This alternative would include the implementation of a community air monitoring program and the use of engineering controls such as vapor/dust suppressants to minimize the potential for impacts from odors, vapors and dust. Fencing and security would restrict access to the site, further minimizing the potential for impacts to the community. Short-term exposure of remedial construction workers to odors, vapors and dust would also be minimized through the proper implementation of a construction health and safety plan. Implementation of appropriate storm water management, soil erosion and sediment control techniques during construction would minimize the potential for migration of contaminated soil off-site. In addition, vehicles used to transport contaminated soil would be lined and tarped before departing the site and equipment contacting contaminated soil would be properly decontaminated prior to moving off-site, also minimizing the potential for off-site migration of contaminated soil and impacts to the community. Once contaminated soil has been removed, a 6-inch layer of RCA or soil would be placed at the bottom of the excavation to minimize impacts to workers involved in construction of the building.

Demolition of the existing high-rise apartment building and excavation and off-site disposal of approximately 101,000 cubic yards would have significant short-term impacts. Excluding the short-term impacts associated with demolition of the high-rise apartment building,

Alternative 2 short-term impacts during remediation include increased truck traffic, construction-related noise, as well as the potential for impacts associated with generation of odors, vapors and/or dust. These impacts would be more significant with respect to Alternative 2, which is expected to take approximately 10 months to implement and is significantly longer than the 3 months estimated to complete Alternative 1.

In summary, both alternatives would be effective in the short-term, through the removal of contaminated soil, and through the implementation of institutional controls under Alternative 1. Implementation of engineering controls and appropriate health and safety measures would minimize the potential for short-term impacts. However, the potential for short-term impacts to the community and on-site workers during construction activities associated with Alternative 2 is much greater than with Alternative 1, due to the extensive remedial timeframe and volume of soil requiring removal.

2.3.1.4 - Long-term Effectiveness and Permanence

Excavation and removal of accessible contaminated soil from Tax Lot 1 and implementation of institutional controls would be a long-term permanent and effective remedial alternative. Removal of approximately 12,000 cubic yards of soil from Tax Lot 1 provides a permanent alternative for the site since the potential for exposure to this soil and potential future environmental impacts would be minimized. Although contaminated soil would remain on Tax Lot 1, it would be isolated from contact due to the presence of existing buildings and pavement; therefore, the magnitude of remaining risk would be low. Establishment of institutional controls would also minimize the potential for future impacts to human health and the environment by controlling the potential for exposure to remaining contaminated media, making this an effective alternative.

Alternative 2 - Excavation/Removal of Soil to NYSDEC RSCOs, would be an effective and permanent alternative for the site since it would eliminate the potential for exposure to contaminated soil on Tax Lot 1. Additionally, reliance on long-term controls would not be required after implementation of Alternative 2.

However, since the potential for exposure to remaining contaminated soil after implementation of Alternative 1 is minimal due to the existing buildings, pavement and institutional controls, both alternatives would be equally permanent. Similarly, the effectiveness of both alternatives at reducing long-term risk to human health and the environment would be comparable.

2.3.1.5 - Reduction in Toxicity, Mobility and/or Volume of Contamination

Removal of approximately 12,000 cubic yards of contaminated material from Tax Lot 1, along with groundwater extraction and treatment during the dewatering process, would reduce the toxicity, mobility and volume of contamination on this tax lot. Treatment by thermal desorption of a portion of the excavated soil at an off-site facility would result in a reduction in the toxicity of contaminated soil.

Similar to the discussion above, implementation of Alternative 2 would reduce the toxicity, mobility and volume of contamination on Tax Lot 1 through the excavation and removal of approximately 101,000 cubic yards of contaminated soil and the extraction and treatment of groundwater during excavation of the soil. Treatment of a portion of the excavated soil by thermal desorption at an off-site facility would further reduce the toxicity of the soil.

Due to the significantly larger volume of soil that would be excavated and removed from the site under Alternative 2, as well as the larger volumes of groundwater that would be extracted and treated as part of excavation activities, Alternative 2 would be more effective than Alternative 1 at reducing the toxicity, mobility and volume of contaminated soil and groundwater for Tax Lot 1.

2.3.1.6 - Implementability

Excavation and off-site disposal of accessible contaminated soil on Tax Lot 1 can be completed with standard equipment. All necessary labor, equipment and supplies are readily

available. It is not anticipated to be difficult to obtain the necessary permits associated with implementation of this alternative. Execution of the institutional controls for this alternative would require coordination among River Place I, LLC, Con Edison and NYSDEC. This coordination is also not expected to impact implementation of this alternative. Therefore, this alternative is readily implementable.

Although all necessary labor, equipment and supplies are readily available for implementation of Alternative 2, implementation would be extremely difficult since it involves demolition of a high-rise apartment building and displacement of the residents of the building as well as the commercial businesses located on the property.

Therefore, implementation of Alternative 2 would be more difficult than implementation of Alternative 1.

2.3.1.7 Cost Effectiveness

Estimated capital costs, and the estimated present worth of long-term (30-year) operation, maintenance and monitoring (OM&M) costs associated with each of the alternatives for Tax Lot 1 are presented in Table 2-1. A detailed breakdown of each estimate is provided in Appendix A.

The following assumptions were utilized in the preparation of the cost estimates:

- Costs presented for Alternative 2 do not include costs for building demolition.
- Sheet piling would be installed around the perimeter of the entire area to be excavated and would not be removed.
- All costs (e.g., excavation, backfill, etc.) were estimated based on recent bids for remediation projects and Means Site Work Cost Data, experience in construction, with adjustment for hazardous waste site remediation, and communications with remedial contractors, material suppliers, waste transporters and disposal facilities.
- The estimated present worth of operation, maintenance and monitoring is based on 30 years at 5 percent.

Table 2-1

WEST 42ND STREET
FORMER MANUFACTURED GAS PLANT SITE
REMEDIAL WORK PLAN
ALTERNATIVES COST SUMMARY
TAX LOT 1

Alternative	Estimated Capital Cost[1]	Estimated Present Worth[2] of Annual Operation Maintenance and Monitoring	Total Estimated Present Worth
Tax Lot 1 - 1	$5,665,000	$160,000	$5,825,000
Tax Lot 1 - 2[3]	$40,866,000	0	$40,866,000

[1] Including estimated engineering and administration fees and contingency.
[2] 30 years at 5% interest.
[3] Does not include cost of building demolition.

- A 25 percent contingency has been included.

A more detailed list of explanations and assumptions which apply to the cost estimates is presented in Appendix A.

As shown in Table 2-1, the cost of Alternative 2 is significantly higher than Alternative 1. This is due to the larger volume of soil requiring off-site disposal.

2.3.1.8 - Community Acceptance

Since implementation of Alternative 2 would require demolition of the existing high-rise apartment building, it is likely that this alternative would not be acceptable to the community. However, Alternative 1 would have minimal impacts to the community during implementation and therefore would likely be acceptable. Public comments that are provided during the 30-day public comment period would be evaluated. Based on comments received from the public, the RWP may be modified.

2.3.2 Tax Lot 3 Comparative Evaluation

2.3.2.1 - Conformance to Standards and Criteria

Excavation/removal of contaminated soil with engineering and institutional controls (Alternative 1) would meet the RAOs, as well as the SCGs listed above. Removal of approximately 41,000 cubic yards of contaminated soil which exceeds RSCOs and treatment of groundwater during the dewatering process would reduce the contaminant mass on-site. After remedial construction, any remaining contaminated soil and groundwater would not be accessible due to the proposed construction of a building and parking structure on the property.

On-site workers and the community would be protected during implementation of Alternative 1 through the use of remedial measures such as foam type vapor suppressants during excavation of contaminated soil, in conformance with the applicable SCGs for the site. Wastes

generated as part of implementation of this alternative would be managed in accordance with this RWP and applicable SCGs. Since contaminated material would remain within Tax Lot 3 after this alternative is implemented, institutional controls would provide for future protection of workers and the community from site-related contaminants, consistent with SCGs. The building foundation vapor/water barrier would serve as an engineering control to also provide for future protection of on-site residents.

Similar to the above discussion, Alternative 2 - Excavation/Removal of Soil to NYSDEC RSCOs, would also be compliant with the SCGs and RAOs established for the site. All soil exceeding the RSCOs for VOCs and SVOCs would be removed from Tax Lot 3 and contaminated groundwater would be extracted during dewatering and treated prior to discharge to the sewer in accordance with applicable SCGs. Appropriate vapor, odor and dust suppressant methods would be utilized during the excavation of contaminated soil. Therefore, this alternative would reduce contaminant mass, would be protective of on-site workers and the surrounding community and would comply with the applicable SCGs related to waste management and disposal. Since all soil exceeding RSCOs would be removed from Tax Lot 3 under this alternative, no institutional or engineering controls would be placed on the property, and there would be no potential for future impacts to workers or the community from exposure to contaminated soil.

Since more soil exceeding SCGs would be removed from Tax Lot 3 under Alternative 2, Alternative 2 would be more compliant with RAOs and SCGs established for the site than Alternative 1.

2.3.2.2 - Overall Protectiveness of Public Health and the Environment

Similar to Tax Lot 1, exposure to contaminated soil or groundwater is not anticipated, except by utility/construction workers involved in the excavation of subsurface soil. Implementation of Alternative 1 - Excavation/Removal of Contaminated Soil with Engineering and Institutional Controls, would reduce the potential for human health and environmental exposures to contaminants through the removal of approximately 41,000 cubic yards of

contaminated soil, and through the placement of institutional and engineering controls on the site. Groundwater extraction and treatment during dewatering activities would also reduce the potential for future exposures to on-site groundwater contamination. Although some contaminated soil would remain on-site, the potential for contact with this soil after building construction is minimal. Institutional controls would require that any future intrusive activities are performed with proper notification, appropriate personnel protection and proper handling of contaminated materials. Additionally, building construction would include installation of a vapor/water barrier, which would serve as an engineering control and would further reduce the potential for contaminated vapors and groundwater from entering the below-grade structure. Therefore, Alternative 1 is protective of human health and the environment, and would allow for the future use of the site.

Alternative 2 - Excavation/Removal of Soil to NYSDEC RSCOs, would eliminate the potential for human health and environmental exposures to soil contaminants through the removal of approximately 52,000 cubic yards of contaminated soil. By extracting groundwater during dewatering/excavation activities, the potential for exposure to groundwater contamination would be reduced. Since all contaminated soil exceeding RSCOs for VOCs and SVOCs would be removed from Tax Lot 3 under this alternative, there would not be any future exposures to such soil contamination, regardless of future use of the site.

Both alternatives for Tax Lot 3 represent removal of significant volumes of contaminated soil and groundwater. Although some soil exceeding RSCOs would remain on-site as part of Alternative 1, the contaminated soil would be isolated beneath the parking structure, and engineering and institutional controls would be utilized to control future exposures to contaminated soil and groundwater. Therefore, both alternatives would be equally protective of human health and the environment.

2.3.2.3 - Short-term Effectiveness and Impacts

Both alternatives for Tax Lot 3 have components similar to those identified for the alternatives described for Tax Lot 1, which could result in impacts to the community and on-site

workers. Since off-site disposal of approximately 52,000 cubic yards and transportation on-site of approximately 16,000 cubic yards (in-place volume) of fill material is required, it is estimated that approximately 5 to 7 months would be needed to complete remedial construction for Alternative 2. Implementation of Alternative 1 would require off-site disposal of approximately 41,000 cubic yards of material and on-site importation of approximately 5,000 cubic yards of fill, which it is estimated would require approximately 3 to 5 months to complete.

Both alternatives would be effective in the short term through the removal of large volumes of contaminated soil and reducing the potential for exposure to contaminated soil and groundwater. However, since the overall remediation time for Alternative 2 would be longer than Alternative 1, Alternative 2 represents greater short-term impact during implementation than Alternative 1. These impacts would include an extended period of construction-related truck traffic and noise as well as an increased potential for impacts from vapors, odors and dust. The potential for off-site migration of contaminated soil from soil erosion and construction, and hauling vehicles is also greater for Alternative 2 due to the larger volumes of soil being removed from the site. Therefore, although both alternatives would be effective in the short term, Alternative 1 represents lesser short-term impacts than Alternative 2.

2.3.2.4 - Long-term Effectiveness and Permanence

Alternative 1 - Excavation/Removal of Contaminated Soil with Engineering and Institutional Controls, is considered an effective long-term and permanent remedial action. Removal of approximately 41,000 cubic yards of soil provides a permanent alternative since the potential for exposure to this soil would be eliminated. The risk posed by the contaminants that remain on-site would be minimal, since the remaining contaminated soil would be isolated from direct exposure, institutional controls would be established to protect future workers from the potential for exposure to contaminated media, and the vapor/water barrier, an engineering control, would serve as an additional factor of safety to minimize the potential for exposure to vapors and contaminated groundwater.

Alternative 2 would result in removal of all soil exceeding NYSDEC RSCOs for VOCs and SVOCs from the site and, therefore, would be effective and permanent since the potential for exposure to this soil would be eliminated. Although under Alternative 2 all soil exceeding RSCOs for VOCs and SVOCs would be removed from Tax Lot 3, it would not be more effective or permanent in the long-term than Alternative 1, since the potential for exposure to remaining contaminated soil after implementation of Alternative 1 is minimal. Therefore, comparatively, both alternatives would be equally permanent and their effectiveness at reducing long-term risk to human health and the environment would be comparable.

2.3.2.5 - Reduction in Toxicity Mobility and/or Volume of Contamination

Both alternatives for Tax Lot 3 would reduce the toxicity, mobility and volume of contamination on-site through the removal of approximately 41,000 cubic yards and 52,000 cubic yards of contaminated soil for Alternatives 1 and 2, respectively. Execution of these alternatives would also result in a reduction in the toxicity, mobility and volume of contaminated groundwater, through dewatering and treatment on-site prior to discharge to the sewer system. However, with respect to both soil and groundwater, Alternative 2 would result in greater reductions. Contaminated soil would be disposed and/or treated at an off-site facility. Treatment by thermal desorption of a portion of the excavated soil would reduce the toxicity of contaminated soil.

Since, under Alternative 2, an additional approximately 11,000 cubic yards of contaminated soil would be removed from the site and larger volumes of groundwater would be extracted, Alternative 2 would be more effective than Alternative 1 at reducing the toxicity, mobility and volume of contaminated soil and groundwater for Tax Lot 3.

2.3.2.6 - Implementability

The necessary labor, equipment, materials and supplies for implementation of Alternative 1 - Excavation/Removal of Contaminated Soil with Engineering and Institutional Controls and Alternative 2 - Excavation/Removal of Soil to NYSDEC RSCOs are readily available.

Standard techniques can be utilized to remove contaminated soil and debris for both alternatives. Coordination with building construction activities would be necessary, but would not impact implementation of either alternative. It is also expected that it would be possible to obtain necessary permits without impact to implementation of either alternative. Additionally, although execution of the institutional controls under Alternative 1 would require coordination among Con Edison, River Place II, LLC and NYSDEC, the coordination effort required is not expected to impact overall implementation of the alternative. Therefore, Alternatives 1 and 2 are equally implementable.

2.3.2.7 - Cost Effectiveness

Estimated capital costs and the present worth of long-term (30-year) operation, maintenance and monitoring (OM&M) costs associated with each of the alternatives for Tax Lot 3 are presented in Table 2-2. A detailed breakdown of each estimate is provided in Appendix A.

- Sheet piling would be installed around the perimeter of the entire area to be excavated and would not be removed.
- All costs (e.g., excavation, backfill, etc.) were estimated based on recent bids for remediation projects and Means Site Work Cost Data, experience in construction, with adjustment for hazardous waste site remediation, and communications with remedial contractors, material suppliers, waste transporters and disposal facilities.
- The estimated present worth of operation, maintenance and monitoring is based on 30 years at 5 percent.
- A 25-percent contingency has been included.

A more detailed list of explanations and assumptions which apply to the cost estimates is presented in Appendix A.

As shown on Table 2-2, the cost of Alternative 2 is significantly higher that Alternative 1.

Table 2-2

WEST 42ND STREET
FORMER MANUFACTURED GAS PLANT SITE
REMEDIAL WORK PLAN
ALTERNATIVES COST SUMMARY
TAX LOT 3

Alternative	Estimated Capital Cost[1]	Estimated Present Worth[2] of Annual Operation Maintenance and Monitoring	Total Estimated Present Worth
Tax Lot 3 - 1	$16,049,000	$160,000	$16,209,000
Tax Lot 3 - 2	$21,534,000	$0	$21,534,000

[1] Including estimated engineering and administration fees and contingency.
[2] 30 years at 5% interest.

2.3.2.8 - Community Acceptance

Both alternatives for Tax Lot 3 would likely be acceptable to the community since large volumes of contaminated soil are being removed from the site and institutional and engineering controls would be implemented as necessary for future protection of human health and the environment. Public comments that are provided during the 30-day public comment period would be evaluated. Based on comments received from the public, the RWP may be modified.

2.3.3 Land Use

Alternative 1 for Tax Lot 1 allows for preservation of an existing building, and both alternatives evaluated for Tax Lot 3 allow for future development of a new residential building with associated parking structure. Alternative 2 for Tax Lot 1 would presumably include reconstruction of the River Place I structure. Future planned development on Tax Lot 3 would be made possible by removal of contaminated subsurface soil, the extraction of groundwater during the dewatering process and establishment of institutional controls which would minimize the potential for impacts to future residents of the site.

Based on information provided by the New York City Department of Planning, the site is located within Manhattan Community District 4, near the southwestern boundary of the Special Clinton District and is zoned C6-4, a medium bulk office district. C6 districts provide for, among other uses, some residential development in mixed buildings. The Special Clinton District was created to preserve and strengthen the residential character of the community, maintain the mixture of income groups present in the area and ensure that Clinton is not adversely affected by new development. For 2002, approximately 18% of land use was reported to be multi-family residential in Manhattan Community District 4, which is bounded by the Hudson River to the west, West 59th Street and West 60th Street to the north and extends east to Eighth Avenue in the area of the site. A review of the City Department of Planning website for rezoning studies and proposals, recently approved rezoning and planning projects did not reveal any active City planning activities which would impact the site. Based on the above information, provided by

the Department of Planning, the planned future use of the site is consistent with zoning and existing land use plans as well as surrounding property use.

As with the adjacent River Place I development, additional land use factors such as accessibility to infrastructure, proximity to cultural resources and proximity to natural resources have been taken into consideration as part of the development plans for the site and are not considered to be inconsistent with the remediation alternatives and planned future use of the site. Citizens' participation in connection with the remediation plan and planned future use of the site would be described in the Citizens Participation Plan to be prepared separately by Con Edison and River Place II, LLC.

2.4 Recommended Remedial Alternative

Based on the evaluation of the remedial alternatives described above, excavation and removal of accessible soil above the clay layer and establishment of institutional controls for Tax Lot 1, as discussed in Alternative 1, would be protective of human health and the environment and meets the remedy selection criteria. Although implementation of Alternative 2 provides for removal of a larger volume of contaminated soil from Tax Lot 1, demolishing an existing high-rise apartment building is not a viable option and is not necessary to achieve the stated remedial action objectives for the site.

With regard to Tax Lot 3, Alternative 1 - Excavation/Removal of Contaminated Soil with Institutional and Engineering Controls is the proposed remedy for this tax lot. Both of the alternatives evaluated for Lot 3 would be equally protective of human health and the environment through the removal of contaminated soil and, for Alternative 1, implementation of institutional and engineering controls. Both alternatives are also equally effective and permanent in the long-term and would allow for future development of the property. However, short-term impacts to the surrounding community would be greater for Alternative 2, due to the extended period of increased vehicle traffic, construction noise and potential for exposure to contaminated vapors, odors and dust associated with the removal of a greater volume of soil. Additionally, the cost for Alternative 2 would be significantly greater than for Alternative 1 and, as discussed

above, although Alternative 2 would be more effective at reducing the volume of contaminants at the site, it would not provide for significant additional protection of human health or the environment.

3.0 SUMMARY OF PROPOSED REMEDIES

3.1 Introduction

The following remedies are proposed for implementation at the site:

BCP Site ID No. C231024 (Tax Lot 1)

Alternative 1 - Excavation/removal of accessible soil to top of clay layer with institutional controls.

BCP Site ID No. C231012 (Tax Lot 3)

Alternative 1 - Excavation/removal of contaminated soil with engineering and institutional controls.

The remedial construction activities for both tax lots will be performed integral with the construction of the new residential building by a qualified remedial contractor under the full-time supervision of the remedial engineer. Presented below is a description of planned remedial activities and institutional and engineering controls.

3.2 Remedial Construction

Remedial construction activities will include premobilization work such as applying for and obtaining permits, followed by mobilization to the site, site preparation, excavation, off-site transportation and disposal of waste, backfilling and remediation closeout activities. Plans prepared as part of the remedial construction activities will be reviewed and approved by NYSDEC prior to implementation. A description of the planned remedial construction activities follows.

3.2.1 Construction Health and Safety Plan

A Construction Health and Safety Plan (CHASP) will be prepared by the construction contractor. Site personnel performing remedial construction work will be required to read and comply with the requirements of the CHASP.

The CHASP will be prepared in accordance with 29 CFR 1910.120 and will include the following items:

- Health and safety organization, including résumés of personnel responsible for health and safety
- Project site description and hazard assessment
- Training requirements
- Medical surveillance requirements
- Project site control procedures
- Standard operating procedures and engineering controls
- Personnel protective equipment requirements
- Personnel hygiene and decontamination protocols
- Equipment decontamination procedures
- Air monitoring requirements
- Emergency equipment/first aid requirements
- Emergency responses/contingency procedures
- Heat and cold stress procedures
- Record keeping requirements
- Community protection plan

The construction contractor will be responsible for implementing the CHASP. NYSDEC will review and approve the CHASP prior to implementation of the remedy.

3.2.1.1 – Community Air Monitoring Plan

As part of the CHASP, the construction contractor will prepare a Community Air Monitoring Plan (CAMP) prior to mobilization. The remedial contractor will be responsible for implementing the CAMP. The plan will comply with the requirements of the New York State Department of Health Generic Community Air Monitoring Plan included as Appendix B. An air Quality Monitoring Plan prepared by the remedial contractor is provided in Appendix C.

3.2.2 Construction Quality Assurance/Quality Control Plan (CQA/QC)

A Construction Quality Assurance/Quality Control Plan will be prepared by the remedial contractor for review by the remedial engineer. The plan will identify procedures to be utilized to ensure the quality of the work performed meets the objectives of this RWP. The remedial engineer will confirm that the CQA/QC plan will include, at a minimum, the following:

- A description of the quality control organization including a chart showing the lines of authority.
- The names, qualifications, duties and responsibilities of each person assigned a QC function.
- Procedures for scheduling and managing submittals including those from subcontractors.
- The number and type of each sample to be collected and analyzed including waste characterization and documentation sampling requirements.
- Description of sample collection methods for each sample matrix including sample containers, sample custody, sample packaging, storage and shipping procedures.
- The analytical protocols to be utilized.
- Quality control methods and procedures for each specific test to be used during construction.

- The name, address and qualifications of each proposed testing laboratory and the intended project-specific function.
- A description of all instrumentation and equipment to be used for testing on-site, as well as operating and calibration procedures.
- Reporting procedures for quality assurance activities including proposed reporting formats.
- Method for notification of changes.

The construction contractor will be responsible for implementing the CQA/QC plan. NYSDEC will review and approve the CQA/QC plan prior to implementation of the remedy.

3.2.3 Storm Water Management, Soil Erosion and Sediment Control

Storm water management, soil erosion and sediment control will be performed in accordance with the New York State Guidelines for Urban Erosion and Sediment Control. The construction contractor will be responsible for collection and disposal of storm water on-site, preventing off-site migration of storm water, maintaining separation of potentially contaminated storm water with uncontaminated storm water and soil, preventing off-site migration of sediment, protecting existing storm water collection structures and protecting soil stockpiles from erosion. Temporary stockpiles of contaminated soil will be placed on bermed plastic liners and covered with plastic liners to prevent erosion. Stockpiles of clean fill will also be placed on bermed liners. Liners will be secured in place with stakes or concrete blocks.

Additional soil erosion and sediment controls (e.g., hay bales or silt fences) will be installed as necessary around the perimeter of the site and around storm water drainage inlet structures to prevent contaminated runoff from migrating off-site and into storm water collection systems. On-site storm water will be directed towards the open excavation for collection by the dewatering system.

3.2.4 Permits

The construction contractor will be responsible for obtaining federal, state and City permits required for remediation prior to mobilization. Permit conditions will be complied with, and copies of permits will be maintained at the site.

3.2.5 Construction Schedule

The construction contractor will prepare a construction schedule that details the individual components of the remedial work. The schedule will include significant dates such as mobilization, submittal dates, meetings, dates for starting each phase of work, and demobilization. The schedule will be updated throughout the remedial construction phase.

3.2.6 Surveys and As-built Drawings

The construction contractor will perform an initial site survey to verify the existing site conditions and establish the exact limits of the work. Following completion of the work, the construction contractor will prepare and submit as-built drawings showing the results of the construction activities. The as-built drawing will show the final limits and elevations of excavations, limits of backfill and the locations of documentation soil samples collected. The as-built drawings will be signed and sealed by a Professional Engineer licensed to practice in New York State. All final surveys will be completed by a Land Surveyor licensed to practice in New York State.

3.2.7 Site Security, Control and Access

Security for the work, equipment, materials, supplies, facilities, personnel and incidentals, including the office trailers, will be provided throughout the performance of the work. The site will be surrounded by a fence in accordance with NYC construction and building code requirements. The fences and gates will be closed and locked when there is no activity on site, and any breaks or gaps will be repaired immediately.

Equipment that will continue to operate after normal working hours will include appropriate automatic shutoffs and/or alarms to prevent unsafe operation.

All personnel and visitors will be required to sign in and sign out upon arrival and departure. A log of vehicles and equipment entering and leaving the site will be maintained. Warning signs, will be placed approximately every 200 linear feet on the perimeter fence to alert passersby and discourage trespassing. At the site entrance and egress points, signs stating "Proper Personal Protective Equipment Must Be Worn," "No Eating, Drinking or Smoking," and "Restricted Area - No Unauthorized Access" will be posted. Additionally, each access and egress point will be indexed with a unique number (see Figure 3-1).

Within the limits of the site, work zones consisting of a Clean Zone, a Contaminant Reduction Zone, a Support Zone and an Exclusion Zone will be established (see Figure 3-2). The Exclusion Zone will always be located adjacent to the excavation front. As the excavation front will be continuously changing, the location of this zone will also change.

The Support Zone will be permanently sited near the midpoint of the western boundary of the site and will be divided into two areas: the Material Processing Area (MPA) and the Materials Support Area (MSA). The MPA will be the designated area for adding to excavated soil stabilization media such as kiln dust and blending ("rendering"). Approximately 100 cubic yards of kiln dust will be stockpiled within the MPA for use, if needed, in stabilizing waste material. The MPA will also be the location where materials are loaded onto transport vehicles for off-site disposal. The MSA or lay down area will be used to store equipment that will be used in remedial operations.

The Contaminant Reduction Zone will initially be sited in the northwestern corner of the site near Gate 1, and will be moved to Gate 2 near completion of the project. Decontamination of trucks, hydraulic equipment and personnel will be performed within the limits of the Contaminant Reduction Zone.

LEGEND:

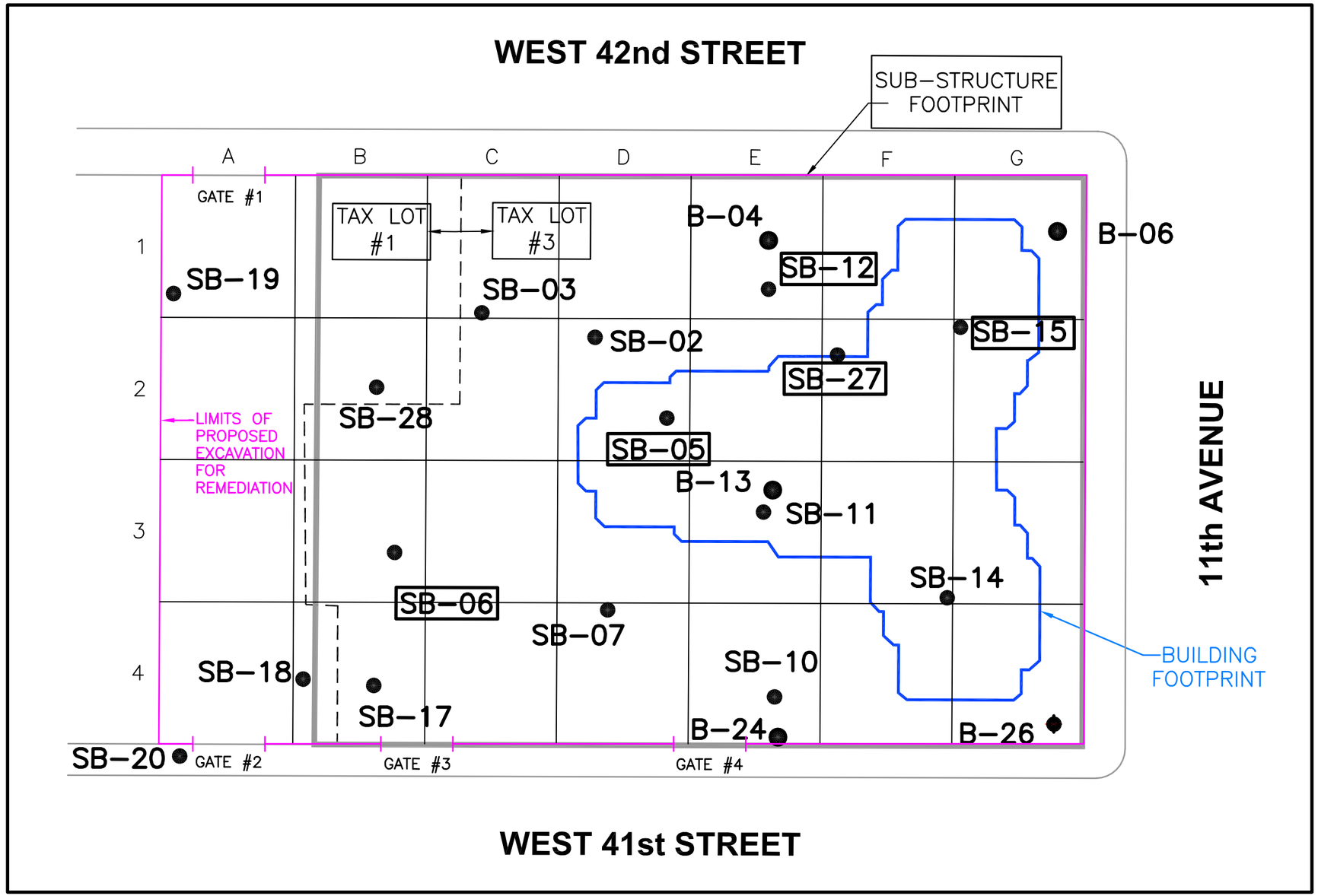
TAX LOT BOUNDARY

PROPOSED BASEMENT/GARAGE FOOTPRINT

PROPOSED BUILDING FOOTPRINT

SB–19 EXISTING SAMPLE TO BE UTILIZED FOR DOCUMENTATION SAMPLE

B
2 DOCUMENTATION SAMPLE GRID



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Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
WEST 42ND STREET FORMER MANUFACTURED GAS PLANT SITE

DOCUMENTATION SAMPLING LOCATION MAP

FIGURE 3-1

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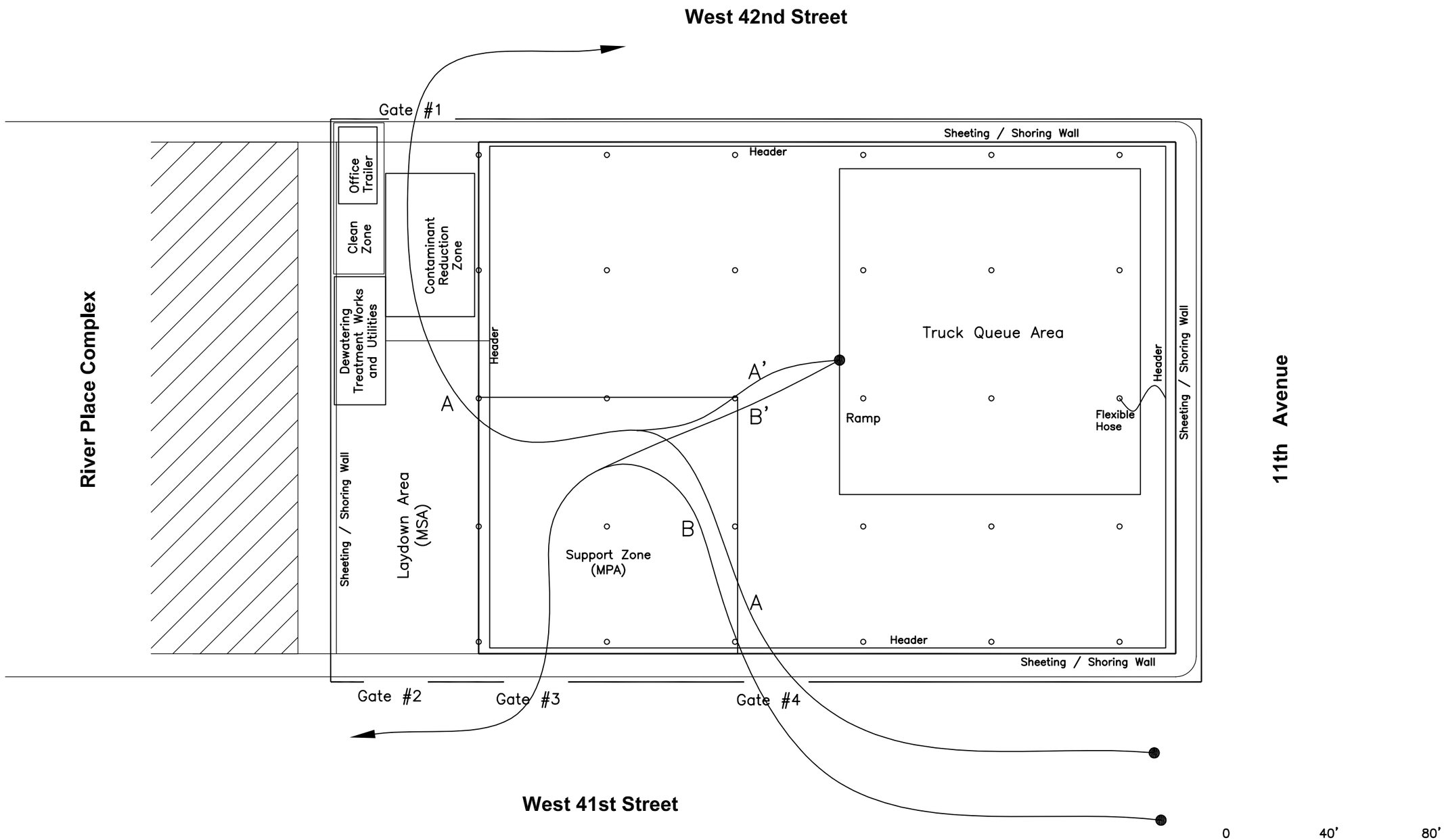

SOURCE: IMPACT ENVIRONMENTAL

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
WEST 42nd STREET FORMER MANUFACTURED GAS PLANT SITE

SITE CONTROL MAP

FIGURE 3-2

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The Clean Zone will be a contaminant-free area designated for visitors and/or remedial staff. Personal protective equipment will not be required in the Clean Zone. The office trailer will be located within the limits of the Clean Zone.

Personnel and visitors entering the Exclusion Zone and Contaminant Reduction Zone will be required to have 40-hour HAZWOPER training and participate in a medical surveillance program. Personnel leaving the Exclusion Zone will be required to proceed through the Contaminant Reduction Zone prior to entering the Support Zone or Clean Zone. Site personnel and visitors who do not enter the Exclusion Zone and Contaminant Reduction Zone will not be subject to HAZWOPER training and medical surveillance requirements. Once excavation work has been completed and clean fill is placed over the base of the excavation, site personnel will not be subject to HAZWOPER training and medical surveillance requirements.

3.2.8 Traffic Control

Truck entrance will be made via one of three security checkpoints on West 41st Street and egress via one of three security checkpoints on West 42nd Street. The site will be fenced and there will be no other means of entrance or egress.

Truck traffic will move in accordance with one of two routes. Route A is intended for use at the beginning of the project and includes entering the site at Gate 4 on West 41st Street and exiting at Gate 1 on West 42nd Street. Route B is intended for use later in the project, when excavation has resulted in significant surface relief. Vehicles will enter the site at Gate 4 on West 41st Street and exit Gate 3 also on West 41st Street. At the end of the project, it is likely that Gates 3 and 4 will be used, but Gate 3 will become the entrance and Gate 4 the exit for the site.

Trucks traveling to the site will exit the Lincoln Tunnel and turn left onto Dyer Avenue proceeding one block to West 41st Street. They will then travel west to the site entrance.

All efforts will be made to queue transport vehicles on-site while waiting to be loaded. This can be best accomplished by having direct contact with the transport company and each individual truck driver via cell phone. The transportation supervisor on-site will compile a log of telephone numbers so that transport times can be coordinated in the most efficient way and off-site queuing can be prevented. Should off-site queuing become necessary, it will be performed along the north side of West 41st Street, east of the curb cut for River Place II (so that trucks do not queue in front of the residential building on Lot 1). Site personnel will be required to park on-site, at a designated location arranged for by the construction contractor, or in legal parking locations off-site.

3.2.9 Site Preparation and Temporary Facilities

Upon mobilization to the site, temporary facilities and utilities including a fence with gates, work zone demarcation, erosion control devices, office trailers, storage trailers, portable toilets, telephone service, electrical power and lighting, potable water, decontamination facilities, air monitoring devices and staging areas will be established for use. Existing concrete/pavement will be removed during site preparation.

Office space for an on-site NYSDEC field representative will be provided, including a desk, telephone and internet capability. Access to a fax machine will also be provided. Stabilized construction pads will be installed at the exits of the site. Top dressing of the pad with additional stone, or replacement of the stone will be performed on an as needed basis. In addition to the stabilized construction pad, vehicle tires may require pressure washing prior to leaving the site; therefore, a wash containment pad will be installed after the stabilized construction pad (see Figure 3-3). The wash containment pad will be constructed of Seamans XR5 chemical-resistant fabric (see Appendix D for product information). Special collection trenches and a sump will be welded into the pad. Additionally, built-in track mats will be installed on the surface to prevent wear from the truck tires. The wash water used to decontaminate the truck tires will be transferred via sump pump that includes a watertight bulkhead fitting to the dewatering treatment system. Collected sediments will be managed with other waste material removed from the site.

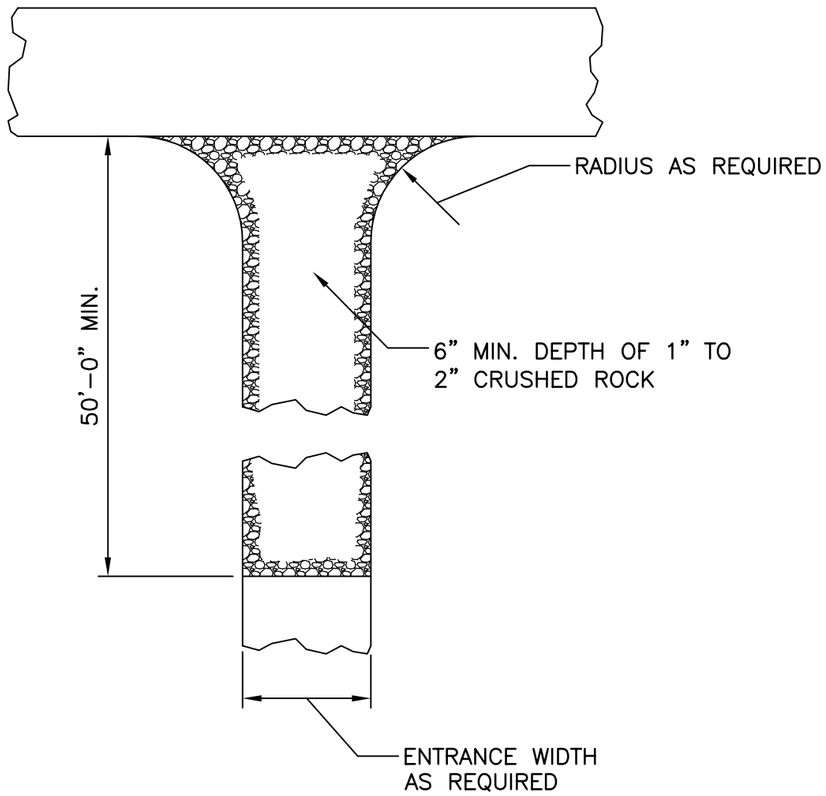
Potable water will be supplied to the site from the nearest hydrant. Utilities on public and private properties will be identified and located in accordance with local and state requirements. In addition, to identify subsurface utilities outside of public rights-of-way on the project site, including underground water conduits, maps will be secured prior to mobilization. The services of an independent utility markout service contractor may be used. This contractor will be qualified to locate and markout utilities in the vicinity of the work using appropriate equipment and methods, prior to construction.

3.2.10 Equipment and Material Storage and Laydown Areas

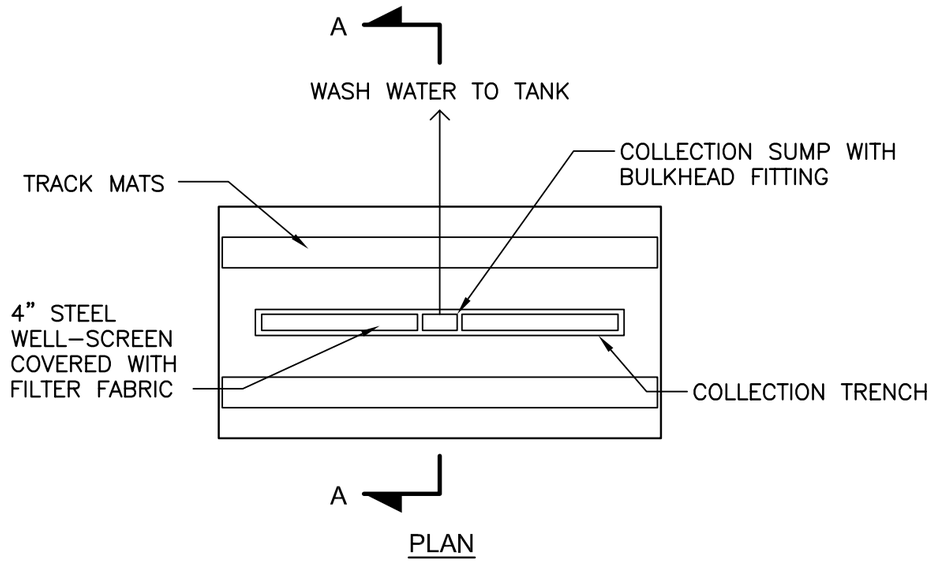
As indicated above, equipment and materials to be used in the work will be stored in the Materials Support Area. Soil stockpiles will be surrounded with suitable erosion controls and stockpiled on and covered by plastic sheeting to prevent windblown dust or erosion. Soil containers will be lined and covered prior to transport. Equipment will be stored so as to not hinder access to the site in the event of an emergency.

3.2.11 Equipment and Personnel Decontamination Facilities

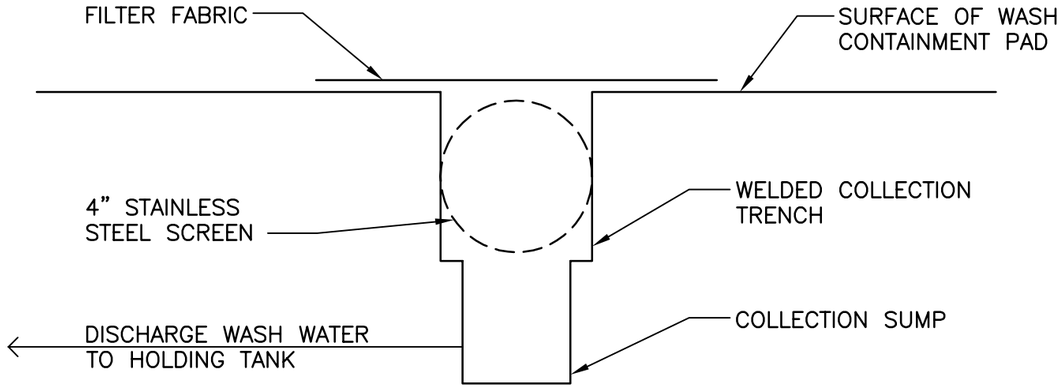
Equipment and personnel decontamination facilities will be described in detail in the HASP. Permitted tractor-trailer trucks entering the subject property will be escorted to the Material Processing Area. Processed materials will be loaded onto the trucks with a hydraulic excavator. Fully loaded trucks will be directed to the Contaminant Reduction Zone near the site exit for inspection. The inspection will be performed over a prefabricated containment area that has been filled with 3/4-inch crushed stone aggregate to immobilize soil removed from the truck body. If necessary, a pressurized solution of Alconox will be used to clean the trucks; however, this will be avoided where possible. A drainage sump will be installed within a corner of the containment structure so that rinse water can be directed into the treatment system prior to discharge to the sewer system. Where sediments accumulate within the structure, the contents will be dug out and managed as MGP-impacted fill material.



VEHICLE TRACKING PAD
N.T.S.



PLAN



SECTION A-A

WASH CONTAINMENT PAD
N.T.S.

SOURCE: IMPACT ENVIRONMENTAL

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
WEST 42nd STREET FORMER MANUFACTURED GAS PLANT SITE

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VEHICLE TRACKING PAD AND WASH CONTAINMENT PAD

FIGURE 3-3

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All hydraulic earthwork equipment that is exposed to hazardous substances will be decontaminated on-site with an Alconox/water solution followed by a clean water rinse at the conclusion of the project. Decontamination of this equipment will also be performed over the containment structure.

The personnel decontamination area will be constructed between the limits of the Exclusion Zone and Support Zone. Personnel decontamination facilities will include a designated entrance and exit area, an area for decontamination of nondisposable personnel protective equipment, including storage areas for clean wash water and detergents, a container for storage of wastewater and a container for disposal of disposable personnel protective equipment.

3.2.12 Monitoring Well Abandonment

Existing groundwater monitoring wells LMW-01 through LMW-04 will be abandoned prior to initiation of the remedial activities in accordance with NYSDEC groundwater monitoring well decommissioning procedures. Specific procedures as developed by the remedial contractor are described below.

Abandonment of wells will be performed using a tremie pipe to inject cement grout to the depth that subsequent excavation activities will truncate the well. The remaining portion of the well that will be truncated during excavation activities will be filled with clean quartz sand and sealed with an appropriately sized PVC end-cap. As excavation occurs and wells casings (screens or risers) are exposed, they will be cut and re-sealed with a PVC end-cap.

When excavation final elevations are reached within a portion of the site, the wells in the completed excavation area will be inspected to confirm that the remaining portion of well(s) contain cement grout. If the quartz sand is present in lieu of the cement grout, it will be purged with pressurized potable water and replaced with cement grout to grade. If the grout is present, but noted ineffective for sealing the well (e.g. fractured or uncured), the well will be over-drilled

with a hollow stem auger to extract the casing, and the annulus filled with cement grout installed under pressure with a tremie pipe.

Wells that will not be disturbed by proposed excavation activities will be abandoned as follows. The screened portion of the well will be filled with sand. The balance of the casing will be filled using a tremie pipe to inject cement grout to the top of the casing. A PVC end-cap will be installed at the top of the casing. If the well is set within a covered cast manhole or subgrade curb box, the annulus will be filled with concrete and the cover will not be replaced. If a well is finished to grade without being set within a manhole or curb box, the casing will be exposed within a hand-dug excavation measuring 2 feet in diameter and 1-foot in depth below grade. The well casing will then be cut down 6 inches below grade and capped. The excavation will then be filled with concrete to grade.

3.2.13 Excavation and Material Handling

Overview

As discussed in Section 2.0, excavation on Tax Lot 3 and a portion of Tax Lot 1 will be completed as part of the remedial action for the site. Excavation will be performed in conjunction with the construction of the proposed building on Tax Lot 3, and accessible contaminated soil above the clay layer within the landscaped area of Tax Lot 1 will be removed. Excavation will include removal of holder foundations and any visible soil heavily saturated with product present at the predetermined bottom of the excavation. The limits of excavation will be surveyed in the field prior to initiation of remedial activities by a Land Surveyor licensed to practice in New York State. The distance of the sheet piling on the western edge of the building to the residential tower River Place I will be 50 feet. This distance is necessary to protect the foundation support piles of the existing building from damage from the tiebacks. The tiebacks will derive their load carrying capacity from friction between a rock socket and the cement grout. To ensure no disruption to the existing foundation piles, no rock socket drilling will be conducted below the tips of the piles. An appropriate design for support of the proposed excavation is interlocking steel sheeting with two rows of tiebacks. The first level of tiebacks is located at a depth of about

5 feet below grade, the angle of inclination is no more than 1.5H:1V, and a 15-foot rock socket. For a depth to rock of 30 feet, this geometry requires a 50-foot setback from the excavation to the existing building.

Excavation will occur in three phases. The first phase of the excavation will include removal of the shallow subsurface soil (approximately 0 to 5 feet below ground surface). This phase will also include trenching for installation of sheeting. Soil between 5 feet below existing grade and the water table will be removed during the second phase of excavation. When the site has been excavated to the water table, the tops of the gas holders will be covered with an impermeable flexible membrane to prevent accumulation of precipitation within the holders. The third phase of excavation will be removal of deep subsurface soil between the water table and the final excavation depths. The third phase will require constant dewatering, as discussed below.

The proposed apartment building includes a subgrade parking garage that will extend to an average depth of approximately 19 feet below existing grade (elevation –12). Certain areas specified by the structural requirements of the proposed building will require deeper excavation, to a depth of 28 feet below existing grade (elevation –18) to accommodate deep building structures such as elevator pits. There will be no setback between the garage foundation walls and the sidewalk on the north, south and east sides of the site. Excavation elevations will be guided using a series of laser levels. A description of the excavation and material handling activities is provided below.

Excavation Support

Interlocking steel sheet piling will be utilized to provide support for the vertical sidewalls as well as provide a barrier for groundwater infiltration into the excavation. Pre-excavation/ trenching to an estimated depth of 8 feet will be required within the fill material to remove obstructions that may interfere with driving of the sheeting. A vibratory hammer will be used for the installation of watertight sheeting. The sealant to be installed within the interlocks, as selected by the remedial contractor, is Adeka Ultra Seal A-50. Product information provided by the remedial contractor is provided in Appendix E. The sealant will be applied to all sheeting

interlocks. Walls of the excavation will be shared with the watertight sheeting and whalers that are anchored with tiebacks. Tiebacks will be drilled using track-mounted drill rigs that drill on a angle. When drill bits have advanced to the calculated distance within the ground, steel tie rods will be cemented-grouted in place. Upon curing of the cement, the tiebacks will be tension-tested to demonstrate satisfaction of the design parameters. The steel sheeting and tiebacks will be left in place after construction clean conditions are achieved for use as the exterior forms for concrete foundations and walls.

Sheet piling will be extended approximately 30 feet below ground surface. The sheeting will truncate a horizontally continuous formation of overburden clay.

Sheet piling will remain in-place and will be considered permanent. The permanent sheet piling located on the western edge of the excavation will minimize the potential for migration of contamination from the unexcavated portion of Tax Lot 1 into the remediated portions of the site. The remaining perimeter sections of sheeting (i.e., the eastern, southern and northern edges of the excavation) are not considered an engineering control.

Excavation Plan

Phase One of the excavation will be performed using one hydraulic excavator to remove shallow soil and clear obstructions as necessary for the placement of sheeting. Sheeting installation will also be part of Phase One.

Two tracked excavators and an articulated end dump will be used during Phase Two and Phase Three. One tracked excavator will be used to dig within the Exclusion Zone and cast loads to an adjacent excavator or to the end dump where, if necessary, excavated soil will be rendered with stabilized soil from the excavation and/or with kiln dust in the Material Processing Area, prior to load-out into transport vehicles. Rendering may be necessary to satisfy the moisture content requirements of the selected disposal facility. The excavator that is performing rendering operations will also serve as the primary excavator to perform load-out activities. In general, excavation will progress from the southeast to the northwest of the site; however, changes may

be necessary based upon the physical and chemical characteristics of the overburden. The gas holders will be cut down as excavation work proceeds.

All media excavated from the site will be screened within the exclusion zone both visually and with organic vapor analyzers to detect potential variance from the data from the in-place soil characterization analyses (see discussion below). Anomalous measurements or observations will prompt contingency measures.

Demolition of Subsurface Structures

During excavation, existing subsurface structures will be demolished and removed when encountered. This will include the walls and floors of the former gas holders as well as the foundation walls and floor of the former Purifying House. The debris generated from demolition of the subsurface structures will be managed as described below in the Material Handling Section.

Dewatering

Dewatering will be required during Phase Three excavation activities to facilitate material handling, provide for observation of the excavation bottom and provide appropriate conditions for backfilling. Extracted groundwater will be treated on-site to meet New York City Department of Environmental Protection Limitations for Effluent. During excavation and backfilling (where applicable), water will be extracted through the use of drainage sumps and well points, if necessary, treated and discharged to maintain proper subsurface conditions. Drainage sumps will be installed within the excavation, as necessary, for use with electric submersible trash pumps, to dewater the excavation area. Water will be pumped through flexible hose to a perimeter header to the on-site treatment system. The first tier of the treatment train will be separation by an oil-water separator tank. The second tier will include filtration with bag filters. The third tier of treatment will include a settlement weir tank. The fourth tier will include carbon filtration. Effluent flow metering and sampling and analysis of the effluent will be performed in accordance with the requirements of the discharge permit.

Vapor, Odor and Dust Controls

As discussed in Section 3.2.1, air monitoring will be performed throughout the duration of the work and will dictate actions required to control emissions. It is anticipated that dust, vapors and/or odors will be generated during implementation of the remedy. Standard dust/odor suppression techniques that may be employed during excavation activities as well as any other material handling activities at the site include:

- Application of foam suppressants to the excavation and/or stockpiled soils;
- Installing gravel pads at vehicle egress points;
- Application of wetting agents to soil, stockpiles, excavation faces, buckets and equipment during excavation or roadways;
- Tarping/covering containers;
- Restricting vehicle speeds to 10 miles per hour;
- Covering of excavations after completion of excavation activities; and
- Covering of stockpiles.

In addition, the site will be surrounded with spray misters that create a 10-micron water droplet fog to suppress odors as well as fugitive dust. The spray mist system which has been selected by the remedial contractor is the Piian Odor Control System. If needed, a chemical odor neutralizer may be added to the spray bar water source. Information regarding the Piian Odor Control System, furnished by the remedial contractor, is provided in Appendix F.

Similarly, it is anticipated that organic vapors will be encountered during implementation of the remedy. Air monitoring will determine the need for use of vapor suppression techniques. Standard vapor suppressant techniques that may be employed include:

- Application of foam suppressants to the excavation and/or stockpiled soils;

- Tarping/covering containers;
- Restricting vehicle speeds to 10 mph;
- Covering of excavations after completion of the excavation activities;
- Covering of stockpiles;
- Application of kiln dust; and
- Minimization of material stockpiling on-site and direct loading excavated material to hauling vehicles.

If dust and vapor suppression techniques do not lower the particulate and/or organic compound concentrations to an acceptable level, work will be suspended until acceptable corrective measures are implemented.

Material Handling

Debris

Fill material on-site has been described as containing relatively large quantities of debris such as brick, wood timbers, concrete and metal. Large blocks of mica schist and the remnants of subsurface MGP structures are also located on-site, including brick and concrete walls and foundations as well as associated piping.

Excavated debris that has a dimension greater than 3 inches that can be easily segregated from the excavated soil and does not contain any liquid or solid residues will be disposed of as construction and demolition debris. This debris may require decontamination prior to disposal. Remaining debris, which cannot be segregated or decontaminated, will be disposed of with contaminated soil. This debris may need to be subjected to size reduction to be acceptable to disposal facilities.

Excavated Soil

Shallow Subsurface Soil (0-5 feet)

Additional pre-characterization of shallow soil will be required prior to shipment to approved facilities. Based on site characterization data, it is anticipated that the shallow subsurface soil across the majority of the site will not exhibit the presence of MGP-related contaminants. Pre-characterization sampling will be completed in place and prior to mobilization of the remedial equipment in accordance with the treatment or disposal facility requirements. The site will be divided into six sampling quadrants measuring 110 feet by 110 feet. Four grab samples will be collected from the upper 5 feet of soil within each quadrant and composited into one sample, which will be analyzed for the following parameters:

Category of Analysis	Analytical Method	Analytes	Frequency
Semivolatile	USEPA Method 8270	Benzyl Alcohol; Bis(2-chloroethyl) ether; Bis(2-chloroisopropyl)ether; Diethylphthalate; and Methoxychlor.	1, 4-point composite sample per 2,000 cubic yards
Organochloride Pesticides and PCBs	USEPA Method 8081	All analytes	1, 4-point composite sample per 2,000 cubic yards
Metals	USEPA Methods 6010 and 7471	Chromium - hexavalent (VI); and Chromium - trivalent (III).	1, 4-point composite sample per 2,000 cubic yards
RCRA Characteristics	USEPA Methods 1030, 1110 and 9010/9030	Ignitability; corrosivity; and reactivity.	1, 4-point composite sample per 2,000 cubic yards
Asbestos	Polarized Light Microscopy	Asbestos content	1, 4-point composite sample per 2,000 cubic yards

In addition, a portion of each grab sample will be analyzed for VOCs by USEPA Method 8260 prior to the compositing.

Deep Subsurface Soil (Below 5 feet)

Soil deeper than 5 feet below existing grade may be impacted by MGP-related contaminants. This material will likely be handled as a nonhazardous industrial waste. This is consistent with NYSDEC policy in Technical and Administrative Guidance Memorandum (TAGM) 4060. Additional pre-characterization of this material will be required prior to shipment to approved facilities. Pre-characterization sampling will be completed prior to mobilization of the remedial equipment. Characterization will be completed in place and in accordance with the treatment or disposal facility requirements. The site will be divided into 23-foot by 23-foot quadrants. Each quadrant will be 15 feet in depth. Grab samples will be collected from the each quadrant and analyzed as follows:

Category of Analysis	Analytical Method	Analytes	Frequency
Total Petroleum Hydrocarbons	USEPA Method 8015	Diesel Range Organics to C-44	2 grab samples for the first 180 tons, 1 grab sample per 180 tons thereafter
Total Volatile Organics	USEPA Method 8260	More testing in addition to existing results	2 grab samples for the first 180 tons, 1 grab sample per 180 tons thereafter
Total Semivolatile Organics	USEPA Method 8270	More testing in addition to existing results	2 grab samples for the first 180 tons, 1 grab sample per 180 tons thereafter
RCRA Characteristics	USEPA Methods 1030, 1110 and 9010/9030	Ignitability; corrosivity; reactivity-sulfide/cyanide	1 grab sample per 500 tons
TCLP Metals	USEPA Methods 1311/6010 and 7471	As, Ba, Cd, Cr, Cu, Hg, Ni, Pb, Se, Ag, Zn	1 sample per 500 tons
TCLP Organics	USEPA Methods 1311/8000 Series	Volatile organics, semivolatile organics, pesticides and herbicides	1 sample per 500 tons
Total Sulfur	ASTM D129	Sulfur content	1 sample per 900 tons
Total PCBs	USEPA Method 8082	PCB target list	1 sample per 500 tons
pH	USEPA Method 9045C	pH	1 sample per 500 tons
TOX	USEPA Method 9020B	Total Organic Halides	1 sample per 500 tons

Although active dewatering will be performed during excavation activities, excavated soil may require further dewatering prior to load out for off-site transportation and disposal. Dewatering may be accomplished by gravity drainage at an on-site staging area. Mixing with and/or addition of stabilizing agents may also be required to further reduce the moisture content and heterogeneity of excavated materials.

MGP Residuals

Liquid wastes that may be encountered in subgrade conduits or interstitial spaces that are unearthed during excavation will be handled, stored and disposed of in accordance with all applicable waste disposal requirements. As necessary, liquid wastes will be handled with an industrial vacuum truck. Sample collection and analysis will be performed in accordance with the requirements of the disposal facility, and will include RCRA characteristics of toxicity, corrosivity, ignitability and reactivity.

Personal Protective Equipment and Miscellaneous Waste

During the course of the work, used personal protective equipment, general refuse and miscellaneous remediation waste will be generated. It is expected that the majority of this material will be nonhazardous and will be managed as a solid waste. The construction contractor will be required to characterize waste as required by the disposal facility prior to transportation off-site.

3.2.14 Contingency Plans

Utility Emergencies

A Code 753 utility mark-out will be completed as per 16 New York City Rules and Regulations (NYCRR) Part 753. Consistent with the One-Call (also called Dig Safe New York) criteria, a request will be made at least 72 hours prior to initiating fieldwork. Dig Safe can be

contacted by telephone (1-800-272-4480) or the Internet (http://www.OCUC.net). Confirmations that the utilities have been marked out, as per Code 753 requirements, which are received from the participating utilities by facsimile or telephone, will be documented. All hard-copy confirmations will also be available in the field during remedial activities.

Discovery of Underground Storage Tank or Vessel

If a tank or vessel (including conduit that contains liquids) is discovered during excavation, the tank will be registered with NYSDEC and subsequently decommissioned in accordance with NYSDEC requirements. The following procedure will be implemented:

- The NYSDEC Project Manager and the Remedial Engineer will be notified immediately by telephone or cellular phone and by e-mail.
- Conditions identified will be photo-documented.
- A determination of the type, state and volume of any contained material will be made.
- If the contents cannot be identified by physical conditions, a sample will be collected for chemical analysis.
- The Site Health and Safety Officer will determine the need for a change of PPE.
- When the contents have been identified, an appropriate waste hauler will remove and transport the contents off-site for disposal.
- Manifests for the volume of product removed will be retained for inclusion in the Final Engineering Report.
- The structure will be cleaned, rendered vapor-free, cut or broken up in an appropriate manner, removed and properly disposed.
- If the former contents were unlike other waste material found at the site and accepted by the disposal facility, any visually impacted soil/fill will be excavated and placed upon sheeted plastic within the Exclusion Zone for testing, transport and off-site disposal. A waste characterization analysis limited to reactivity, ignitability and TCLP for toxicity will be performed.

3.2.15 Waste Transportation and Disposal

Prior to transport off-site, sampling of soil will be required to obtain waste characterization data for disposal purposes (as discussed in Section 3.2.13 above). Approved, permitted transporters will transport the wastes generated on-site to permitted off-site disposal facilities. All trucks will have functional intact tarps to cover their loads. Only Con Edison-approved transporters and disposal facilities will be employed for this work.

Con Edison will be the generator of record for this project and, if necessary, will provide the EPA generator identification number for shipment of any hazardous wastes. Waste will not be transported for disposal without prior approval from Con Edison. The waste transporters will provide manifests for any hazardous waste shipped as part of this project. Manifests will be provided to Con Edison for review, approval and signature.

Permitted trucks containing uncontaminated and recognizable concrete, asphalt, brick and rock debris will receive a product ticket to act as a transportation manifest. Trucks transporting this waste will not require a NYSDEC permit.

All trucks containing contaminated materials will provide the remedial contractor with documentation of valid, current NYSDEC Part 364 permits. NYSDEC Part 364 permitted trucks exiting the site containing contaminated materials will be given a nonhazardous waste transport charter to act as a transportation manifest. The charters will be printed on sequentially numbered four-part carbonless form paper. Portions of each charter will be completed by the driver of each truck, a representative of the generator and a representative of the receiving TSDF or disposal facility. The charter will be attached to a weight receipt from a certified scale. Copies of the manifests, bills of lading and certificates of disposal will be maintained in the project files.

3.2.16 Documentation Sampling

After reaching final remediation depth, samples will be collected from the bottom of the excavation to document the characteristics of soil left in place. The excavation footprint is

approximately 64,000 square feet in area. The NYSDEC Draft DER-10 Technical Guidance allows sampling frequency to be determined by NYSDEC if the excavation perimeter exceeds 300 feet. Therefore, sampling at a frequency of 2,000 square feet and at a depth of less than 1-foot below the excavation bottom is planned (see Figure 3-1 for documentation sampling grid). Sidewall sampling will not be possible due to the presence of sheet piling. Documentation samples will be analyzed for VOCs, SVOCs, PCBs, metals and cyanide. Validated analytical results will be submitted to NYSDEC upon receipt of data and will also be provided in the Remedial Action Report. The purpose of this sampling is to provide a record of conditions remaining in the subsurface below the clean fill cover and new concrete building foundation and not for evaluating the necessity for further remedial action. Field sampling procedures and quality assurance protocols will be conducted in accordance with the CQA/QC Plan.

3.2.17 Backfill

Backfill will be clean fill imported to the site or recycled concrete aggregate (RCA). Prior to use, proposed backfill will be approved by NYSDEC. RCA product utilized on site will be manufactured by a NYSDEC Registered Construction and Demolition Debris processing facility. The RCA product will be comprised exclusively of recognizable, uncontaminated concrete and concrete products, asphalt pavement, brick, glass, soil, and rock. Since RCA is a commercial product, it is not considered a regulated waste (6 NYCRR Part 360-1.15[B][11]) and, therefore, it will not be subject to environmental quality testing as a prerequisite for its use.

The locations where RCA will be used as backfill will be consistent with the guidelines established by the NYSDEC Division of Solid Waste for Registered RCA processing facilities. Consistent with the criteria, RCA will not be used unless it is to be covered with no less than 4 feet of clean uncontaminated soil or stone aggregate.

3.2.18 Clean Fill Cover

The final component of the remedial construction will include the installation of a 2-foot thick layer of clean fill within the landscaped portion of Tax Lot 1 and placement of a 6-inch

thick layer of clean fill and/or recycled concrete aggregate (RCA) at the bottom of the excavation on the remaining portion of Tax Lot 1 and Tax Lot 3. Clean fill will only be accepted from certified sources and will be approved by NYSDEC prior to placement. The clean fill cover soil, when placed, will minimize the potential for exposure of construction workers involved in site development to contamination during subsequent construction activities such as driving building piles, installing pile caps and the water/vapor barrier, and constructing the subgrade parking garage floor slab and foundation walls.

3.2.19 Water/Vapor Barrier

As part of building construction, a water/vapor barrier will be installed on the below-grade foundation structure. The horizontal and vertical component of the water/vapor barrier, which will be exposed to contaminated groundwater and vapors, will be composite sheets consisting of a thick HDPE film, a pressure sensitive adhesive and protective coating. The contractor will be required to install the water/vapor barrier in accordance with the specifications provided in Appendix G. The specifications provide details on protecting the water/vapor barrier from damage and wear during application as well as during the construction period. The remedial engineer will be responsible for inspection and photographic documentation during site preparation, installation and post-installation construction activities to confirm that the manufacturer's specifications are followed and the water/vapor barrier, once placed, is not disturbed.

3.2.20 Site Restoration

Upon completion of remedial activities at the site, all equipment (with the exception of equipment required for building construction), any remaining materials and temporary access/tracking pads will be removed from the site. All equipment being demobilized will be properly decontaminated prior to removal off-site. Equipment that has been in contact with contaminated material and will remain on-site will also be decontaminated. Subsequently, the decontamination pad will be removed from the site.

3.3 Institutional and Engineering Controls

As discussed in Section 2.0, institutional controls will be implemented for the entire site (Tax Lot 1 and Tax Lot 3). The institutional controls for the site include establishment of an environmental easement that will:

- ensure that the restrictions placed on the site as well as the engineering control for Tax Lot 3 remain in place;
- ensure appropriate future use and that future property owners are aware of the existing conditions on the site;
- include a restriction prohibiting use of groundwater to ensure there will not be any future exposures to groundwater;
- include required notifications prior to commencement of any ground-intrusive activities that may encounter contaminated materials. Notification of NYSDEC and any on-site workers will be required prior to excavating soil;
- include a soil management plan, identifying requirements in the event of excavation, which will be included as part of the operations and maintenance monitoring plan (OM&M);
- include a health and safety plan and community air monitoring plan for use during future ground-intrusive activities, which will be described in the OM&M Plan;
- include provision for continued periodic soil vapor intrusion monitoring on River Place I property, which will be described in the OM&M Plan;
- include provision for groundwater monitoring which will be described in the OM&M Plan;
- include an annual inspection program to ensure appropriate use of the site and minimize potential for exposures, which will be described in the OM&M Plan; and
- include an annual certification program requiring the owner to certify that the institutional and/or engineering controls are in place, have not been altered and are still effective, which will be described in the OM&M Plan.

In addition to the above institutional controls, as discussed above the water/vapor barrier installed as part of building construction will serve as an engineering control for Tax Lot 3. Careful attention will be given to any indications that this engineering control has been

compromised as part of the annual inspection discussed above, and appropriate investigations and corrective actions will be taken when necessary.

3.4 Operation, Maintenance and Monitoring (OM&M) Plan

An OM&M Plan will be prepared for Tax Lot 1 and Tax Lot 3 to provide guidance for proper long-term maintenance of the remedy. The OM&M Plans will include the following:

- Introduction and purpose;
- Site description and summary of existing environmental conditions and potential exposure scenarios;
- Description of remedy;
- Inspections procedures for the annual inspection program to ensure appropriate use of the site and minimize potential for exposures;
- Procedures for the annual certification program requiring the owner to certify that the institutional and engineering controls are in place, have not been altered and are still effective;
- Groundwater Monitoring Plan describing the groundwater monitoring program including sampling points, frequency, collection procedures, and analytical requirements; and QA/QC, data validation and reporting requirements;
- Soil Management Plan (including soil characterization and disposal requirements);
- Soil Vapor Intrusion Monitoring Plan for River Place I;
- Contingency Plan which will describe the procedures to be conducted in an event of an emergency;
- Health and Safety Plan and Community Air Monitoring Plan;
- Citizen Participation Plan;
- Reporting requirements; and
- Personnel organization, responsibilities and training requirements.

The OM&M Plans will be separate documents that will be prepared during implementation of the remedy. The Plans will be provided to NYSDEC and NYSDOH for review. The OM&M Plans will be updated, as necessary, to address changes to the site and will be maintained in the management offices of the respective buildings.

3.5 Post-remediation Monitoring

Groundwater monitoring to evaluate changes in groundwater contaminant concentrations and to ascertain the level of any natural attenuation which may occur will be performed. New monitoring wells will be installed after construction is complete since existing wells will be removed during construction. The locations of the new wells will be provided in the OM&M Plan.

Groundwater monitoring will consist of quarterly sampling of two upgradient wells and four downgradient wells for 2 years. Subsequent to the first 2 years of monitoring the groundwater, data will be evaluated to determine future groundwater monitoring requirements. The first sampling round will be performed 6 months after remediation is completed. Groundwater samples will be analyzed for VOCs, SVOCs, metals and cyanide. Details of this and other post-remediation measures will be provided in the OM&M Plan described above.

4.0 REPORTING AND DOCUMENTATION

Periodic progress reporting and maintenance of project records during remedial construction will enable involved parties (e.g., regulators) to track the project with respect to schedule and the requirements of the Remedial Work Plan. Additionally, at the completion of remedial construction, a Remedial Action Report will be prepared as described below.

4.1 Monthly Progress Report

The construction contractor will be required to prepare progress reports each month during implementation of the selected remedial action. Each report will include information on the work completed during the month, the anticipated schedule for the following months, and a description of any problems encountered which will impact project progress and their resolution. Progress reports will be available for regulatory agency review.

4.2 On-site Record Keeping

Throughout implementation of the remedial action, records will be maintained by the construction contractor and engineer performing construction inspection to document activities completed on-site. Records that will be maintained include the following:

- Daily field activity reports
- Visitor sign-in/sign-out logs
- Construction photographs
- Instrument calibration logs
- Waste manifests/bills of lading and disposal facility receipts
- Waste characterization sampling results and waste treatment/ disposal facility prequalification forms
- Chain-of-custody forms
- Air monitoring forms
- Contractor submittals
- Dewatering effluent discharge volumes and sampling results
- Measurements of material quantities for progress payments
- Surveys
- Incident/accident reports
- Meeting minutes
- Documentation sampling results

4.3 Remedial Action Report

In accordance with the draft Brownfield Cleanup Program Guide, within 90 days of completion of remediation, a Remedial Action Report (RAR) will be prepared. This report will include the following:

- Description of remedial actions performed;
- Deviations from the Remedial Work Plan, if any;
- Copies of records maintained during the remediation;
- Problems encountered during construction and their resolution;
- A discussion on the quantification and listing of waste/contaminants treated or removed from the site;
- Detailed "as-built" drawings showing the surveyed limits of the excavation, the locations of documentation samples, construction details and locations of sheeting left in place;
- Copies of all records documenting off-site disposal of waste material;
- Documentation sampling results; and
- A copy of the environmental easement.

Also in accordance with the draft Brownfield Cleanup Program Guide, the report will include a certification by a Professional Engineer registered in New York State, stating that the work was implemented and construction activities were completed in substantial conformance with this RWP and that the engineering and institutional controls are included in the environmental easement.

5.0 PROJECT MANAGEMENT

5.1 Key Participants and Responsibilities

Key participants involved in the remediation and development of the West 42nd Street Former Manufactured Gas Plant site under the Brownfield Cleanup Program include the following:

Key Participants	Primary Responsibilities
Participant: Consolidated Edison Company of New York	Oversee planning, implementation and reporting for remedial construction in accordance with approved RWP.
Volunteers/Property Owners: River Place I, LLC and River Place II, LLC	Procure and direct contractors and consultants for design, remedial construction and site development in accordance with approved RWP. Establish institutional controls in accordance with approved RWP.
Regulatory Agencies: New York State Department of Environmental Conservation and New York State Department of Health	Regulatory oversight.
Remedial Engineer: To be determined	Construction inspection, record keeping, reporting and preparation of the Remedial Action Report.
Remediation/Construction Contractor: To be determined	Furnish labor, material, supplies, etc. for remedial construction and site development in accordance with approved plans.

5.2 Project Communication and Management

Throughout the project, project meetings will be held to discuss work progress, plan upcoming activities for the work and discuss any unanticipated site conditions encountered. The construction contractor's superintendent will be required to attend the project meetings, as well as the construction contractor's Health and Safety Officer and QA/QC Officer, when discussion of issues related to their responsibilities is required. In addition, Con Edison's Project Manager and representatives of the property owner and remedial contractor will attend the project

progress meetings. Representatives of NYSDEC and NYSDOH will be made aware of the schedule for project meetings. Following an initial pre-construction meeting, project meetings will be held once per week at the site during the remediation.

Con Edison's Project Manager will be communicating with the property owners to ensure the project is proceeding in accordance with the approved Remedial Work Plan. Con Edison's Project Manager and the property owners will also coordinate communication with regulatory agencies, the public and other interested parties. During remedial construction, a resident engineer will be assigned to the project by the oversight engineer to provide full-time on-site inspection of the work, engage in day-to-day communications with the construction contractor's superintendent and maintain records and prepare reports as described in Section 4.0.

6.0 PROJECT SCHEDULE AND KEY MILESTONES

A preliminary schedule for implementation of the remedial alternative is provided below. Key milestones are identified in order to monitor work progress.

Schedule Milestone	Estimated Completion Time from Submittal of Draft Remedial Work Plan
Submittal of Draft Remedial Work Plan for NYSDEC and Public Review	Day 0
Public Meeting	Day 30
NYSDEC/NYSDOH/Public Review Period End	Day 45
Receive Comments from NYSDEC	Day 50
Submittal of Final Draft Remedial Work Plan	Day 60
NYSDEC Approval of Final Draft Remedial Work Plan	Day 75
NYSDEC Approval of Final Remedial Work Plan	Day 80
Mobilization	Day 80
Implementation of Remedial Alternative	Day 170
Submittal of the Remedial Action Report	Day 230
Regulatory Review of Remedial Action Report	Day 260
Submittal of Final Remedial Action Report	Day 290

Since implementation of the remedial alternative will be coordinated with site development as indicated above, the schedule for starting remedial construction will in part depend on the schedule for building design and procurement of the contractor for building construction.

7.0 REFERENCES

In addition to the information sources identified on figures contained in this work plan, a significant amount of detail regarding implementation of the remedial alternatives was excerpted from the document titled, "Material Handling Work Plan," prepared by Impact Environmental, dated June 16, 2004, and furnished by Con Edison to D&B.

APPENDIX A

COST ESTIMATE

TABLE A-1
WEST 42ND STREET FORMER MANUFACTURED GAS PLANT SITE
TAX LOT 1
ALTERNATIVE 1 - EXCAVATION/REMOVAL OF ACCESSIBLE SOIL
TO TOP OF CLAY LAYER WITH INSTITUTIONAL CONTROLS

COST ESTIMATE

Item	Estimated Quantity	Units	Estimated Unit Cost	Estimated Total
CAPITAL COSTS				
Mobilization/Demobilization	1	LS	$190,000.00	$190,000
Site Trailer and Utilities	1	LS	$14,000.00	$14,000
Emission Controls				
Application of Foam for Vapor Suppression	1	LS	$18,000.00	$18,000
Excavation of Contaminated Soil				
Pre-characterization Sampling	1	LS	$75,000.00	$75,000
Sheeting for Excavation	16,000	SQ FT	$75.00	$1,200,000
Soil Excavation	12,000	CY	$29.00	$348,000
Health and Safety During Remediation	1	LS	$160,000.00	$160,000
Transportation and Disposal of Soil 0 to 5 Feet Deep	5,300	TON	$44.00	$233,000
Transportation and Disposal of Soil Deeper than 5 Feet	16,600	TON	$58.00	$963,000
Sewer Discharge Fee	2,800,000	Gallons	$0.003	$9,000
Extraction and Treatment of Groundwater	1	LS	$98,000.00	$98,000
Documentation Sampling	1	LS	$4,000.00	$4,000
Backfill				
Buy/Haul/Place General Fill	9,000	CY	$40.00	$360,000
Community Air Monitoring Program	1	LS	$75,000	$75,000
Installation of New Groundwater Monitoring Wells	3	Wells	$10,000.00	$30,000
Contingency Allowance (25%)				$944,000
Engineering and Admin. Fees (25%)				$944,000
TOTAL ESTIMATED CAPITAL COST				**$5,665,000**

TABLE A-1
WEST 42ND STREET FORMER MANUFACTURED GAS PLANT SITE
TAX LOT 1
ALTERNATIVE 1 - EXCAVATION/REMOVAL OF SOIL
TO TOP OF CLAY LAYER WITH INSTITUTIONAL CONTROLS

COST ESTIMATE (continued)

Item	Estimated Quantity	Units	Estimated Unit Cost	Estimated Total
ANNUAL OPERATING, MONITORING AND MAINTENANCE (OM&M) COSTS				
Annual Inspections/Certifications				
Inspection	1	Mandays	$800	$800
Annual Certification	2	Mandays	$800	$1,600
Estimated Annual Costs				$2,400
Present Worth of Annual Inspections (30 yrs, i=5%)				**$40,000**
Groundwater Monitoring (Costs Per Event)				
Groundwater Sampling	2	Mandays	$500	$1,000
Purge Water Disposal	4	Drums	$200	$800
Equipment, Materials and Supplies	1	LS	$1,000	$1,000
Sample Analysis	4	Samples	$500	$2,000
Reporting	2	Mandays	$500	$1,000
Estimated Per Event Monitoring Costs				$5,800
Present Worth of Annual Groundwater Monitoring (30 yrs, i=5%)				**$120,000**
TOTAL ESTIMATED OM&M COST				**$160,000**
TAX LOT 1- ALTERNATIVE 1 TOTAL ESTIMATED COSTS				**$5,825,000**

TABLE A-2
WEST 42ND STREET FORMER MANUFACTURED GAS PLANT SITE
TAX LOT 1
ALTERNATIVE 2 - EXCAVATION/REMOVAL OF SOIL
TO NYSDEC TAGM 4046 RSCOs

COST ESTIMATE

Item	Estimated Quantity	Units	Estimated Unit Cost	Estimated Total
CAPITAL COSTS				
Mobilization/Demobilization	1	LS	$1,360,000.00	$1,360,000
Site Trailer and Utilities	1	LS	$115,000.00	$115,000
Emission Controls				
Application of Foam for Vapor Suppression	1	LS	$100,000.00	$100,000
Excavation of Contaminated Soil				
Pre-characterization Sampling	1	LS	$745,000.00	$745,000
Sheeting for Excavation	60,000	SQ FT	$75.00	$4,500,000
Soil Excavation	101,000	CY	$29.00	$2,929,000
Health and Safety During Remediation	1	LS	$1,344,000.00	$1,344,000
Transportation and Disposal of Soil 0 to 5 Feet Deep	36,500	TON	$44.00	$1,606,000
Transportation and Disposal of Soil Deeper than 5 Feet	145,300	TON	$58.00	$8,427,000
Sewer Discharge Fee	61,000,000	Gallons	$0.003	$197,000
Extraction and Treatment of Groundwater	1	LS	$1,720,000.00	$1,720,000
Documentation Sampling	1	LS	$31,000.00	$31,000
Backfill				
Buy/Haul/Place General Fill	98,000	CY	$40.00	$3,920,000
Community Air Monitoring Program	1	LS	$250,000	$250,000
Contingency Allowance (25%)				$6,811,000
Engineering and Admin. Fees (25%)				$6,811,000
TAX LOT 1- ALTERNATIVE 2 TOTAL ESTIMATED COSTS				**$40,866,000**

Notes to Cost Estimate
West 42nd Street Former Manufactured Gas Plant Site
Tax Lot 1

1. **Mobilization/Demobilization** - includes estimated costs for mobilization and demobilization of labor, equipment and facilities. This line item also includes the estimated costs for bonds, insurance, attendance at meetings, and preparation of submittals, permit applications and as-built drawings. Estimated at 5% of capital cost without contingency allowance.

2. **Site Trailer and Utilities** - Based on "Probable Remedial Cost" prepared by Seasons Industrial Contracting. Existing fence would be used.

3. **Emissions Controls** - includes the estimated cost for rental of a pneumatic foam vapor suppressant unit. Estimated foam use based on site area of 16,000 square feet and the equivalent of 7 applications for Alternative 1 and based on an area of 109,000 square feet and the equivalent of 10 applications for Alternative 2 in accordance with communications with Russmar Inc.

4. **Pre-Characterization Sampling** – Estimated in-place characterization sampling and analysis costs for soil disposal are based on collection and analysis of samples as described in the Remedial Work Plan.

5. **Sheeting of Excavation** - includes estimated costs for installation of watertight sheeting around the perimeter of the limits of excavation. Sheeting would remain in place. Unit cost based on "Probable Remedial Cost" prepared by Seasons Industrial Contracting.

6. **Soil Excavation** - includes estimated costs for labor, equipment and materials to excavate soil, and load soil/material onto trucks for disposal. Includes estimated costs for additional handling required for wet soils (i.e., blending prior to disposal). Unit cost based on "Probable Remedial Cost" prepared by Seasons Industrial Contracting.

7. **Health and Safety During Remediation -** includes estimated costs for personal protective equipment, supervision by certified industrial hygienist, and HAZWOPER labor and contingency measures as indicated in costs provided by Seasons Industrial Contracting.

8. **Transportation and Disposal -** includes estimated costs for transportation of soil/fill from the site to the disposal facility and estimated disposal costs. Unit costs and material density estimates based on information from Seasons Industrial Contracting.

9. **Dewatering (Extraction and Treatment of Groundwater and Sewer Discharge Fee) -** includes estimated costs for installation of well points, pumps, piping and treatment to sewer standards and sewer discharge fee. Estimate does not include extraction and treatment of free phase product which it is not expected will be encountered.

10. **Documentation Sampling** - includes estimated costs for collection of one sample every 2,000 square feet of excavation floor and analysis of each sample for VOCs, SVOCs and cyanide. Accounting for samples collected during the SCS, collection of 5 samples will be required to finalize documentation sampling for Alternative 1 and 55 samples for Alternative 2.

11. **Backfill** - includes estimated costs for furnishing, placing and compacting general fill from an off-site source. Note: the estimated volume of backfill required is less than the estimated volume of excavation since part of Tax Lot 1 will be occupied by the new building.

12. **Community Air Monitoring -** includes estimated costs for installation of fixed air monitoring stations around the site to monitor in real-time for volatile organic compounds and airborne respirable particulates.

13. **New Monitoring Wells** - includes estimated costs for labor, equipment and materials for installation of 20-foot deep monitoring wells.

14. **Annual Inspections/Certifications** - includes estimated costs for labor required to perform annual inspections and prepare annual certification.

15. **Groundwater Monitoring** - includes estimated costs for collection of groundwater samples from three new wells. Sampling will be conducted quarterly for 2 years. Subsequent sampling will be conducted annually. Groundwater samples will be analyzed for VOCs, SVOCs, metals and cyanide.

16. The cost estimate was prepared for the purpose of evaluating the alternatives presented in the Remedial Work Plan and the intended use is limited to that purpose.

17. Although not included in the estimate, the additional cost of building demolition and related work would further increase the total estimated cost for Alternative 2 for Tax Lot 1.

TABLE A-3
WEST 42ND STREET FORMER MANUFACTURED GAS PLANT SITE
TAX LOT 3
ALTERNATIVE 1 - EXCAVATION/REMOVAL OF CONTAMINATED SOIL
WITH ENGINEERING AND INSTITUTIONAL CONTROLS

COST ESTIMATE

Item	Estimated Quantity	Units	Estimated Unit Cost	Estimated Total
CAPITAL COSTS				
Mobilization/Demobilization	1	LS	$530,000.00	$530,000
Site Trailer and Utilities	1	LS	$47,000.00	$47,000
Emission Controls				
Application of Foam for Vapor Suppression	1	LS	$37,000.00	$37,000
Excavation of Contaminated Soil				
Pre-characterization Sampling	1	LS	$300,000.00	$300,000
Sheeting for Excavation	28,000	SQ FT	$75.00	$2,100,000
Soil Excavation	41,000	CY	$29.00	$1,189,000
Health and Safety During Remediation	1	LS	$547,000.00	$547,000
Subsurface Structure Removal	1	LS	$650,000.00	$650,000
Transportation and Disposal of Soil 0 to 5 Feet	16,000	TON	$44.00	$704,000
Transportation and Disposal of Gas Holder Soil	6,000	TON	$76.00	$456,000
Transportation and Disposal of Soil Deeper than 5 Feet	52,000	TON	$58.00	$3,016,000
Sewer Discharge Fee	11,100,000	Gallons	$0.003	$36,000
Extraction and Treatment of Groundwater	1	LS	$392,000.00	$392,000
Documentation Sampling	1	LS	$10,000.00	$10,000
Backfill				
Buy/Haul/Place General Fill	5,000	CY	$40.00	$200,000
Community Air Monitoring Program	1	LS	$125,000	$125,000
Vapor Barrier				
Purchase	1	LS	$165,000.00	$165,000
Installation	1	LS	$165,000.00	$165,000
Installation of New Groundwater Monitoring Wells	3	Wells	$10,000.00	$30,000
Contingency Allowance (25%)				$2,675,000
Engineering and Admin. Fees (25%)				$2,675,000
TOTAL ESTIMATED CAPITAL COST				**$16,049,000**

TABLE A-3
WEST 42ND STREET FORMER MANUFACTURED GAS PLANT SITE
TAX LOT 3
ALTERNATIVE 1 - EXCAVATION/REMOVAL OF CONTAMINATED SOIL WITH ENGINEERING AND INSTITUTIONAL CONTROLS

COST ESTIMATE (continued)

Item	Estimated Quantity	Units	Estimated Unit Cost	Estimated Total
ANNUAL OPERATING, MONITORING AND MAINTENANCE (OM&M) COSTS				
Annual Inspections/Certifications				
Inspection	1	Mandays	$800	$800
Annual Certification	2	Mandays	$800	$1,600
Estimated Annual Costs				$2,400
Present Worth of Annual Inspections (30 yrs, i=5%)				**$40,000**
Groundwater Monitoring (Costs Per Event)				
Groundwater Sampling	2	Mandays	$500	$1,000
Purge Water Disposal	4	Drums	$200	$800
Equipment, Materials and Supplies	1	LS	$1,000	$1,000
Sample Analysis	4	Samples	$500	$2,000
Reporting	2	Mandays	$500	$1,000
Estimated Per Event Monitoring Costs				$5,800
Present Worth of Annual Groundwater Monitoring (30 yrs, i=5%)				**$120,000**
TOTAL ESTIMATED OM&M COST				**$160,000**
TAX LOT 3 - ALTERNATIVE 1 TOTAL ESTIMATED COSTS				**$16,209,000**

TABLE A-4
WEST 42ND STREET FORMER MANUFACTURED GAS PLANT SITE
TAX LOT 3
ALTERNATIVE 2 - EXCAVATION/REMOVAL OF SOIL
TO NYSDEC TAGM 4046 RSCOs

COST ESTIMATE

Item	Estimated Quantity	Units	Estimated Unit Cost	Estimated Total
CAPITAL COSTS				
Mobilization/Demobilization	1	LS	$720,000.00	$720,000
Site Trailer and Utilities	1	LS	$60,000.00	$60,000
Emission Controls				
Application of Foam for Vapor Suppression	1	LS	$59,000.00	$59,000
Excavation of Contaminated Soil				
Pre-characterization Sampling	1	LS	$455,000.00	$455,000
Sheeting for Excavation	41,000	SQ FT	$75.00	$3,075,000
Soil Excavation	52,000	CY	$29.00	$1,508,000
Health and Safety During Remediation	1	LS	$693,000.00	$693,000
Subsurface Structure Removal	1	LS	$650,000.00	$650,000
Transportation and Disposal of Soil 0 to 5 Feet	16,000	TON	$44.00	$704,000
Transportation and Disposal of Gas Holder Soil	6,000	TON	$76.00	$456,000
Transportation and Disposal of Soil Deeper than 5 Feet	72,000	TON	$58.00	$4,176,000
Sewer Discharge Fee	20,400,000	Gallons	$0.003	$66,000
Extraction and Treatment of Groundwater	1	LS	$579,000.00	$579,000
Documentation Sampling	1	LS	$10,000.00	$10,000
Backfill				
Buy/Haul/Place General Fill	16,000	CY	$40.00	$640,000
Community Air Monitoring Program	1	LS	$175,000	$175,000
Vapor Barrier				
Purchase	1	LS	$165,000.00	$165,000
Installation	1	LS	$165,000.00	$165,000
Contingency Allowance (25%)				$3,589,000
Engineering and Admin. Fees (25%)				$3,589,000
TAX LOT 3 - ALTERNATIVE 2 TOTAL ESTIMATED COSTS				**$21,534,000**

Notes to Cost Estimate
West 42nd Street Former Manufactured Gas Plant Site
Tax Lot 3

1. **Mobilization/Demobilization** - includes estimated costs for mobilization and demobilization of labor, equipment and facilities. This line item also includes the estimated costs for bonds, insurance, attendance at meetings, and preparation of submittals, permit applications and as-built drawings. Estimated at 5% of capital cost without contingency allowance.

2. **Site Trailer and Utilities** - Based on "Probable Remedial Cost" prepared by Seasons Industrial Contracting. Existing fence would be used.

3. **Emissions Controls** - includes the estimated cost for rental of a pneumatic foam vapor suppressant unit. Estimated foam use based on site area of 54,000 square feet and the equivalent of 7 and 10 applications for Alternatives 1 and 2, respectively, in accordance with communications with Russmar Inc.

4. **Pre-Characterization Sampling** – Estimated in-place characterization sampling and analysis costs for soil disposal are based on collection and analysis of samples as described in the Remedial Work Plan.

5. **Sheeting of Excavation** - includes estimated costs for installation of watertight sheeting around the perimeter of the limits of excavation. Sheeting would remain in place. Unit cost based on "Probable Remedial Cost" prepared by Seasons Industrial Contracting.

6. **Soil Excavation** - includes estimated costs for labor, equipment and materials to excavate soil, and load soil/material onto trucks for disposal. Includes estimated costs for additional handling required for wet soils (i.e., blending prior to disposal). Unit cost based on "Probable Remedial Cost" prepared by Seasons Industrial Contracting.

7. **Health and Safety During Remediation -** includes estimated costs for personal protective equipment, supervision by certified industrial hygienist, and HAZWOPER labor and contingency measures as indicated in costs provided by Seasons Industrial Contracting.

8. **Transportation and Disposal -** includes estimated costs for transportation of soil/fill from the site to the disposal facility and estimated disposal costs. Unit costs and material density estimates based on information from Seasons Industrial Contracting.

9. **Dewatering (Extraction and Treatment of Groundwater and Sewer Discharge Fee) -** includes estimated costs for installation of well points, pumps, piping and treatment to sewer standards and sewer discharge fee. Estimate does not include extraction and treatment of free phase product which it is not expected will be encountered.

10. **Documentation Sampling** - includes estimated costs for collection of one sample every 2,000 square feet of excavation floor and analysis of each sample for VOCs, SVOCs and cyanide. Accounting for samples collected during the SCS, collection of 16 samples will be required to finalize documentation sampling for Tax Lot 3.

11. **Backfill** - includes estimated costs for furnishing, placing and compacting general fill from an off-site source.

12. **Community Air Monitoring -** includes estimated costs for 4 fixed air monitoring stations installed around the site to monitor in real-time for volatile organic compounds and airborne respirable particulates.

13. **New Monitoring Wells** - includes estimated costs for labor, equipment and materials for installation of 20-foot deep monitoring wells.

14. **Annual Inspections/Certifications** - includes estimated costs for labor required to perform annual inspections and prepare annual certification.

15. **Groundwater Monitoring** - includes estimated costs for collection of groundwater samples from three new wells. Sampling will be conducted quarterly for 2 years. Subsequent sampling will be conducted annually. Groundwater samples will be analyzed for VOCs, SVOCs, metals and cyanide.

16. The cost estimates were prepared for the purpose of evaluating the alternatives presented in the Remedial Work Plan and the intended use is limited to that purpose.

APPENDIX B

NEW YORK STATE DEPARTMENT OF HEALTH
GENERIC COMMUNITY AIR MONITORING PLAN

APPENDIX 1A

New York State Department of Health
Generic Community Air Monitoring Plan

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for volatile organic compounds (VOCs) and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate NYSDEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

All 15-minute readings must be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

All readings must be recorded and be available for State (DEC and DOH) personnel to review.

APPENDIX C

AIR QUALITY MONITORING PLAN

Air Quality Monitoring Plan

Remedial Work Plan Supplement

West 42nd Street
Former Manufactured Gas Plant Site
Brownfield Cleanup Program
Manhattan, New York

Impact Environmental
170 Keyland Court ◦ Bohemia ◦ New York ◦ 11716 ◦ 631.269.8800

IMPACT ENVIRONMENTAL

Air Quality Monitoring

Air monitoring for non-methane hydrocarbons and for particulates will be measured and logged real time at each property boundary and at the exclusion zone. Additionally, meteorological data inclusive of barometric pressure, temperature, humidity, wind direction, wind speed and wind chill will be monitored with a portable weather station. The locations of each monitoring station are presented in Figure 1. One monitoring station will be positioned at each the north, south and east boundaries. These boundaries are adjacent to public sidewalks and roads that are contiguous with neighboring commercial and industrial properties.

Two monitoring stations will be positioned along the western boundary of the site. This boundary is contiguous with property containing residential dwellings. The doubling of the monitoring stations will provide increased sensitivity, and, therefore, a higher level of protection for the adjoining residential land use.

All monitoring instrumentation will be calibrated at the frequency and in accordance with the procedures recommended by the manufacturers. The construction contractor will be required to maintain records of calibration events. Net readings of each instrument will be calculated as total readings less ambient concentrations.

Ambient Air Quality Determination

Each day, prior to the initiation of any on-site remedial activities, the wind and air quality monitoring network will be used to quantify an ambient background concentration for particulate and non-methane hydrocarbons. The ambient air quality measurements will be taken from the upwind side of the site. The hydrocarbons will be analyzed to determine its chemical species with a gas chromatograph. The speciated analysis will provide data to assist in the identification of the source of the detected hydrocarbons (e.g. vehicle exhaust, diesel engine emissions, gasoline powered generators, etc.). The GC will have a precision as measured by Relative Standard Deviation median values of between 3 and 20% and a 95^{th} percentile value of 25-35%. Accuracy as

measured by an Absolute Percent Difference median values of between 10 to 40% and 95th percentile values of 20 to 30%. Additionally, the GC will have a minimum detection limit for speciated hydrocarbons of 0.1 ppm.

Air Quality Measurements

Air quality monitoring at each property line is necessary as wind directions are vectors that typically vary by 180 degrees throughout a 12-hour period. The presence of large high-rise structures in the area further increases vector variation. The simultaneous monitoring of the wind and air quality at each boundary of the site will aid in determining the source of any detected air quality data anomalies. An understanding of the source will aid in the selection of appropriate contingency measures (see section xxx). Furthermore, the proposed monitoring will generate data that will assist in the identification and quantification of contributory off-site air pollution sources.

Real time air quality monitoring for non-methane hydrocarbons will be performed utilizing MultiRAE Plus portable photo ionization detection meters manufactured by RAE Systems. The MultiRAE Plus has a hydrocarbon detection range of 0-2,000 ppm with 0.1 ppm resolution, and it combines a photo ionization detector with the standard four gases of a confined space monitor (O_2, LEL, and two toxic gas sensors). The MultiRAE Plus detector is wireless allowing real-time monitoring information from the detector to be integrated into an existing AreaRAE system. A wireless, radio frequency modem allows detectors to communicate and transmit readings and other information on a real-time basis with a remotely located AreaRAE base controller up to two miles away. Data from all of the detectors will be compiled with PC-based software that can show all historic data in graphic or text form. This data will be included within final closure documentation.

Real time air quality monitoring for particulates will be performed utilizing a ThermoMIE Data Ram electromagnetic radiation sensor. The instrument can be configured to respond only to dust particles less than 10 microns in diameter, dust particles less than 2.5 microns in

diameter or total suspended particulate. A wireless, radio frequency modem allows detectors to communicate and transmit readings and other information on a real-time basis with a remotely located base controller. Data from all of the detectors will be compiled with PC-based software that can show all historic data in graphic or text form. This data will be included within final closure documentation.

Site generated odors will be measured over a 15 minute period using the n-butanol scale adapted from ASTM E544-99.

Measured site air quality readings will define a site condition that will be generalized with color-coding; green, preliminary yellow, yellow and red. Audible and visual alarms will be installed throughout the site that will identify the air quality conditions on-site. Decisions and prompts flow diagrams for each air quality parameter are included as Figures 2, 3 and 4. The condition prompts have been summarized in table 1 below.

Table 1

Target	CAMP Action Level	Site Condition			
		Green	Preliminary Yellow	Yellow	Red
Total Non-methane hydrocarbons	5 ppm above ambient	<3.7 ppm	3.7 to 5.0 ppm over one sample cycle	3.7 to 5.0 ppm over three sample cycles	>5.0 ppm over three sample cycles
Respirable Particulate Matter [PM10]	150 ug/m3 above ambient	<113 ug/m3	114 to 150 ug/m3 over one sample cycle	114 to 150 ug/m3 over three sample cycles	150 ug/m3 over three sample cycles
Odor	3	<3 and no odor complaints	-	-	>3 or odor complaints

Monitoring will continue during all conditions, however, where the site is determined to be in condition Yellow or Red additional hydrocarbon analysis will be performed with a portable gas chromatograph. The data generated from the analysis will be used to assist in determining the source of the detected hydrocarbons. If it is determined that the

source is primarily a function of off-site influences, monitoring will continue until such time as the influence is discontinued. Where possible, efforts will be made to expedite the discontinuance of the off-site source(s).

Contingency Plan

Where condition yellow or red exists at the project, contingency measures will be implemented. Additionally, the individuals identified on the CHASP key personnel list will be electronically paged or contacted by cell phone. The contingency measures are summarized in table 2 below.

Table 2

Site Condition	Contingency Measure
Yellow	• Continue monitoring air quality • Establish trend of data and determine if evaluation/wait period is warranted • Temporarily stop work • Temporarily relocate work to an area with potentially lower emissions • Apply water to the area of activity or haul roads to minimize dust • Reschedule work activities • Cover all or part of the excavation area • Apply VOC emission suppressant foam over open excavation front or stockpiles • Slow the pace of the offending activity • Install a localized perimeter barrier fence • Adjust the physical setup of the spray bar misters to increase coverage in the work area • Adjust chemical odor/dust suppressant solution used with misters
Red	• Continue monitoring air quality • Apply the yellow Condition contingency measures presented above • Encapsulate construction area and treat air exhaust • Perform work during cold temperatures • Cease construction activities • Re-evaluate air monitoring plan
Notes: The bulleted response actions specified under each alert can be implemented in any order that is most appropriate under the existing site conditions.	

The contingency plan will be incorporated into the CHASP as a separate summary document for quick access and reference by all personnel. The summary document will contain the following sections: fixed station and perimeter air monitoring map; emergency contact list; example contingency meeting report; target concentrations for site alert conditions; response actions for site alert levels; total VOC decision diagram; respirable particulate matter decisions diagram and odor decision diagram.

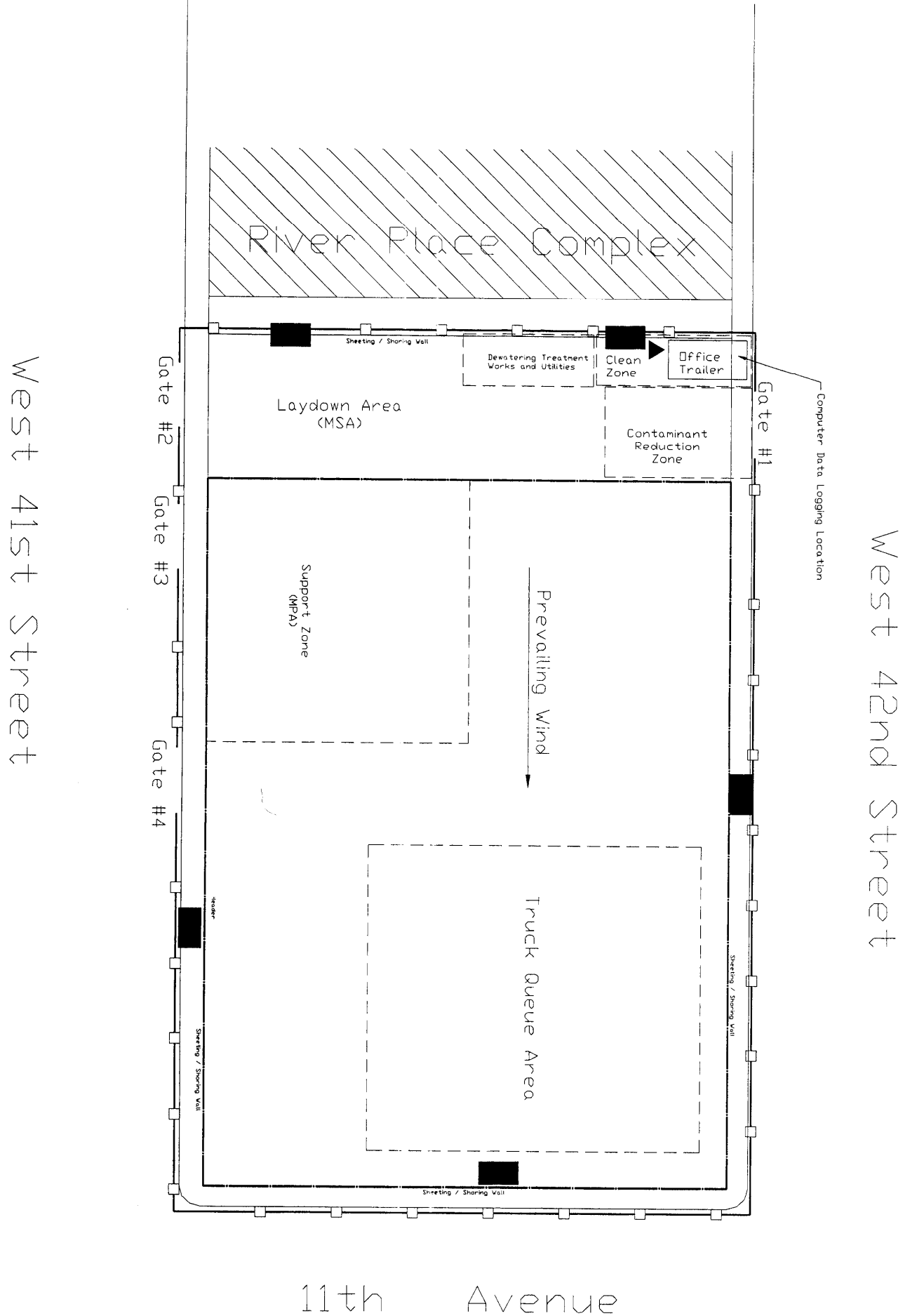


Figure 1: Perimeter Air Quality Monitoring Stations

Legend Scale: 1" = 4(

Perimeter Air Quality Monitoring Station

Figure 2
Odor Decisions and Prompts Flow Diagram

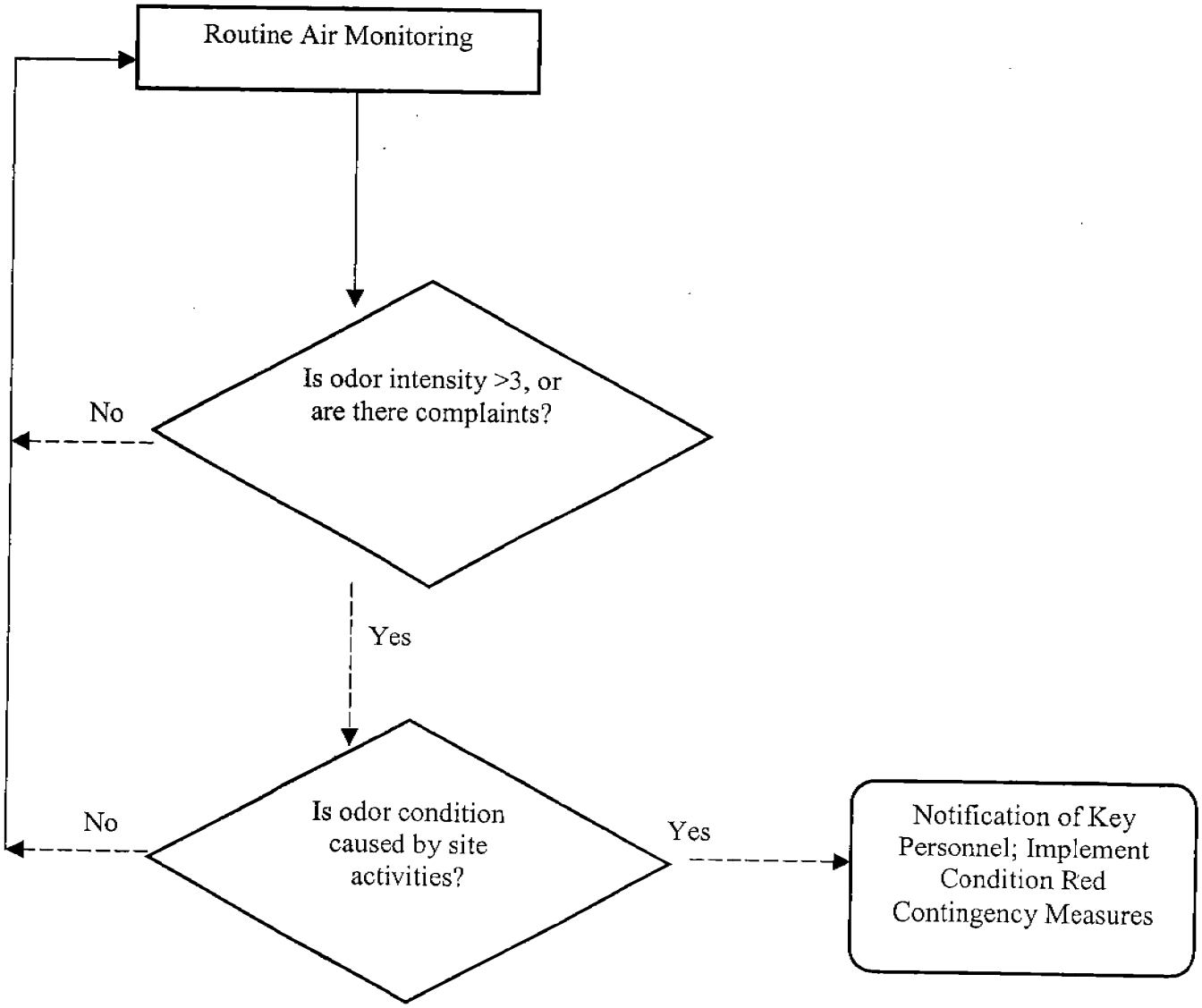


Figure 3
Particulate [PM10] Decisions and Prompts Flow Diagram

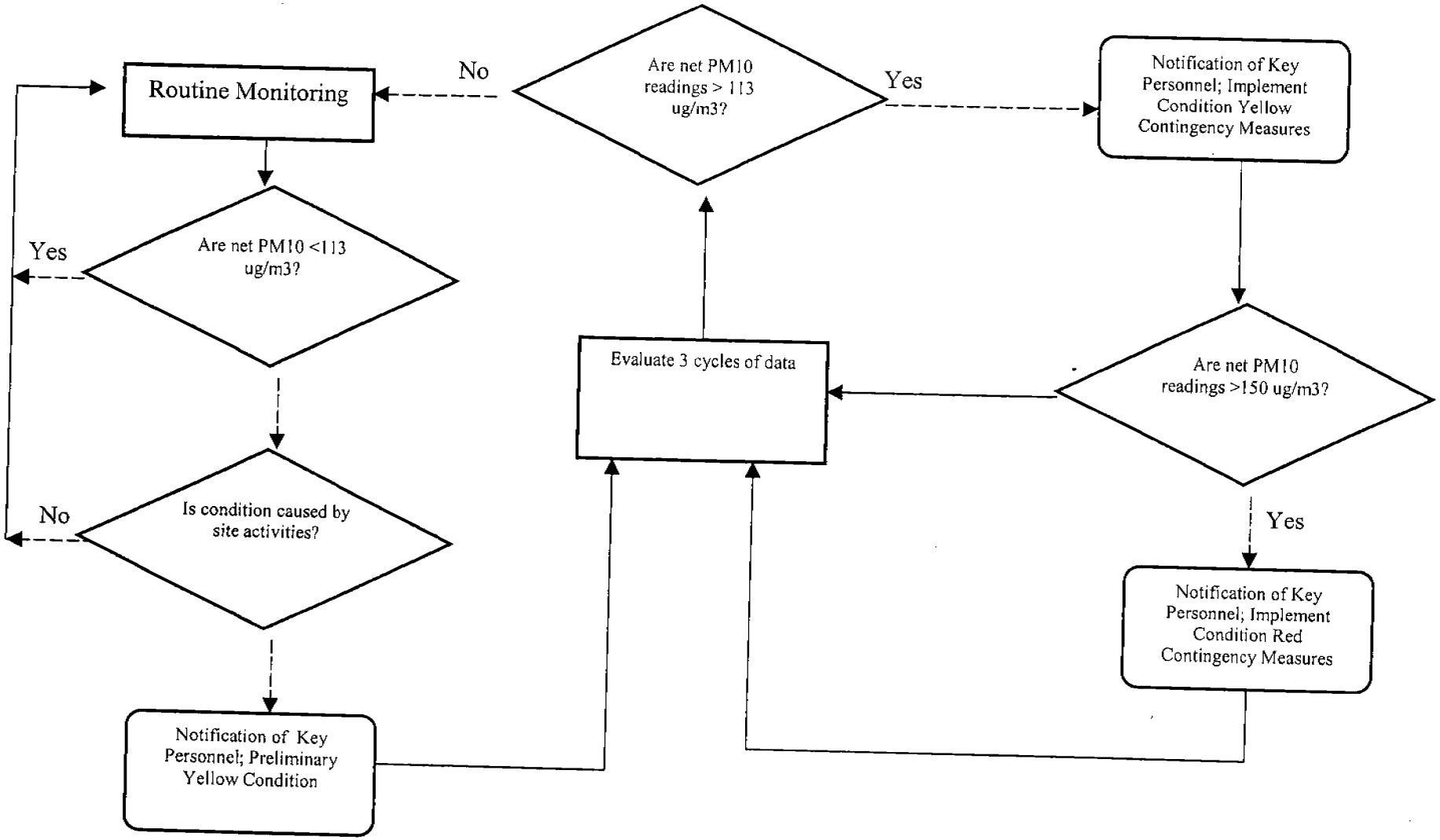
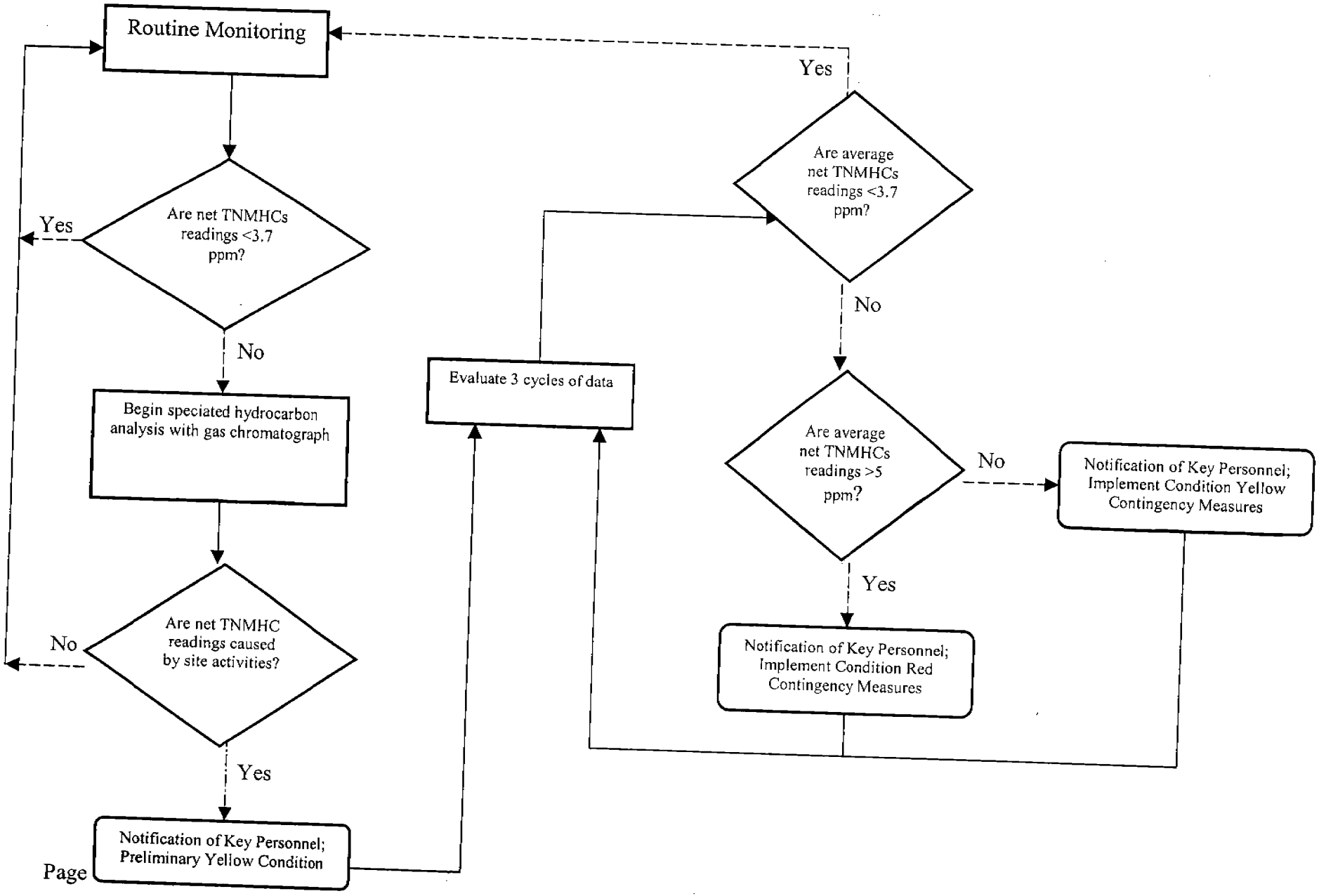


Figure 4
Total Non-Methane Hydrocarbons [TNMHCs] Decisions and Prompts Flow Diagram



APPENDIX D

CHEMICAL/ENVIRONMENTAL RESISTANCE CHART

CHEMICAL/ENVIRONMENTAL RESISTANCE CHART
XR-5® Fluid Resistance Guidelines

The data below is the result of laboratory tests and is intended to serve only as a guide. No performance warranty is intended or implied. The degree of chemical attack on any material is governed by the conditions under which it is exposed. Exposure time, temperature, and size of the area of exposure usually varies considerably in application, therefore, this table is given and accepted at the user's risk. Confirmation of the validity and suitability in specific cases should be obtained.

When considering XR-5 for specific applications, it is suggested that a sample be tested in actual service before specification. Where impractical, tests should be devised which simulate actual service conditions as closely as possible.

Exposure	Rating	Exposure	Rating
AFFF	A	JP-4 Jet Fuel	A
Acetic Acid (5%)	B	JP-5 Jet Fuel	A
Acetic Acid (50%)	C	JP-8 Jet Fuel	A
Ammonium Phosphate	T	Kerosene	A
Ammonium Sulfate	T	Magnesium Chloride	T
Antifreeze (ethylene glycol)	A	Magnesium Hydroxide	T
Animal Oil	A	Methanol	A
Aqua Regia	X	Methyl Alcohol	A
ASTM Fuel A (100% Iso-octane)	A	Methyl Ethyl Ketone	X
ASTM Oil #2 (Flash pt. 240° C)	A	Mineral Spirits	A
ASTM Oil #3	A	Naphtha	A
Benzene	X	Nitric Acid (5%)	B
Calcium Chloride Solutions	T	Nitric Acid (50%)	C
Calcium Hydroxide	T	Perchloroethylene	C
20% Chlorine Solution	A	Phenol	X
Clorox	A	Phenol Formaldehyde	B

Conc. Ammonium Hydroxide	A	Phosophoric Acid (50%)	A
Corn Oil	A	Phosophoric Acid (100%)	C
Crude Oil	A	Phthalate Plasticizer	C
Diesel Fuel	A	Potassium Chloride	T
Ethanol	A	Potassium Sulphate	T
Ethyl Acetate	C	Raw Linseed Oil	A
Ethyl Alcohol	A	SAE-30 Oil	A
Fertilizer Solution	A	Salt Water (25%)	B
#2 Fuel Oil	A	Sea Water	A
#6 Fuel Oil	A	Sodium Acetate Solutions	T
Furfural	X	Sodium Bisulfite Solution	T
Gasoline	B	Sodium Hydroxide (60%)	A
Glycerin	A	Sodium Phosphate	T
Hydraulic Fluid- Petroleum Based	A	Sulphuric Acid (50%)	A
Hydraulic Fluid- Phosphate Ester Based	C	50% Tanic Acid	A
Hydrocarbon Type II (40% Aromatic)	C	Toluene	C
Hydrochloric Acid (50%)	A	Transformer Oil	A
Hydrofluoric Acid (5%)	A	Turpentine	A
Hydrofluoric Acid (50%)	A	Urea Formaldehyde	A
Hydrofluosilicic Acid (30%)	A	UAN	A
Isoprophyl Alcohol	T	Vegetable Oil	A
Ivory Soap	A	Water (200°F)	A
Jet A	A	Xylene	X

		Zinc Chloride	T

RATING KEY:
A - Fluid has little or no effect
B - Fluid has minor to moderate effect
C - Fluid has severe effect
T - No data-likely to be acceptable
X - No data-not likely to be acceptable

For questions on XR-5 or other specialty fabrics available, please call us at 1-800-474-7294.

Ratings are based on visual and physical examination of samples after removal from the test chemical after the samples of Black XR-5 were immersed for 28 days at room temperature. Results represent ability of material to retain its performance properties when in contact with the indicated chemical.

APPENDIX E

ADEKA ULTRA SEAL A-50 PRODUCT INFORMATION

Piling Accessories — Joint Sealant

- WADIT®
- Ultra Seal®

Foster Piling

WADIT®

- Sheet piling sealants of the new generation
- Tested groundwater-compatible hot sealing compound for sheet piling rocks

Applications

- Sealing of steel sheet piling walls in conjunction with pile driving work in water-bearing formations. Sealing of concrete and steel components.
- Sealing of the edge interlocks of sheet piling walls to prevent penetration of soil constituents and, thus, seizing during pile driving.

Product description

WADIT is based on naturally grown raw materials, free of ingredients harmful to the environment and, thus, optimally environmentally compatible so that its use in groundwater-bearing strata poses no problems. Sealing compound residues may be left in the ground for an indefinite period of time.

Processing informtion

The industrial safety regulations for handling hot liquid building materials must be observed. The containers may be melted open together with the packing. Make sure that the packing is clean and dry.

For heating WADIT, we recommend using a thermostat-controlled heater indirectly healed with thermal oil as this will
normally avoid local overheating of the sealing compound. While WADIT is being poured into the sheet piling locks, the sheet piles must be in a perfectly horizontal position.

In order 10 achieve a reliable bond between sealing compound and steel, special care should be taken to ensure that the steel sections are clean, dry and free of grease. The 'rolling skin' clinging to new steel sections (which partially consists of grease and oil) should be removed by means of a rotating brush. Using a torch, briefly soften sealant residues in sheet piling locks. The consumption of WADIT is largely determined by the condition of the sheet piling locks (new or used, tolerances). During the cold season, steel sections which are sealed at the open air must always first be lightly preheated with a torch in order to avoid a cold shock (which would certainly lead to the formation of a moisture film on the steel).

Furthermore parts in storage which have not yet been sealed should always be protected against moisture. Atmospheric precipitation shall be sufficient reason to stop all sealing works on site.

The applicable codes of recommended practice for processing bituminuos materials must be observed.

However, if outside temperatures necessitate the addition of WADIT FLEX (see following table for dosing instructions), than this shall be added directly into the heater immediately after the Introduction of WADIT.

The amounts of WAD IT FLEX to be added depend on the outside temperature at the time of the pile driving operation.

Dosing Instructions for WADIT FLEX

Outside Temperature	Amount of WADIT FLEX to be added to 25 kg of WADIT
Above 10° C	No addition required
+5° C to +10° C	Normally, no addition required. In sppecial cases; 2 litres
0° C to +5° C	2 to 4 litres
Below 0° C	4 to 6 litres

Important:
Overheating may substantially impair the quality of the sealing compound and must therefore be avoided at air events. The temperature must be kept between 130° C and a maximum of 170° C and should be regularly checked with a thermometer. During the heating phase, the sealing compound must be stirred at regular intervals. If WADIT emits a dense whitish - yellow fog during healing, the sealing compound has been overheated and probably already damaged. A sealing compound which has been damaged in this manner should no longer be used. To avoid thermal damage, WADIT should not be melted more than twice at the most.

Cleaning of tools and treatment of residual compound

WADIT is soluble in organic solvents, such as while spirit and xylene or diesel, As particularly environment-friendly solvents we recommend rape oil and rape oil methyl ester (bio diesel), Dissolved in the latter, WADIT can be mixed with lime or cement to form a paste which may be dumped on rubbish tips in small amounts.

Containers and storage (25 kg containers)

For prolonged periods of time, the containers should be stored indoors at temperatures under +30°C.

Recommended action in the event of accidents/burns

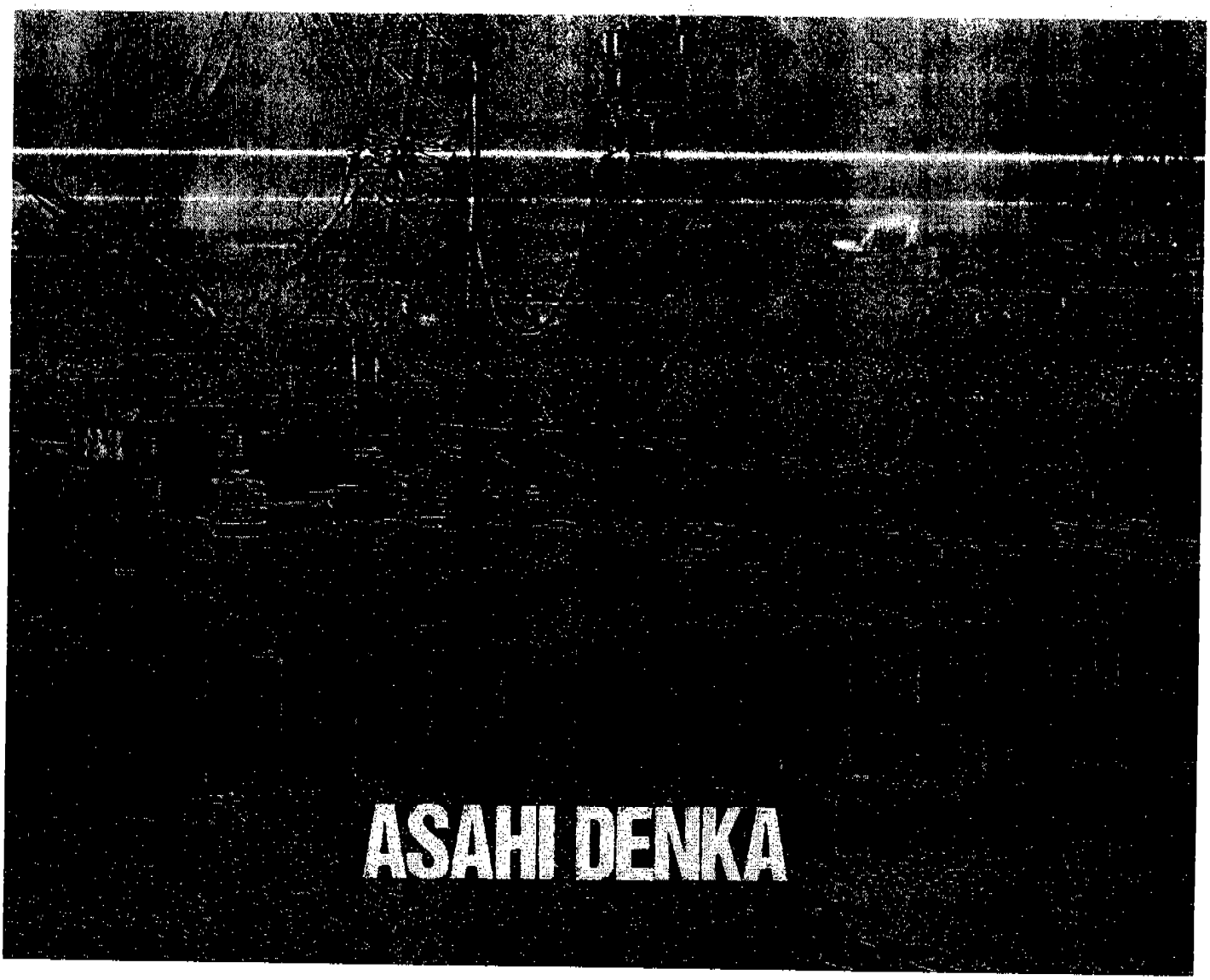
Skin burns caused by unworkmanlike handling of WADIT should be treated immediately by cooling the area affected with cold water for several minutes. Do not peel adhering material from the skin or remove it with solvents! Cooled WADIT acts like a sterile bandage and drops off with the scab.
In any case, also see a doctor!

Although WADIT as such is in no way harmful to the skin, any direct contact should be avoided for general hygienic reasons. Inhaling hot vapors that form when the material is healed should definitely be avoided. The vapors may cause slight nausea, but do not constitute a toxid hazard.

Waterstop for sheet piles

ADEKA ULTRA SEAL®

A-50



Waterstop for sheet piles

ADEKA ULTRA SEAL A-50

Steel sheet piles are widely used for shore protection works, bridge abutments, earth retaining walls and coffer dams.
With the advancement of construction technologies, concerns over the problems of safety, water pollution, and pumping costs have grown.
This has resulted in a demand for a product with a higher water sealing ability.
ADEKA ULTRA SEAL A-50 is a revolutionary new waterstop system.
Perfect sealing can be achieved due to its unique water swelling characteristics.

Growing demand for perfect seals for sheet piles.

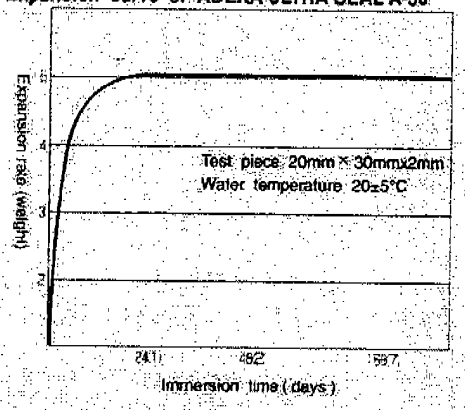
Problems caused by water leakage in sheet pile construction

Safety:
Disasters from ground subsidence may occur
Drainage:
For environmental protection, leaked water cannot be drained into rivers and seas, also when ground improving additives are used, water treatment facilities for drainage will be needed.
Economic efficiency:
High leakage will require water draining systems with increased capacity resulting in higher maintenance and running costs.
Construction site:
Safe and comfortable working environment cannot be secured.

Waterstopping mechanism

ADEKA ULTRA SEAL A-50 is a totally new, simple and easy water stopping system. When in contact with water, it expands to 5 times its volume in 24 hours and fills the gaps of the interlocking section of sheet piles. It withstands more than 50 metres of hydrostatic head.

Expansion curve of ADEKA ULTRA SEAL A-50



Expansion of Ultraseal A-50

Before soaking in water, thickness:3mm

After soaking in water for 24 hours

Outstanding Waterstopping Abilities
ADEKA ULTRA SEAL A-50

Characteristics

1 Cured rubber films expand when in contact with water and withstand more than 50meters of hydrostatic head.

2 Because of its strong adhesive strength, the rubber stays firmly in place on a sheet pile even when it is driven into the ground.

3 ADEKA ULTRA SEAL A-50 expands in the interlock sections of sheet piles which have been already driven in the ground.

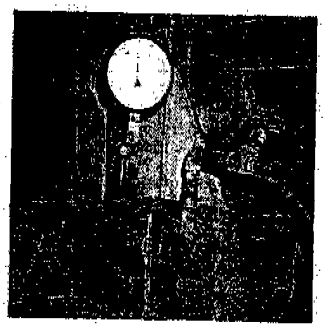
4 Since ADEKA ULTRA SEAL A-50 does not contain any solvents it makes application easy and even. It is environmentally safe.

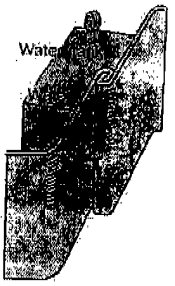
5 The cured rubber does not pollute water.

6 Different from other gelled products,the cured rubber can be easily removed by blowing with an air jet because it loses its adhesiveness in contact with water.

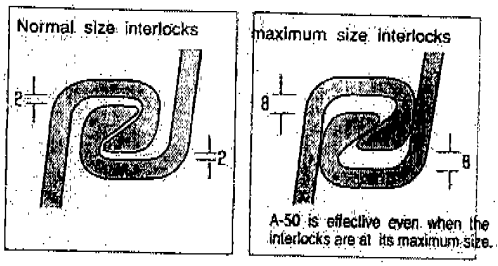
7 It is an organic product which does not contain any solvents. A large amount of storage (2,000 liters) is possible, compared with conventional products.

Hydrostatic head test 5kg/cm²





Gaps of interlock section of sheet piles,



A-50 is effective even when the interlocks are at its maximum size.

Composition, Properties

ADEKA ULTRASEAL A-50 is a liquid rubber which expands when in contact with water. It is free from low boiling point solvents. After curing in air, it becomes a stable polymeric rubber.

Properties before curing (liquid rubber state)	JIS=ASTM	
Appearance	Eye measurement	Clear liquid
Specific gravity	25°C by a hydrometer	1.05±0.05
Viscosity (CP)	25°C B type balance	1100±250
Tackfree	20°C 60% RH	Less than 20hours
Curing time	20°C 60% RH	Less than 60hours

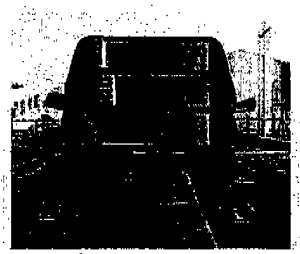
Properties after curing (rubber state)	JIS=ASTM	
Curing	HS-A	20
Tensile strength	kg/cm	More than 47
Elasticity	%	More than 1,000
100% tensile stress	kg/cm	3.7
300% tensile stress	kg/cm	6.1
500% tensile stress	kg/cm	8.8
Strength against tearing	kg/cm	11

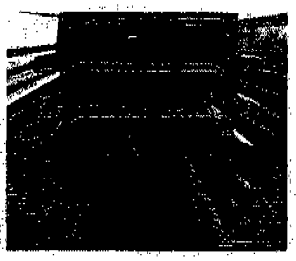
For the use in cold weather districts, add 500 grams of curing stimulator S-10. to 15kg of ADEKA ULTRASEAL A-50.
Properties of cured compound are same with ones of A-50.

Installation Procedures

1 Preparations

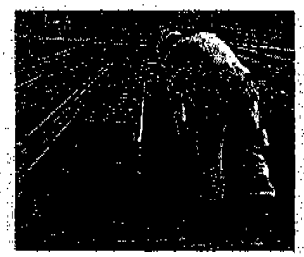
Place blocks as spacers between each pile to allow access for the application of A-50.



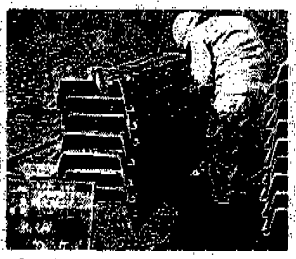


2 Cleaning of interlock sections

Clean off rust, dirt, and debris from the interlock section with a small sander or a wirebrush. Remove bumps at the welded sections.
Blow off dust and debris with an air gun.



Chipping



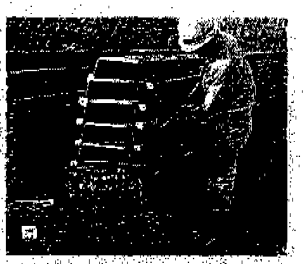
Sanding

Air jet cleaning

3 Application

Apply tape on both ends of sheet piles.
Pour ADEKA ULTRASEAL A-50 approx 5mm thick.

Taping to the end



Pouring A-50

4 Curing and driving

After applying ADEKA ULTRASEAL A-50, cover sheet piles with waterproof sheets to prevent moisture collection.
Drive sheet piles into the ground using conventional equipment.

Storing

Driving sheet piles

Repair works

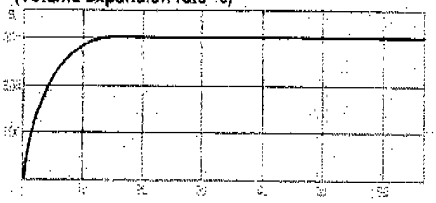
Sheet piles are sometimes repeatedly pulled up and driven down at a construction site, especially when driving in solid rock. Detachment of ADEKA ULTRASEAL A-50 may occur, but repair work can be done simply and easily.

Basic procedures

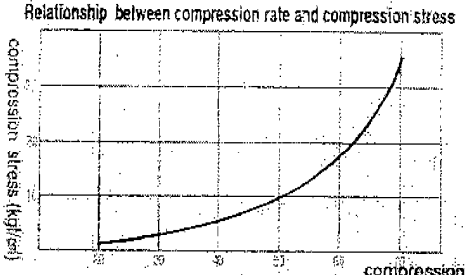
Repair work with ADEKA ULTRASEAL KM (KCH) string (expansion rate : 4 times)

Insert KM(KCH) String which is approx. 1.2 times the width of the gap in diameter along the seam between the sheet piles.

Speed of expansion upon contact with water (volume expansion rate %)



Relationship between compression rate and compression stress

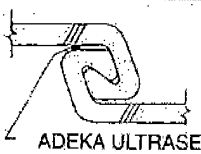


Basic properties of KM series

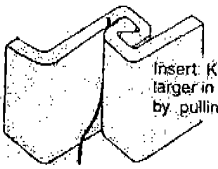
Tensile strength (Kg.f/cm)		more than 20
Elasticity	(%)	more than 550
Expansion rate (Wt%) Soaked in the water		

Water stopping ability after 5 days in the water

Interlock space	0.5	1.0
Hydrostatic head (Kgf/cm)	17.0	9.5



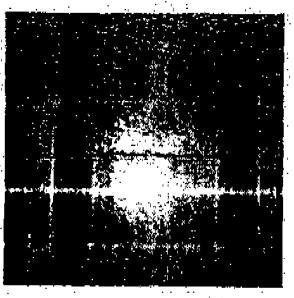
ADEKA ULTRASEAL KM- string



Insert KM-string about 1.2 times larger in diameter than the opening, by pulling it down.

State of water leakage

Insertion of KM- String

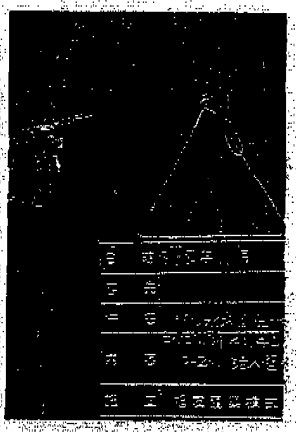


Compression of repair work

Supplementary repair

Repair with cartridge type ADEKA ULTRASEAL P-201 (expansion rate : 2 times)

After the active leak has been stopped by ADEKA ULTRA SEAL KM(KCH) string, additional precautionary repair can be performed. Inject P-201 in the interlock gap above the KM(KCH) repaired area with a caulking gun.



Injection of P-201

ADEKA ULTRA SEAL P-201

Basic properties of P-201 before curing

Appearance	Paste
Specific gravity (20°C)	1.22
Application speed (5°C)	Less than 30 seconds
Application speed (20°C)	Less than 20 seconds
Slump (23°C)	3 mm >
Tack free (20°C 60%RH)	10 hours >

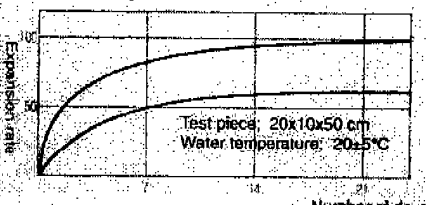
After curing

Hardness (Shor A)	28
Tensile strength (Kgf/cm)	25
Elasticity (%)	1750
Tearing strength (Kgf/cm)	12

Tensile adhesive property of P-201

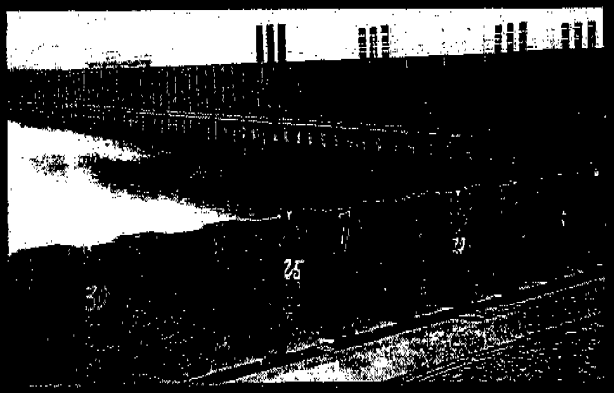
	Plate glass	Aluminium plate	Mortor plate
50% tensile stress (Kgf/cm)	3.9	3.8	3.8
Maximam tensile stress (Kgf/cm)	14.5	14.5	15.5
Elongation (%)	540	595	560

Expansion upon contact with water



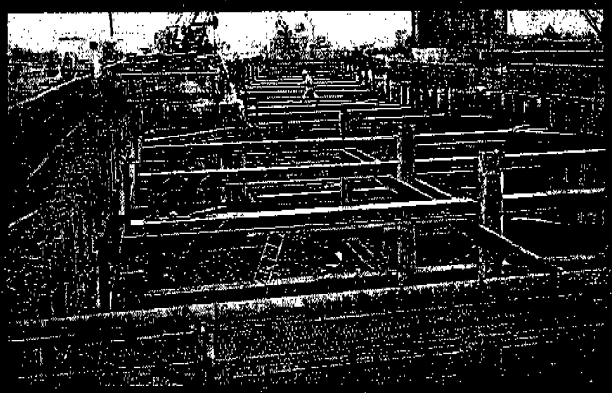
Applications of ADEKA ULTRASEAL A-50

Wharf

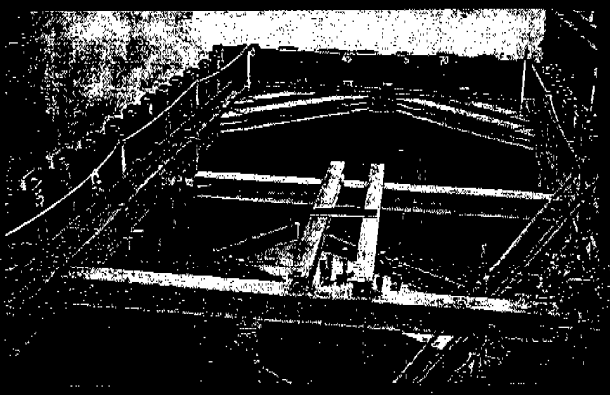


Cofferdam

Utility tunnel

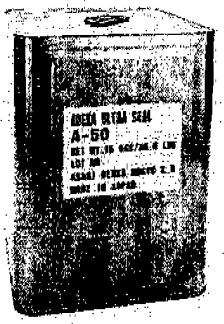


Caisson



Packaging of ADEKA ULTRASEAL A-50

15kg can



Precautions for handling

Keep away from fire. (ADEKA ULTRASEAL A-50 falls under the petroleum group in the hazardous product category No.4 of the Fire Services Act.)
Do not handle with bare hands and avoid contact with skin. If contact occurs, wash with soap and water. Get medical attention if required.

In case sheet piles are hard to remove

Reverse the steps for driving into the ground.
Remove dirt and loosen rusted sections and joints by driving sheet piles into the ground before trying to pull them up.
Drive in the sheet pile adjacent to the one which to be pulled out.
Do not stick to one certain spot. Try other spots.

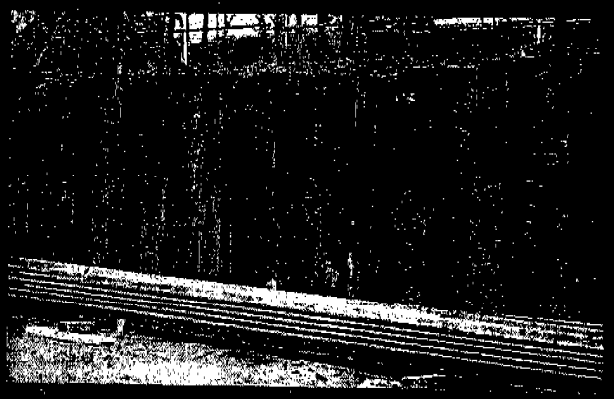
Hazards Identification

Emergency Overview: Clear Yellow Oil-like liquid.
It contains of carcinogenic substance(TDI).

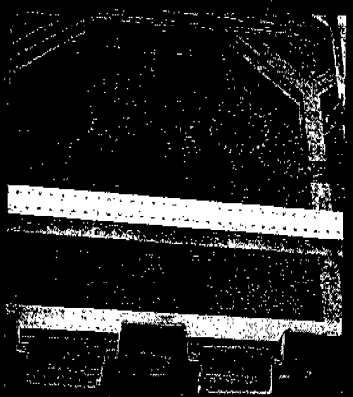
Potential Health Effects

SKIN CONTACT: Prolonged exposure may cause skin irritation.
EYE CONTACT: May cause eye irritation.
INHALATION: Prolonged exposure may cause irritation to the respiratory tract.
INGESTION: Oral toxicity has not been determined.
CHRONIC EFFECTS: It contains carcinogeric Substance (TDI).

Retaining wall



Bridge piers



Retaining wall

Bridge piers

Examination of The ADEKA ULTRASEAL A-50

Results of water examination

Site of sampling
The sampling date 20th Nov. '91 Weather : previous day fine
the day of sampling fine
Sampling to be tested ADEKA URTRASEAL A-50 solution

Item	Specification	Analysis
Temperature	———	———
Water temperature	———	———
Nitrogen nitrate and Nitrogen nitrite	Less than 10	Below 0.02
Chroline ion	Less than 200	1.4
Consumption amount of potassium permanganate	Less than 5	3.5
Ordinary bacteria (The number of colonies in 1ml liter)	Less than 100	———
Colom bacill	Should not be detected	———
Ionic cyanide	Should not be detected	Not detected
Mercury	Should not be detected	Not detected
Organic phosphorus	Should not be detected	Not detected
Copper	Less than 1.0	Below 0.01
Iron	Less than 0.3	Below 0.05
Manganese	Less than 0.3	Below 0.01
Zinc	Less than 1.0	Below 0.005
Lead	Less than 0.1	Below 0.01
Hexavalent Chromium	Less than 0.05	Below 0.02
Cadmium	Less than 0.01	Below 0.005
Arsenic	Less than 0.05	Below 0.005
Fluorine	Less than 0.8	Below 0.15
Calcium, magneelum, and others	Less than 300	Below 5
Evaporation residue	Less than 500	9
Phenol and others	Less than 0.005 of phenol	Below 0.005
Anion surfactant	Less than 0.5	Below 0.2
Value of pH	5.8 < 8.6	6.9
Smell	Normal	Normal
Taste	Normal	Normal

The chemical resistance of ADEKA ULTRA SEAL

Table of Chemical Resistance shows chemical resistance properties of ADEKA ULTRASEAL (KM, KC, MC, P-201,A-30 and A-50) to various chemicals. Unless otherwise specified, test samples were soaked in concentrated or saturated solutions at room temperature.

This table is to be used only as a guideline in selecting material. Call 800.999.3959 or your local representative to confirm suitability of use under exact conditions.

Chemical resistanance of ADEKA ULTRASEAL

Chemical	concentration/ temperature (wt%/deg)	Natural Rubber	KM/KC	MC	P-201	A-30	A-50
Acetaldehyde		F	F	N	N	N	N
Acetic acid	(10/RT)	F	F	F	N	F	N
Acetone		F	F	N	N	N	N
Acetylene		E	E	G	G	G	N
Alums NH3,Cr,K		E	E	E	E	E	E
Aluminum acetate		E	E	E	E	E	E
Aluminum bromide		E	E	E	E	E	E
Aluminum chloride		E	E	E	N	F	N
Aluminum fluoride		E	E	E	E	E	E
Aluminum nitrate		E	E	E	E	E	E
Aluminum sulfate		E	E	E	E	E	E
Ammonia gas		E	E	E	E	E	E
Ammonium carbonate		E	E	E	E	E	E
Ammonium chloride		E	E	E	F	F	F
Ammonium hydroxide		N	N	N	N	N	N
Ammonium persulfate		E	E	E	N	F	N
Ammonium phosphate		E	E	E	E	E	E
Ammonium sulfate		E	E	E	E	E	E
Amyl alcohol		E	E	G	G	G	G
Aniline dyes		G	G	F	N	N	N
Lard oil		F	F	N	N	N	N
Arsenic acid		E	E	E	F	F	F
Asphalt		N	N	N	F	F	N
ASTM oil NO.1		N	N	N	N	N	N
ASTM reference fuel A		N	N	N	N	N	N
Barium chloride		E	E	E	E	E	E
Barium hydroxide		E	E	E	E	E	E
Barium sulfate		E	E	E	E	E	E
Barium sulfide		E	E	E	E	E	E
Benzene		N	N	N	N	N	N
Benzine		N	N	N	N	N	N
Benzyl alcohol		G	G	F	F	F	F

Chemical	concentration/ temperature (wt%/deg)	Natural Rubber	KM/KC	MC	P-201	A-30	A-50
Boric acid		E	E	E	E	E	E
Butane		N	N	N	F	F	F
Butyl alcohol		E	E	G	N	F	N
Calcium acetate		E	E	G	E	E	E
Calcium bissulfite		E	E	E	E	E	E
Calcium chloride		E	E	E	E	E	E
Calcium hydroxide		E	E	E	E	E	E
Calcium hypochlorite		N	N	N	N	N	N
Calcium nitrate		E	E	E	E	E	E
Calcium sulfide		G	G	G	E	E	G
Carbon dioxide		G	G	G	E	E	G
Carbonic acid		N	N	N	N	N	N
Castor oil		E	E	G	G	G	F
Cellsolve		N	N	N	N	N	N
Cellsolve,Acetate		G	G	F	F	F	N
Cellsolve,Butyl		E	E	G	G	G	F
Chlorinated solvents		N	N	N	N	N	N
Chromic acid	(2/70)	N	N	N	N	N	N
Citric acid		E	E	G	G	G	F
Copper chloride		E	E	E	E	E	E
Copper cyanide		E	E	E	E	E	E
Copper sulfate		E	E	E	E	E	E
Corn oil		N	N	N	N	N	N
Cottonseed oil		N	N	N	N	N	N
Cresol		N	N	N	N	N	N
Cycrohexanone		F	F	N	N	N	N
Developing sulutions(Hypos)		E	E	E	E	E	E
Dibutyl phthalate		N	N	N	F	F	F
Diethylene glycol		E	E	G	N	N	N
Diisopropyl ketone		F	F	N	N	N	N
Dimethyl formamide		G	G	F	N	N	N
Diocthyl phthalate		F	F	N	G	G	F
Dioxane		N	N	N	N	N	N
Ethanolamine		G	G	F	F	F	F
Ethyl acetate		F	F	N	N	N	N
Ethyl aceetoacetate		E	E	G	G	G	F
Ethyl alcohol		E	E	G	G	G	G
Ethyl cellulose		G	G	G	G	G	F
Ethyl chloride		E	E	G	G	G	F
Ethyl chlorohydrin		G	G	F	F	F	F
Ethylene diamine		E	E	G	G	G	F
Ethylene glycol		E	E	G	G	G	F
Ethyl oxalate		E	E	G	G	G	F

Chemical	concentration/ temperature (wt%/deg)	Natural Rubber	KM/KC	MC	P-201	A-30	A-50
Ethyl silicate		G	G	F	F	F	F
Fatty acid		F	F	N	F	F	N
Ferric chloride		E	E	E	E	E	E
Ferric sulfate		E	E	E	E	E	E
Fluorboric acid		E	E	E	E	E	E
Fluosilicic acid		E	E	E	E	E	E
Formaldehyde	(40/RT)	G	G	F	N	N	N
Formic acid	(25/RT)	F	F	N	N	N	N
Fuel oil		N	N	N	F	F	N
Gasoline		N	N	N	F	F	N
Gelatin		E	E	G	E	E	G
Galuber's salt		E	E	E	E	E	E
Glycerin		E	E	E	E	E	E
Hexane		N	N	N	F	F	N
Hexyl alcohol		E	E	G	N	N	N
Hydrobromic acid	(37/RT)	E	E	E	N	N	N
Hydrochloric acid	(3/RT)	E	E	E	E	E	G
Hydrochloric acid	(10/RT)	F	F	N	N	F	N
Hydrogen		G	G	G	E	E	G
Hydrogen peroxide	(5/RT)	N	N	N	N	N	N
Hydrogen sulfide		N	N	N	N	N	N
Hydroquinone		E	E	G	G	G	G
Hydrochlorus acid		E	E	E	E	E	E
Isobutyl alcohol		E	E	G	N	N	N
Isopropyl alcohol		E	E	F	F	F	N
Lacquer		N	N	N	N	N	N
Lactic acid		E	E	G	G	G	G
Lead acetate		E	E	E	E	E	E
Lead nitrate		E	E	E	E	E	E
Lead sulfamate		G	G	G	G	G	G
Linseed oil		G	G	F	G	G	F
Liquifide petroleum gas		N	N	N	F	F	N
Lubricating oil		N	N	N	F	F	F
Magnesium chloride		E	E	E	E	E	E
Magnesium hyroxide		E	E	E	E	E	E
Magnesium sulfate		E	E	E	E	E	E
Maleic acid		E	E	G	G	G	F
Malic acid		E	E	G	G	G	F
Marcuric chloride		E	E	E	E	E	E
Marcury		E	E	E	E	E	E
Methyl alcohol		E	E	G	G	G	F
Methyl ethyl ketone		F	F	N	N	N	N
Mineral oil		N	N	N	N	N	N

Chemical	concentration/ temperature (wt%/deg)	Natural Rubber	KM/KC	MC	P-201	A-30	A-50
Monoethanolamine		G	G	F	F	F	N
Naptha		N	N	N	F	F	N
Natural gas		G	G	G	G	G	G
Nickel acetate		E	E	E	E	E	E
Nickel chloride		E	E	E	E	E	E
Nikkel sulfate		E	E	E	E	E	E
Nitric acid	(10/RT)	N	N	N	N	N	N
Nitroethane		E	E	G	N	N	N
Nitromethane		E	E	G	F	F	F
Nitrogen		E	E	E	E	E	E
Octyl alcohol		G	G	F	N	N	N
Oleic acid		F	F	N	F	F	F
Oleive oil		N	N	N	F	F	F
Oxalic acid		G	G	F	F	F	N
Oxygen		G	G	G	E	E	G
Ozone		N	N	N	F	F	F
Palmitic acid		G	G	F	G	G	F
Petroleum		N	N	N	N	N	N
Phenyl hydrazinc		E	E	G	G	G	G
Phenol		F	F	N	N	N	N
Phosphoric acid	(50/RT)	E	E	E	E	E	E
Potassium chloride		E	E	E	E	E	E
Potassium cyanide		E	E	E	E	E	E
Potassium dichlomate	(10/RT)	E	E	E	E	E	E
Potassium hydoxide		E	G	G	G	G	G
Potassium permanganate	(5/RT)	N	N	N	N	N	N
Potassium sulfate		E	E	E	E	E	E
Propane		N	N	N	F	F	F
Propyl alcohol		E	E	G	F	F	F
Pyridine		N	N	N	N	N	N
Salicylic acid		E	E	G	G	G	G
Salt water		E	E	E	E	E	E
Silicon greases		E	E	G	E	E	G
Silicon oil		E	E	G	E	E	G
Silver nitrate		E	E	E	E	E	E
Soap solutions		E	E	E	E	E	E
Soda ash		E	E	E	E	E	E
Sodium bicaarbonate		E	E	E	E	E	E
Sodium bisulfate		E	E	E	E	E	E
Sodium bisulfite		E	E	E	E	E	E
Sodium borate		E	E	E	E	E	E
Sodium chloride		E	E	E	E	E	E
Sodium cyanide		E	E	E	E	E	E

Chemical	concentration/ temperature (wt%/deg)	Natural Rubber	KM/KC	MC	P-201	A-30	A-50
Sodium hydroxide	(10/RT)	E	G	G	F	F	N
Sodium hydroxide	(30/RT)	E	G	G	N	F	N
Sodium hypochlorite	(5/RT)	F	F	F	N	N	N
Sodium metaphosphate		E	E	E	E	E	E
Sodium nitrate		E	E	E	E	E	E
Sodium perborate		E	E	E	E	E	E
Sodium peroxide		E	E	E	N	N	N
Sodium phosphate		E	E	E	E	E	E
Sodium thiosulfate		E	E	E	E	E	E
Sodium sulfide		E	E	E	E	E	E
Soybean oil		N	N	N	F	F	F
Stannic chloride		E	E	E	E	E	E
Stearic acid		G	G	F	G	G	F
Sulfur		G	G	G	G	G	G
Sulfur dioxide		G	G	G	G	G	G
Sulfurric acid	(3/RT)	E	E	E	G	G	G
Sulfurric acid	(10/RT)	E	G	N	N	F	N
Sulfurous acid	(10/RT)	G	G	G	N	F	N
Tannic acid		E	E	G	G	G	F
Tar		G	G	N	F	F	F
Tartaric acid		E	E	G	G	G	F
Toluene		N	N	N	N	N	N
Tributyl phosphate		G	G	F	N	N	N
Triethanolamine		E	E	G	N	N	N
Vegitabule oil		F	F	F	F	F	F
Water		E	E	E	E	E	E
Xylene		N	N	N	N	N	N
Zinc acetate		E	E	E	E	E	E
Zinc chloride		E	E	E	E	E	E
Zinc sulfate		E	E	E	E	E	E

We determined chemical resistance for inorganic chemicals by change of sample's surfaces, rate of soaking water and change of physical properties.

E: Excellent Service
G: Good Service
F: Fair Service
N: Not Recommended/Poor

APPENDIX F

PIIAN ODOR CONTROL SYSTEMS

Piian Odor Control Systems

Flex~Fog System

In the past, atomization technology has come in two "types": small, low cost off-the-shelf sprayers for localized odor problems and more expensive custom-built systems for major odor control problems. Now, Piian Systems introduces the Piian Flex~Fog System, which combines the capabilities of large atomization systems at a very affordable price.

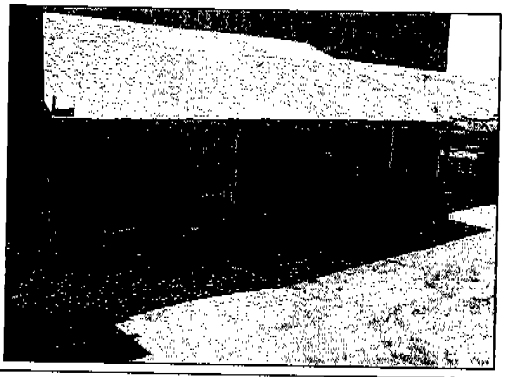
The Piian Flex~Fog System pumps a mixture of ordinary water and all natural odor neutralizer concentrate at 1000PSI pressure through a manifold tube, where it is released through highly specialized low flow atomization nozzles to form a mist of 10 micron sized droplets. The droplets are so fine they remained suspended in the air until complete evaporation occurs. This not only eliminates wetting or dripping, but it provides an extremely efficient system for delivering odor neutralizer and destroying odors.

The Piian Flex~Fog System is comes in a simple self-install kit. The kit includes a 1000PSI pump module, chemical injector pump, a coil of manifold tubing, between 10 and 500 nozzles and all necessary fittings. No tools are required for assembly; simply cut the manifold tube to the required length and "press-on" fittings are used to install the nozzles.

The chemical metering pump that comes with the system injects all natural odor neutralizer concentrate into the water supply feeding the pump module creating a powerful odor fighting system. The metering pump includes both volume and frequency adjustments for accuracy and flexibility. Because the system produces molecular sized droplets of odor neutralizer, they remain suspended in the air, where there attach to and destroy odorous compounds present in the environments around:

APPLICATIONS:

- **Sewage Tanks, Lagoons and Process Equipment**
- **Pig Housing, Poultry Barns and Cattle Paddocks**
- **Farm Manure**
- **Abattoirs & Rendering Facilities**

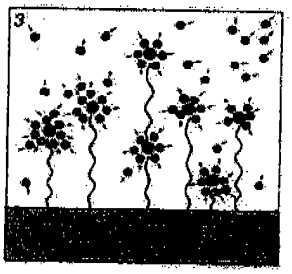


SPECIAL FEATURES:

- **Effective odor control for medium sized environments.**
- **1000PSI Operation, 10 Micron Sized Droplets**
- **No Wetting or Dripping**
- **Fast Installation**
- **Available as a simple easy to install kit, requires no tools, nozzle placement decided during installation, the nozzles simply push onto the manifold tube where you decide.**
- **An exact design is not necessary; kit includes enough nozzles and fittings to install the system several ways.**
- **Fittings and nozzles may be added or removed as you like.**

Three reasons why the Piian Flexi~Fog System is a great solution to your atomization requirements:

1. **Performance – Operating at 1000PSI, the system produces 10 micron sized droplets that evaporate completely in the air without any wetting or dripping.**
2. **Quality – The system includes proven industrial quality components that will provide years of trouble free operation.**
3. **Cost – As the system is packaged as a kit for you to install, we have no design costs, which provides tremendous savings to you.**



Harnessing Nature to Solve Odor Problems.

Piian Odor Control Systems use Piian Odor Neutralizer, a completely natural proprietary blend of plant extracts, essential oils and emulsifiers. When sprayed, atomized or vaporized, molecules of this natural solution surround odorous gases causing immediate odor neutralization, followed by complete destruction of the gas through a biodegrading action. This is an entirely natural process, completely safe and environmentally benign.

Independent laboratory tests, field tests and a long track record have proven Piian Odor Neutralizers ability to destroy common odorous gases and compounds such as Hydrogen Sulfide, Ammonia, Sulfur Dioxide, Mercaptans, Carbon Disulfide, Acetic Acid / Anhydride, Phenols and Styrene.

Additional laboratory tests have verified that Piian Odor Neutralizer is completely safe for dispersion in a workspace environment, manufactured completely from food grade and pharmaceutical grade ingredients; it is non-toxic, non-sensitizing, non-flammable, non-reactive, non-volatile, bio-degradable and ecologically safe.

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
Tel: (760) 778-4370 Fax: (760) 778-4368
Email: info@piian.com Web: www.piian.com

Pricing Subject To Change without Notice

Distributed By:

Piian Odor Control Systems

Flex~Fog System

System Features:

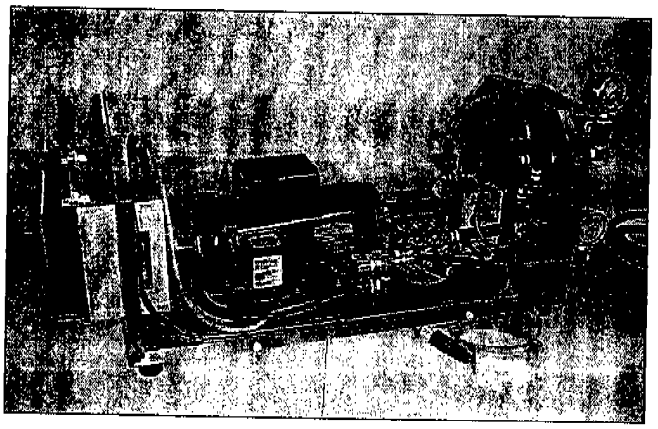
No tools required for nozzle assembly, uses simple "press-on" fittings.
Kit includes everything required to complete an installation.
The system uses only proven industrial quality components.
Standard Duty Kits include 10, 25, 50, 75, 100 and 130 nozzles
Industrial Duty Kits include 50, 100, 130, 200, 300 and 500 nozzles
Full 1 year warranty.

Pump Module Features:

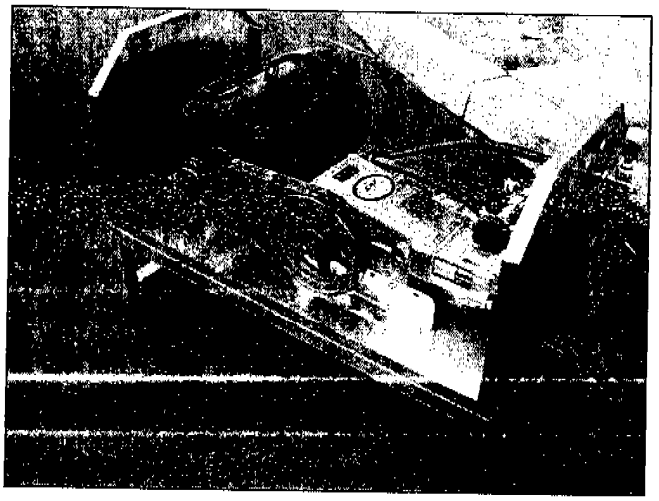
Industrial rated pressure pump and motor
Approved starter relay and controls
Low pressure protection
Pump status lights
10 & 5 Micron water filtration
Inlet and outlet pressure gauges
Automatically drains after each use.
Stainless steel frame and cover

Nozzle Line Features:

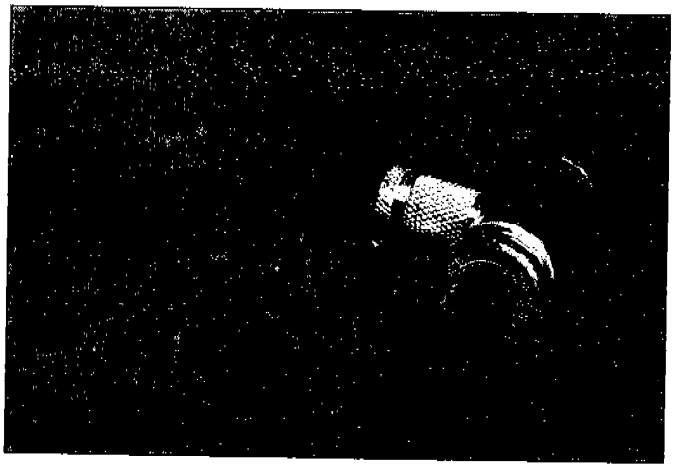
1000PSI operating pressure produces 10 micron droplets.
Simple "press-on" fitting connections, requires no tools.
Any nozzle spacing is possible with several layout options.
360° adjustable nozzle orientation
UV Resistant construction ~ no shrinkage, elongation or brittleness
Anti-drip valves
Automatic drainage after each use



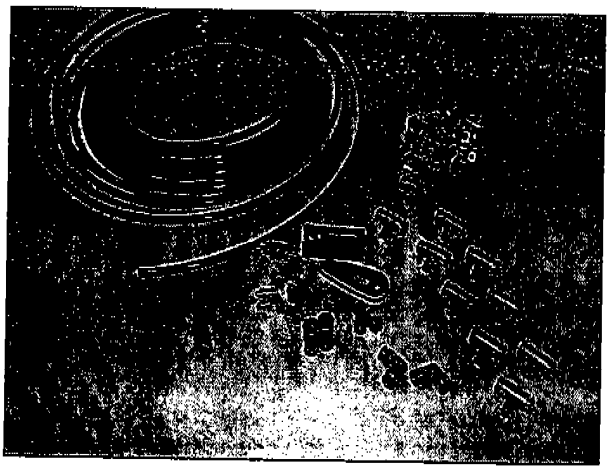
Standard Duty Pump Module



Industrial Duty Pump Module



Push-On Nozzle – 1000PSI – 10 Micrton Droplets



Systems Supplied as a Kit

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
Tel: (760) 778-4370 Fax: (760) 778-4368
Email: info@piian.com Web: www.piian.com
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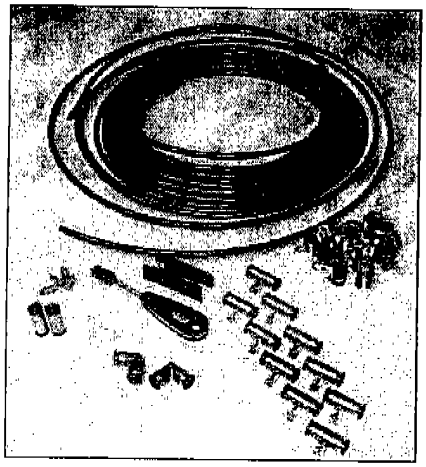
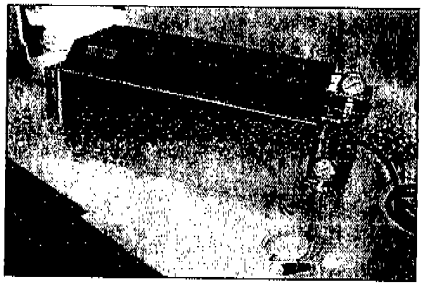
Distributed By:

Piian Odor Control Systems

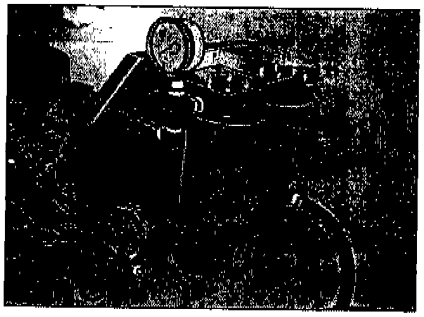
Flexi~Fog System ~ Standard Duty Kits



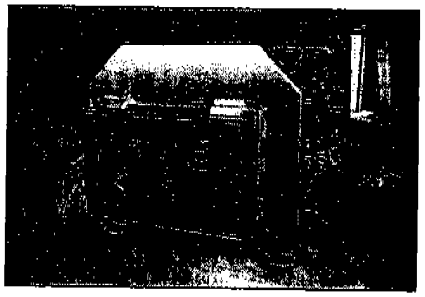
Kit Contents



Standard Duty Pump Module



Standard Duty – Filter Assembly



Standard Duty – Starter Panel

Flexi~Fog Systems Kits - 115 vAC - 60 Hz Power Supply			
10 Nozzle Kit	Includes – 10 Nozzle Assemblies, PL25S 1000PSI Pump Module, Metering Pump, 50ft Manifold Tube, 50 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKS0010	**$2883**
25 Nozzle Kit	Includes – 25 Nozzle Assemblies, PL25S 1000PSI Pump Module, Metering Pump, 100ft Manifold Tube, 50 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKS0025	**$3064**
50 Nozzle Kit	Includes – 50 Nozzle Assemblies, PL50S 1000PSI Pump Module, Metering Pump, 150ft Manifold Tube, 100 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKS0050	**$3333**
75 Nozzle Kit	Includes – 75 Nozzle Assemblies, PL75S 1000PSI Pump Module, Metering Pump, 200ft Manifold Tube, 100 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKS0075	**$3453**
100 Nozzle Kit	Includes – 100 Nozzle Assemblies, PL100S 1000PSI Pump Module, Metering Pump, 250ft Manifold Tube, 150 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKS0100	**$4113**
130 Nozzle Kit	Includes – 130 Nozzle Assemblies, PL130S 1000PSI Pump Module, Metering Pump, 300ft Manifold Tube, 150 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKS0130	**$4686**

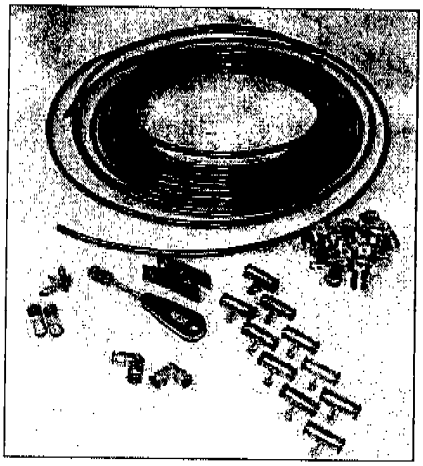
Flexi~Fog Systems Kits - 230 vAC - 50 Hz Power Supply			
10 Nozzle Kit	Includes – 10 Nozzle Assemblies, PL20F 1000PSI Pump Module, Metering Pump, 50ft Manifold Tube, 50 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKF0010	**$3023**
20 Nozzle Kit	Includes – 20 Nozzle Assemblies, PL20F 1000PSI Pump Module, Metering Pump, 100ft Manifold Tube, 50 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKF0020	**$3145**
35 Nozzle Kit	Includes – 35 Nozzle Assemblies, PL35F 1000PSI Pump Module, Metering Pump, 150ft Manifold Tube, 50 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKF0035	**$3394**
55 Nozzle Kit	Includes – 55 Nozzle Assemblies, PL55F 1000PSI Pump Module, Metering Pump, 175ft Manifold Tube, 100 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKF0055	**$3543**
80 Nozzle Kit	Includes – 80 Nozzle Assemblies, PL80F 1000PSI Pump Module, Metering Pump, 200ft Manifold Tube, 100 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKF0080	**$3992**
110 Nozzle Kit	Includes – 100 Nozzle Assemblies, PL100F 1000PSI Pump Module, Metering Pump, 250ft Manifold Tube, 150 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PLKF0110	**$4593**

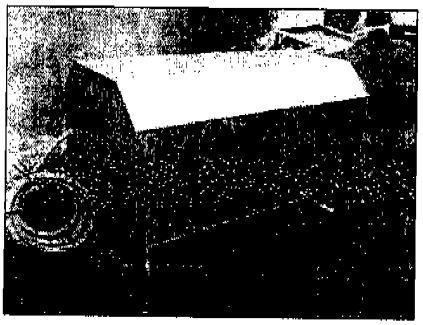
Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
Tel: (760) 778-4370 Fax: (760) 778-4368
Email: info@piian.com Web: www.piian.com
Pricing Subject To Change without Notice

Distributed By:

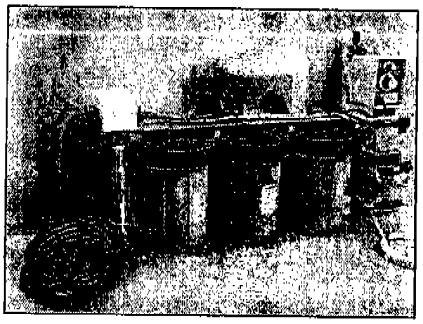
Piian Odor Control Systems

Flexi~Fog System ~ Industrial Duty Kits

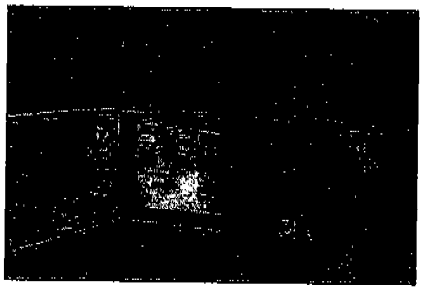




Industrial Duty Pump Module



Industrial Duty – Filter Assembly



Industrial Duty – Starter Panel

Flexi~Fog Systems Kits - 60 Hz Power Supply			
50 Nozzle Kit	Includes – 50 Nozzle Assemblies, PN50S 1000PSI Pump Module, Metering Pump,150ft Manifold Tube, 50 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter.	PFKS0050	**$9305**
100 Nozzle Kit	Includes – 100 Nozzle Assemblies, PN100S 1000PSI Pump Module, Metering Pump,250ft Manifold Tube, 150 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter	PFKS0100	**$10196**
130 Nozzle Kit	Includes – 130 Nozzle Assemblies, PN130S 1000PSI Pump Module, Metering Pump,300ft Manifold Tube, 150 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter	PFKS0130	**$10706**
200 Nozzle Kit	Includes – 200 Nozzle Assemblies, PN220S 1000PSI Pump Module, Metering Pump,500ft Manifold Tube, 200 Loop Clamps, Cable Ties, 4 Tees, 6 Elbows, 6 Unions, 6 End Caps, 10 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter	PFKS0200	**$12080**
300 Nozzle Kit	Includes – 300 Nozzle Assemblies, PN300S 1000PSI Pump Module, Metering Pump,750ft Manifold Tube, 300 Loop Clamps, Cable Ties, 6 Tees, 8 Elbows, 8 Unions, 8 End Caps, 12 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter	PFKS0300	**$13673**
500 Nozzle Kit	Includes – 500 Nozzle Assemblies, PN500S 1000PSI Pump Module, Metering Pump,1200ft Manifold Tube, 500 Loop Clamps, Cable Ties, 8 Tees, 10 Elbows, 10 Unions, 10 End Caps, 16 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter	PFKS0500	**$16870**

Flexi~Fog Systems Kits - 50 Hz Power Supply			
55 Nozzle Kit	Includes – 55 Nozzle Assemblies, PN55F 1000PSI Pump Module, Metering Pump,200ft Manifold Tube, 50 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter	PFKF0055	**$9695**
110 Nozzle Kit	Includes – 110 Nozzle Assemblies, PN110F 1000PSI Pump Module, Metering Pump,300ft Manifold Tube, 150 Loop Clamps, Cable Ties, 2 Tees, 4 Elbows, 4 Unions, 4 End Caps, 6 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter	PFKF0110	**$9955**
185 Nozzle Kit	Includes – 185 Nozzle Assemblies, PN185F 1000PSI Pump Module, Metering Pump,500ft Manifold Tube, 200 Loop Clamps, Cable Ties, 4 Tees, 6 Elbows, 6 Unions, 6 End Caps, 10 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter	PFKF0185	**$11880**
300 Nozzle Kit	Includes – 300 Nozzle Assemblies, PN300F 1000PSI Pump Module, Metering Pump,750ft Manifold Tube, 300 Loop Clamps, Cable Ties, 6 Tees, 8 Elbows, 8 Unions, 8 End Caps, 12 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter	PFKF0300	**$13673**
500 Nozzle Kit	Includes – 500 Nozzle Assemblies, PN500F 1000PSI Pump Module, Metering Pump,1200ft Manifold Tube, 500 Loop Clamps, Cable Ties, 8 Tees, 10 Elbows, 10 Unions, 10 End Caps, 16 Spare Nozzles plus a Nozzle Cleaning Brush and Tubing Cutter	PFKF0500	**$16870**

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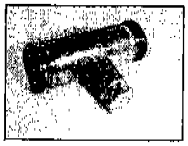
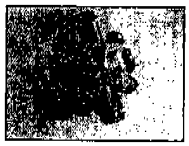
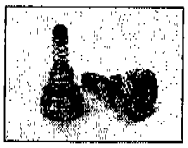
Flexi~Fog System ~ Individual Parts



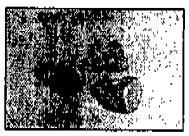
Nozzle Assembly
Add extra nozzles onto a system
Part # PLNA0008
Price **$13.95 ea**



Nozzle Cluster Assembly
For spot treatment
Part # PLNC0008
Price **$62.95 ea**

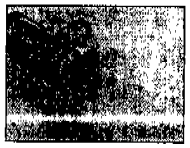


Atomization Nozzles
Replace nozzles on a system
Part # LPNA0004
Price **$23.70 Pack of 6**



Atomization Nozzles Plugs
Block of nozzles on a system
Part # LPPG0001
Price **$5.70 Pack of 6**

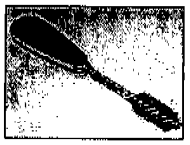
Tubing Connector – Elbow
Install tubing around tight corners
Part # PLEB0006
Price **$12.95 ea**



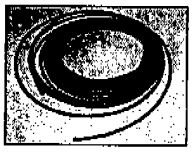
End Cap
Terminate the end of an extra Nozzle
Part # PLEC0006
Price **$8.15 ea**

Standard Pump Module Filters
Part # PFCX1010 (10 Micron)
Price **$6.90 ea**
Part # PFCX1005 (5 Micron)
Price **$6.90 ea**

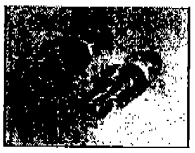
Stainless Hanger Cable
Stretch between two points to hang manifold tube and nozzles
Part # LSAC0001
Price **$45.00 per 100FT Roll**



Nozzle Cleaning Brush
Maintains clean nozzle spray pattern
Part # LTKT0002
Price **$9.95 ea**



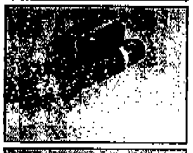
Manifold Tubing
Extend the distance between nozzles or from nozzles to pump module location.
Part # PLMT0006
Price **$62.50 per 50 ft**



Tubing Quick Disconnect
Allows fast connection disconnection of tubing
Part # PLQD0006
Price **$44.95 ea**

Tubing Connector – Union
Connect two pieces of manifold tube
Part # PLTU0006
Price **$9.95 ea**

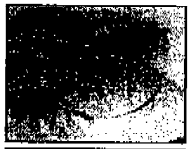
Tubing Connector – Tee
Split manifold tubing into two runs
Part # PLTT0006
Price **$12.75 ea**



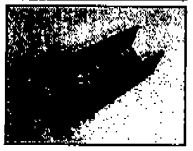
Manifold Ball Valve
Shut off flow of water to sections of nozzles
Part # PFBV0004
Price **$17.95 ea**

Tubing Clamp
Extra Clamps to support nozzles or tubing
Part # LSHC0002
Price **$18.50 Pack of 50**

Industrial Pump Module Filters
Part # PFCB1050 (50 Micron)
Price **$26.50 ea**
Part # PFCB1010 (10 Micron)
Price **$26.50 ea**
Part # PFCB1005 (5 Micron)
Price **$26.50 ea**



Cable Turnbuckle & Crimp Sleeves
Applies tension to Stainless Hanger Cable
Part # LSCT0001
Price **$9.25 ea**



Tubing Cutter
Cuts manifold tube right.
Part # LTKT0003
Price **$12.95 ea**

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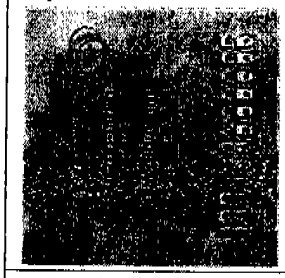
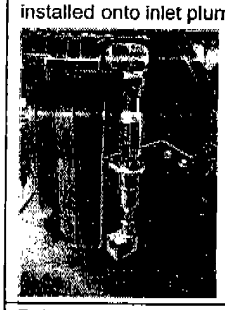
Flexi~Fog System ~ Optional Control Items

Item	Part #	Price
Remote Start Switch – Starts and Stops Pump Module From Relote Location	ESWB0001	**$109.25**
Outdoor Skid Frame – Mounts the pump, filters and starter on to a forklift skid frame for outdoor use	CPSF0001	**$895.00**
Chemical Injection Pump – injects odor neutralizer into inlet water to pump module for odor control applications		
 115 vAC 5.0 GPD 150 PSI Pump	CECJ0115	**$587.40**
230 vAC 5.0 GPD 150 PSI Pump	CECJ0230	**$587.40**
115 vAC 10.0 GPD 110 PSI Pump	CECJ1115	**$637.00**
230 vAC 10.0 GPD 110 PSI Pump	CECJ1230	**$637.00**
115 vAC 14.0 GPD 250 PSI Pump	CECJ2115	**$718.20**
230 vAC 14.0 GPD 250 PSI Pump	CECJ2230	**$718.20**
115 vAC 24.0 GPD 110 PSI Pump	CECJ3115	**$931.40**
230 vAC 24.0 GPD 110 PSI Pump	CECJ3230	**$931.40**
115 vAC 38.0 GPD 150 PSI Pump	CECJ4115	**$1257.20**
230 vAC 38.0 GPD 150 PSI Pump	CECJ4230	**$1257.20**
115 vAC 60.0 GPD 100 PSI Pump	CECJ5115	**$1481.70**
230 vAC 60.0 GPD 100 PSI Pump	CECJ5230	**$1481.70**
High Pressure Zone Valve – splits system in to multiple control zones		
 2 Zone Controller, 3/8" NPT 1200 PSI	LPSN2115	**$565.00**
3 Zone Controller, 3/8" NPT 1200 PSI	LPSN3115	**$965.00**
4 Zone Controller, 3/8" NPT 1200 PSI	LPSN4115	**$1365.00**
5 Zone Controller, 3/8" NPT 1200 PSI	LPSN5115	**$1765.00**
2 Zone Controller, 3/8" NPT 1200 PSI with De-Pressurization Valve	LPSC2115	**$785.00**
3 Zone Controller, 3/8" NPT 1200 PSI with De-Pressurization Valve	LPSC3115	**$1255.00**
4 Zone Controller, 3/8" NPT 1200 PSI with De-Pressurization Valve	LPSC4115	**$1725.00**
5 Zone Controller, 3/8" NPT 1200 PSI with De-Pressurization Valve	LPSC5115	**$2195.00**
* Multiple additional zones and other standard voltages available		
In-line Water Conditioner – modifies the TDS content of inlet water to reduce nozzle maintenance. Unit is installed onto inlet plumbing to system, requires no servicing or maintenance.		
 3/8" NPT Unit, Treats Water Flow Rate from 0.1 – 1.1 GPM	CPWC0002	**$209.00**
1/2" NPT Unit Treats Water Flow Rate from 0.5 GPM to 2.9 GPM	CPWC0004	**$275.00**
3/4" NPT Unit, Treats Water Flow Rate from 2.2 GPM to 5.0 GPM	CPWC0006	**$595.00**
1" NPT Unit, Treats Water Flow Rate from 3.5 GPM to 11.0 GPM	CPWC0008	**$895.00**
1 1/2" NPT Unit, Treats Water Flow Rate from 7.0 GPM to 20.0 GPM	CPWC0012	**$1245.00**
2" NPT Unit, Treats Water Flow Rate from 15.0 GPM to 35 GPM	CPWC0024	**$1825.00**
3" NPT Unit, Treats Water Flow Rate from 30 GPM to 50 GPM	CPWC0036	**$2295.00**
4" NPT Unit, Treats Water Flow Rate from 40 GPM to 100 GPM	CPWC0048	**$2845.00**
D-ionization System - treats unsuitable water for use in up to 5 GPM system	CEDI0004	**POR**
Reverse Osmosis System - treats unsuitable water for use in greater than 5 GPM system	CERS0004	**POR**

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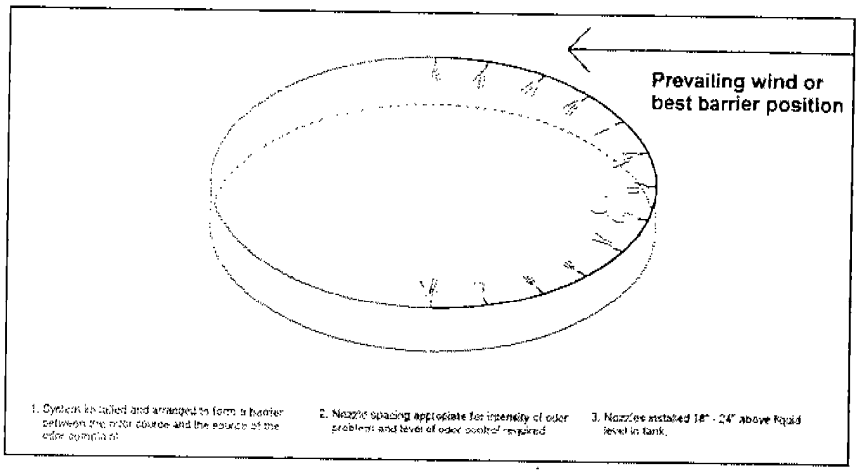
Flex~Fog System ~ Layout Illustrations and Design Factors

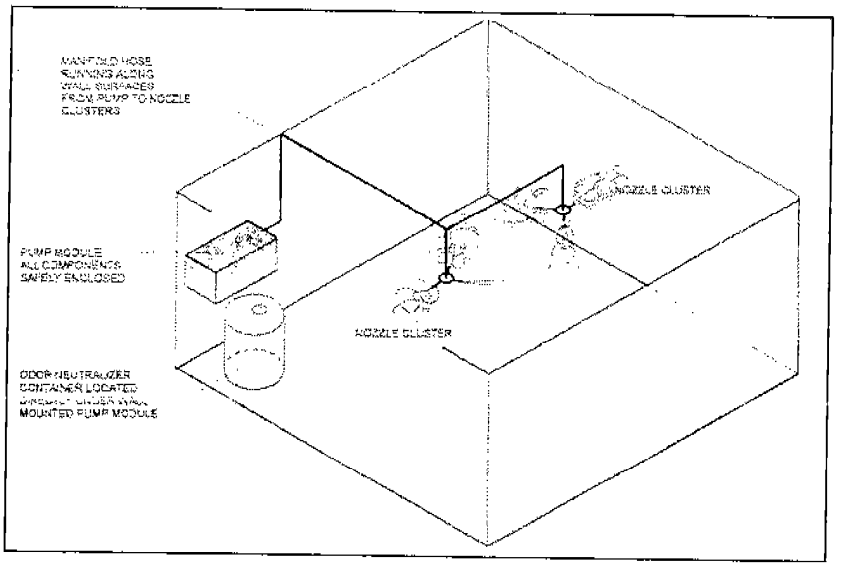


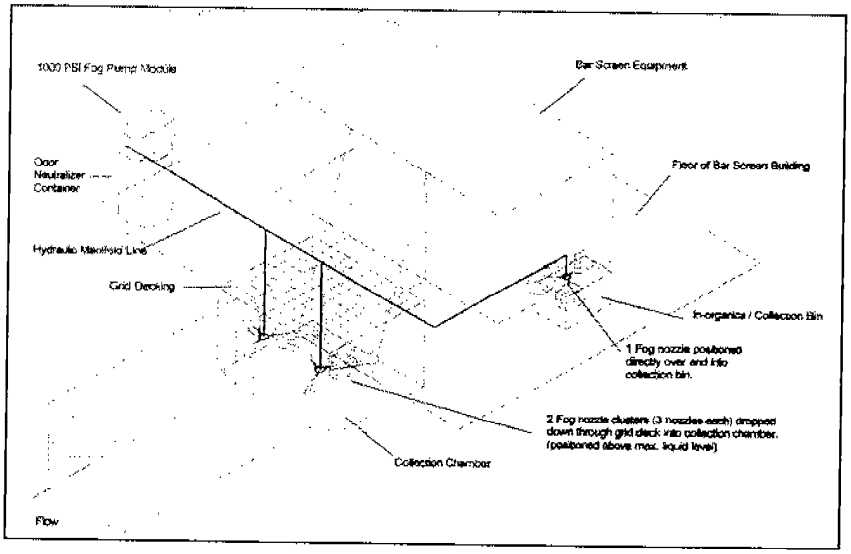
Process and Holding Tanks

The fog system may be attached to the guardrail or upper lip around tanks commonly found in process operations. It is possible to install the atomization lines inside the tank provided the nozzles are accessible for service and that the nozzles remain 24" above the maximum liquid level in the tank.

Spot Treatment with Nozzle Clusters

In process's where there are several points of intense odor emission, nozzle clusters may be suspended / positioned to eliminate odors at their source.





Complex Process Equipment

Nozzle clusters may be positioned under lids, down shafts and inside hoppers etc to treat odors caused by complex processes.

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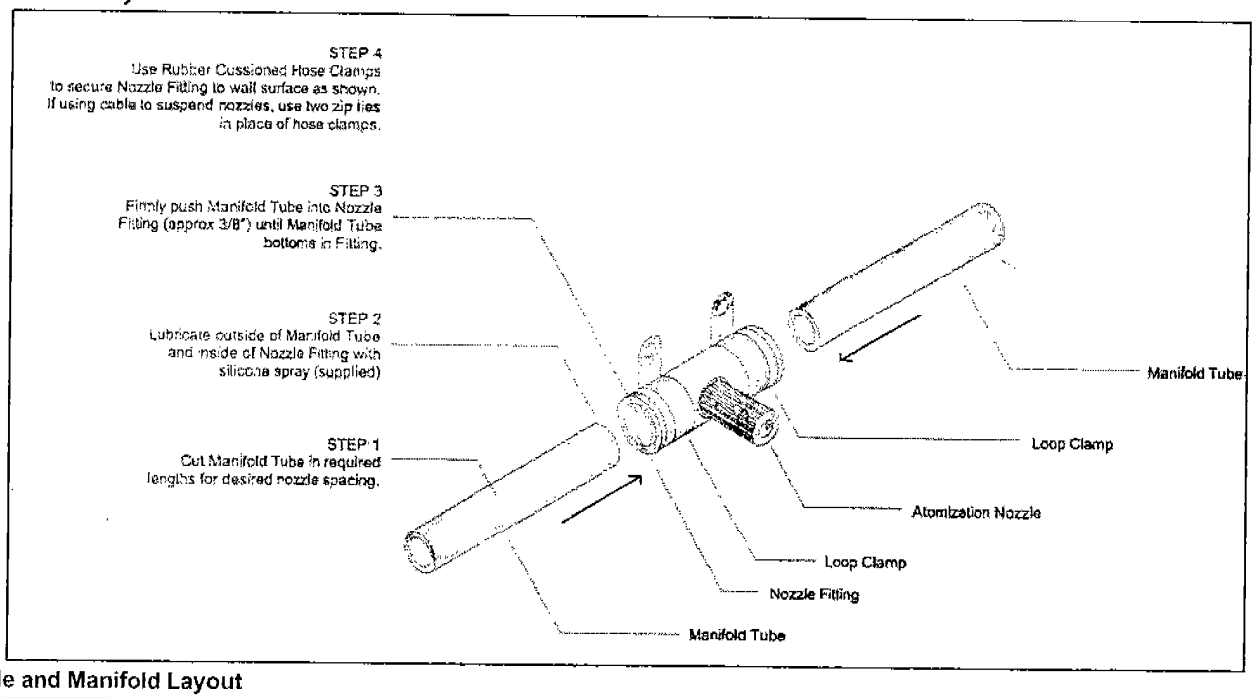
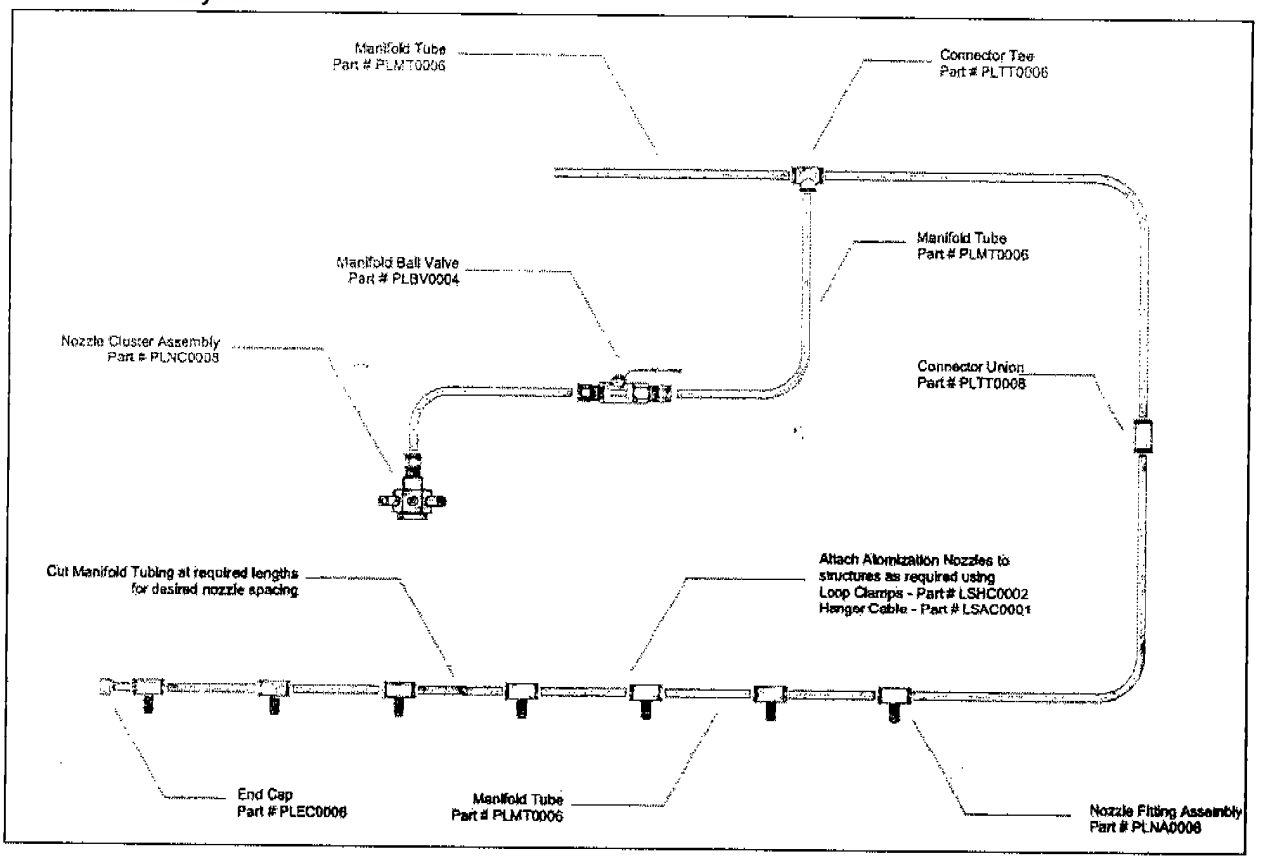
Flex~Fog System ~ Equipment Drawings ~ Nozzles and Tubing

Nozzle Assembly



Nozzle and Manifold Layout



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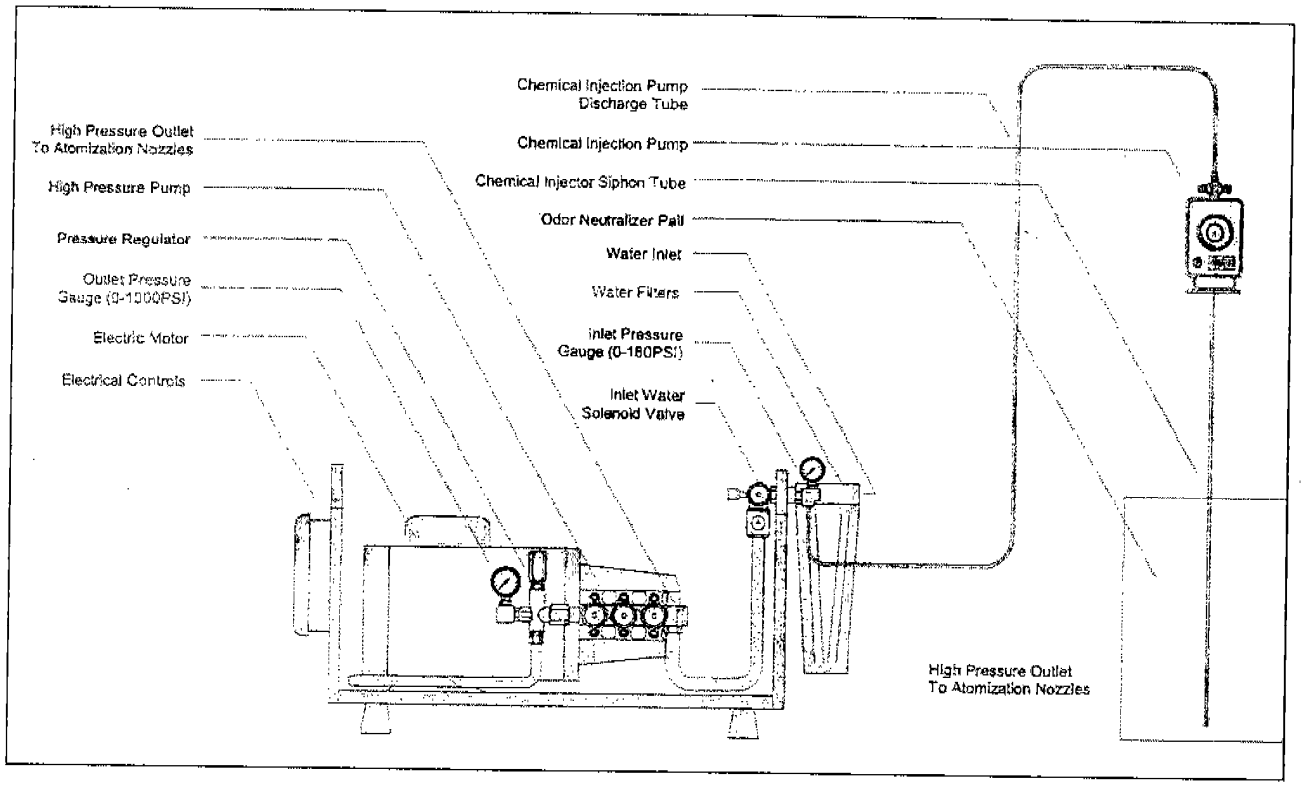
Flex~Fog System ~ Equipment Drawings ~ Standard Duty Pump Modules

Small Standard Duty Pump Packages (Self Contained Pump Module, Chemical Injector, Electrical Controls and Filters)



- Over 10 years of experience goes into the design of each pump module.
- Only the highest quality industrial duty components are used in the construction of a Piian Pump Module.
- The pump module package is designed to operate in the toughest dusty and dirty environments.
- Optional water treatment device is used to adjust hard water characteristics and minimize nozzle maintenance.
- Modules include CAT pumps and Baldor or WEG electric motors which lead their industry in reliability, durability and serviceability.
- Includes LMI Chemical Metering Pump with stroke and frequency adjustment
- The pump module includes a stainless steel frame and cover.
- Double Water Filtration – 10 & 5 micron inlet water filters remove sediment and particulate matter from inlet water supply.
- Nema 4 IEC 60529 & IP66 rated poly carbonate electrical enclosure with lockable enclosure
- 22mm Pilot lights / Fault Lights for power supply, system operation, motor overload and low inlet water pressure
- Reset buttons for motor overload and low inlet water pressure
- ON/OFF/AUTO Operator switch for system operation
- Flush mounted hour meter
- Liquid tight conduit and cord connections

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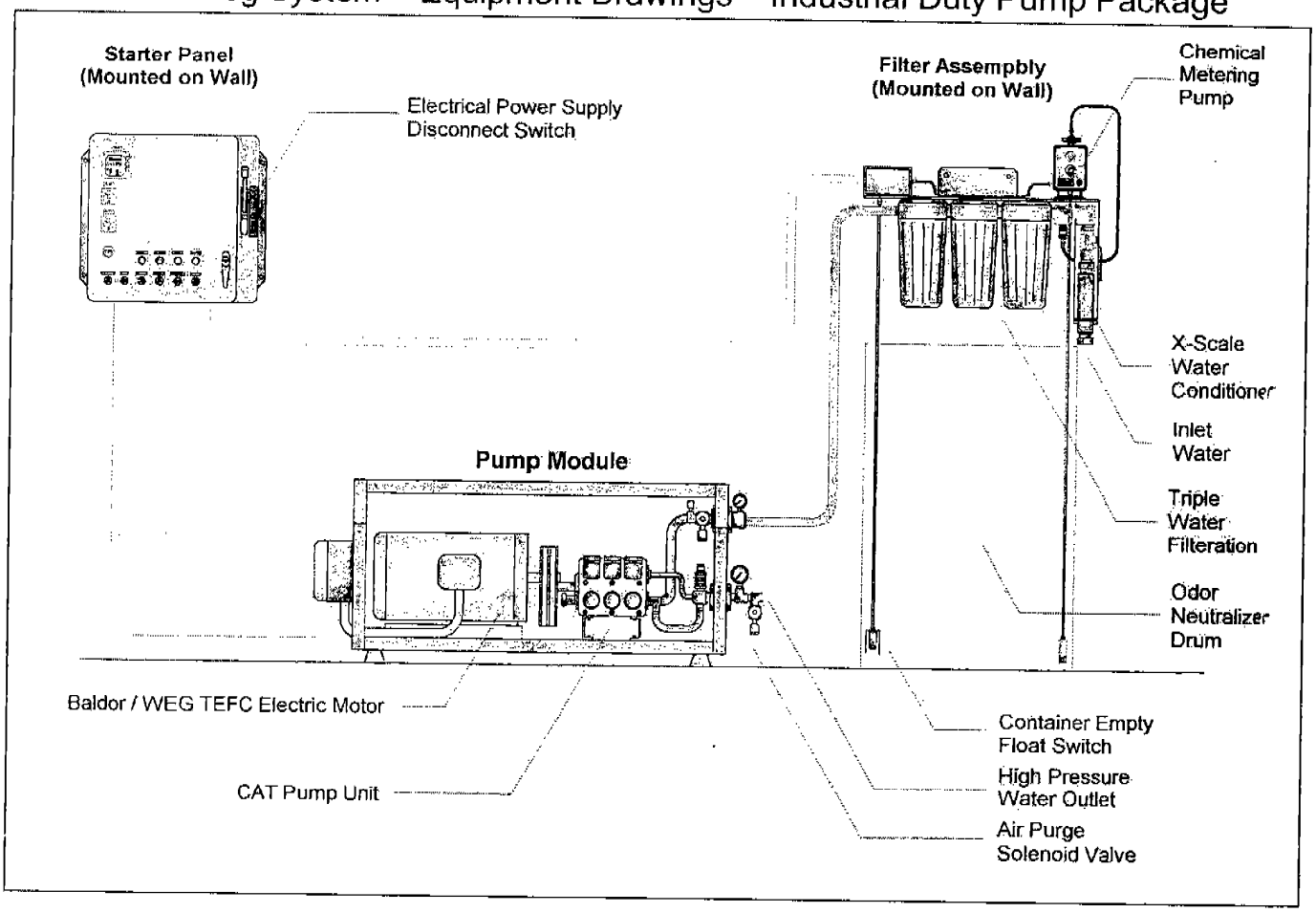
Flexi~Fog System ~ Equipment Drawings ~ Industrial Duty Pump Package



- 1000PSI operating pressure produces 10 micron droplets.
- Designed to operate in the toughest dusty and dirty environments
- System uses only proven industrial quality components.
- Pump Modules include CAT pumps and Baldor or WEG electric motors which lead their industry in reliability, durability and serviceability
- A water treatment device is used to adjust hard water characteristics and minimize nozzle maintenance.
- Includes triple high capacity filters to minimize servicing requirements.
- Includes as standard an air purge mechanism to removes all moisture from the manifold lines and atomization nozzles on each shut down to minimize nozzle maintenance and for freeze protection.
- Includes a fully featured wall mounted NEC / IEC electrical approved starter panel.
- The pump module includes a stainless steel frame and cover.
- Full 1 year warranty.

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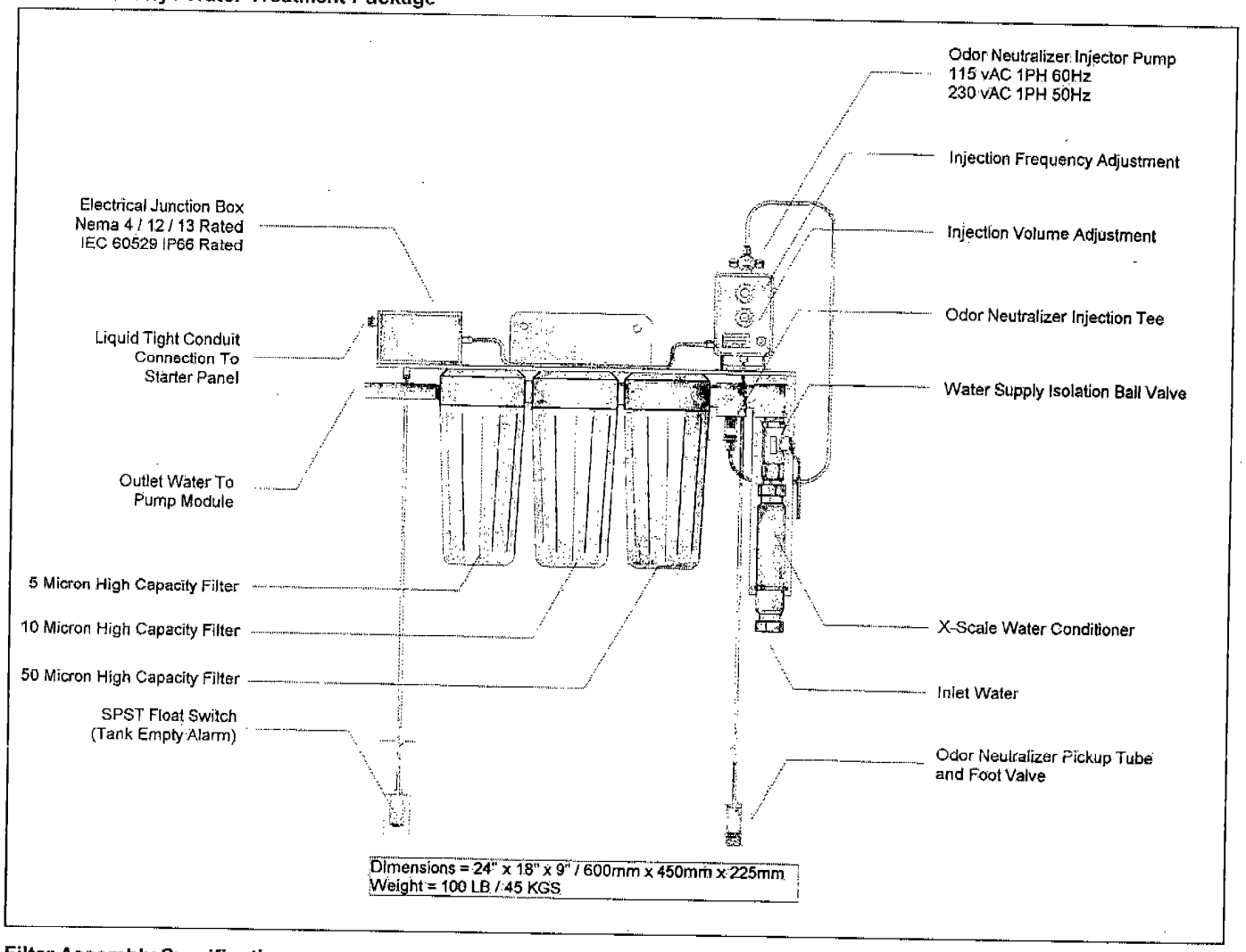
Flexi~Fog System ~ Equipment Drawings ~ Industrial Duty Filter Assembly

Filter Assembly / Water Treatment Package



Filter Assembly Specification:

- Triple Water Filtration – 50, 10 & 5 micron inlet water filters remove sediment and particulate matter from inlet water supply.
- Large High Capacity Filters – maximizes filter life and minimizes servicing requirements
- Specialized X-scale Inlet Water Conditioner – adjusts the TDS content of inlet water to minimize nozzle maintenance, requires no servicing or maintenance.
- Optional LMI Chemical Metering Pump with injection frequency and volume adjustments for flexible and accurate odor neutralizer dosing with a float Switch mechanism and Alarm to alert the user when odor neutralizer container is empty.
- Electrical Enclosure – Nema 4x and IP66 approved electrical junction box with terminal strips with liquid tight conduit & cord connections.
- Filter Assembly includes a heavy duty 1/4" thick bracket that will not flex or bend

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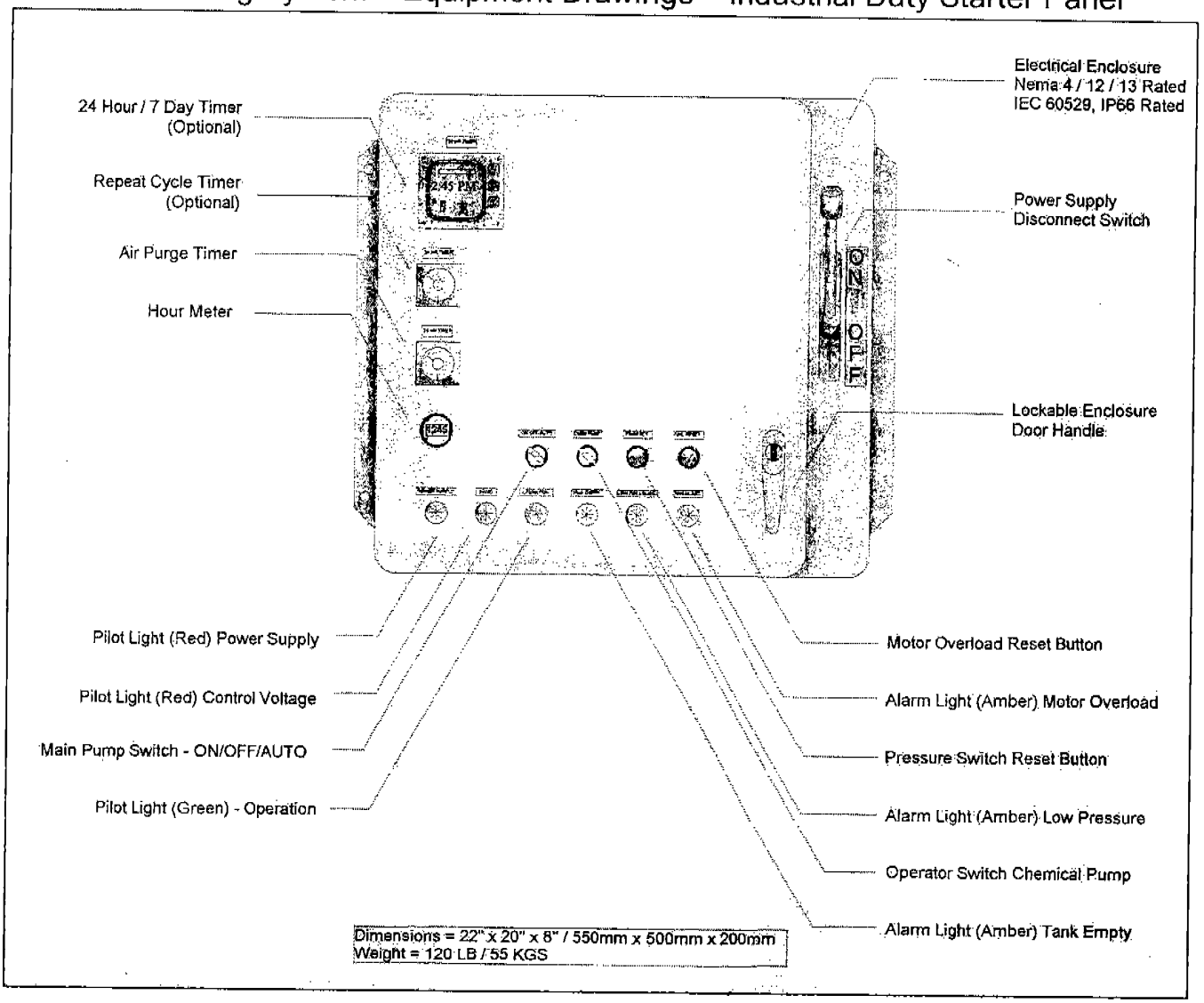
Flexi~Fog System ~ Equipment Drawings ~ Industrial Duty Starter Panel



Starter Panel Specification:

- Nema 4/12/13, IEC 60529 & IP66 rated metal electrical enclosure with lockable enclosure door handle
- 3 Pole, 30AMP electrical power supply disconnect safety switch
- 22mm Pilot lights for power supply, control circuit and system operation
- 22mm Fault lights for motor overload and low inlet water pressure
- Reset buttons for motor overload and low inlet water pressure
- ON/OFF/AUTO Operator switch for system operation
- 22mm Alarm light for odor neutralizer tank empty
- Optional - Separate ON/OFF operator switch for chemical metering pump
- Flush mounted adjustable countdown timer for air purge mechanism
- Flush mounted hour meter
- Numbered terminal strip
- Liquid tight conduit and cord connections

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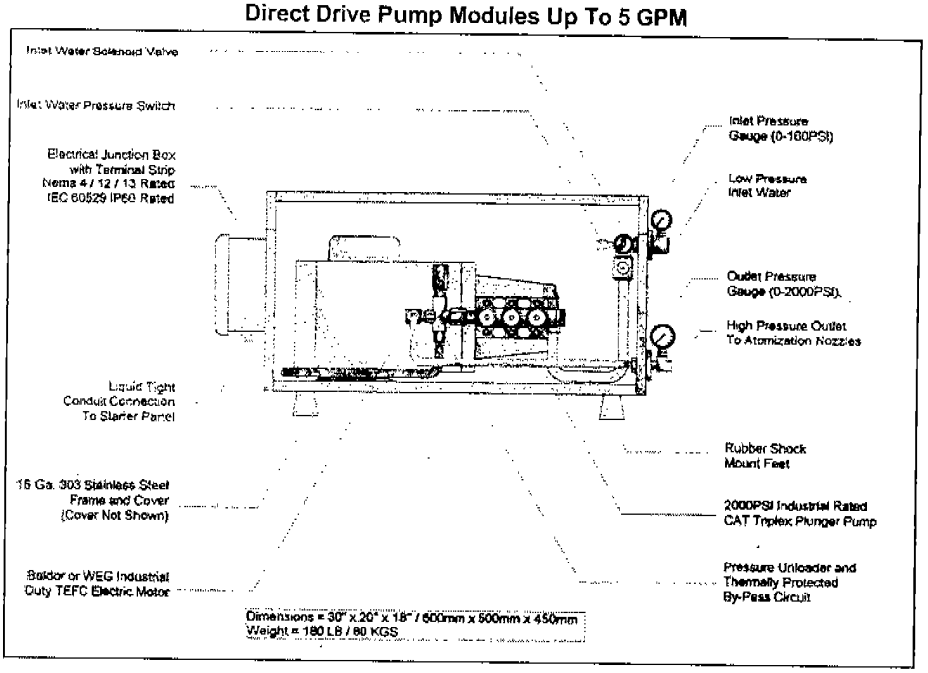
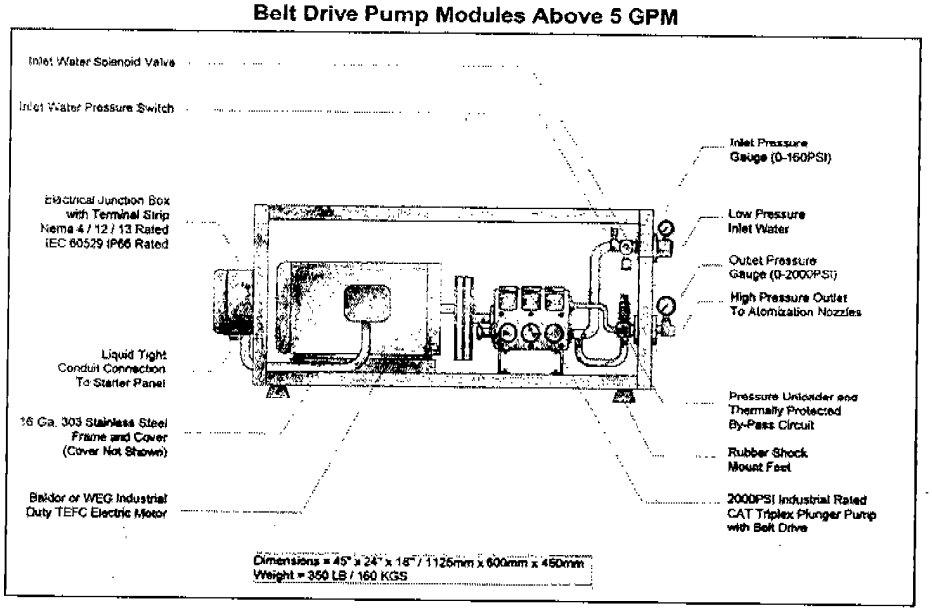
Flexi~Fog System ~ Equipment Drawings ~ Industrial Duty Pump Modules

Direct Drive Pump Modules Up To 5 GPM



Belt Drive Pump Modules Above 5 GPM



Pump Module Specification:

- 1000PSI operating pressure to create 10 micron sized fluid droplets.
- Inlet water solenoid valve to shut off water supply to pump when not in operation.
- CAT triplex plunger pump head 2000 PSI pressure rated with large oil capacity.
- Inlet and outlet water pressure gauge to record water pressure at pump module at all times.
- Pressure regulator, adjusts pressure from 0 to 1200 PSI
- External thermally protected by pass loop. cools & circulates unused pressurized water, drains overheated water if required
- Baldor or WEG TEFC motor, continuous duty rated.
- Nema 4/12/13, IEC 60529 & IP66 rated electrical enclosure with numbered terminal strip with Liquid tight conduit and cord fittings
- Low pressure switch for low inlet water pressure protection – manual reset.
- Vibration damped 303 stainless steel frames with stainless steel weather cover.

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Terms, Conditions & Warranties

The following terms & conditions of sale become a part of all proposals & any subsequent sale of equipment manufactured by Piian Systems, its Divisions or Subsidiaries, hereafter referred to as "we", "us", "our", etc. whether the equipment be purchased directly from us or our Agent, Representative or Dealer or from a Leasing Company. "Buyer" as used herein includes not only the purchaser but also the original user & original owner of the equipment.

PRICES

1. Prices are firm for a period of 60 days from date of our published price schedule or proposal, provided shipment will be accepted within six months of price schedule or proposal.
2. Prices are F.O.B. point of manufacture. Shipments are normally made freight collect.
3. Prices are in U.S. currency & do not include any excise, sales, use or properly taxes, export or import duties or other taxes of any taxing authority. Prices are subject to increase equal in amount to any tax we may be required to collect or pay on the sale or use of the equipment Such amount will be payable when invoiced.

TERMS OF PAYMENT

1. Unless otherwise specified by us, the following payment schedule applies to all accepted domestic orders, based on the total value of the order:
   To $20,000 - Net 30 calendar days from date of shipment, subject to credit approval. All orders to be prepaid without credit approval. Visa / Master Card Accepted up to $1000.
   $20,001 up - 50% payable at time of placement of order,40% payable five (5) calendar days prior to shipment, 10% 30 calendar days from date of shipment
   Accounts not paid within 30 days of invoice date will bear a service charge of one & a half percent (1 1/2%) per month on the balance due.
2. Unless otherwise specified by us, the following payment schedule applies to all accepted international orders, based on the total value of the order:
   To $100,000 - Prepaid by wire transfer with purchase order. Visa / MasterCard Accepted up to $1000
   $100,001 up - Prepaid by wire transfer or Irrevocable letter of credit plus $900 processing charge, terms of letter of credit subject to our approval prior to acceptance.

ACCEPTANCE

1. All orders are subject to acceptance in Palm Springs, California in writing by our sales manager or one or our corporate officers. Typographical & clerical errors in quotations & acknowledgements are subject to correction.
2. For credit verification, we may require a financial statement or other financial information from the Buyer. At our option prior to shipment of the equipment, we may require the utilization of a financing statement & security agreement or Irrevocable Letter of Credit. Title to equipment shall pass to Buyer only upon payment in full.
3. Any contract for the sale of equipment by us shall be treated as made & as performed in the State of California.

CHANGES IN DESIGN

1. Specifications are subject to change without notice. We are not obligated to apply any change or improvement on equipment previously manufactured.
2. Changes in design or construction of equipment made at the request of the Buyer after its order has been accepted, or in the case of custom equipment orders after the approval of drawings will be made at the expense of the Buyer under terms to be mutually agreed.

CANCELLATION

Accepted orders cannot be cancelled or assigned without prior written agreement by our sales manager or one of our corporate officers & payment of a charge of not less than 15%, of the purchase price to cover lost time & h&ling expenses in the case of a cancellation.

SHIPMENT

1. We reserve the right to select a transportation carrier that has equipment to meet the shipping requirements of our equipment & the requirements of our shipping facility.
2. We are not responsible for shipping delays beyond our reasonable control. It is understood that we are free of any & all liability & penalty for delayed shipments caused by transportation delays, inability to obtain necessary labor, components & or materials for fabrication & assembly, labor disturbances, wars, riots, fires, accidents, explosions, floods, epidemics, quarantine, adverse weather, governmental acts or regulations, or acts of God

RISK OF LOSS & DAMAGES

We assume no responsibility for loss or damage to equipment incurred after we load the equipment on the transportation carrier. Risk of loss or damage shall thereafter be borne by the Buyer regardless of whether title has passed to Buyer upon shipment. Claims for such loss or damage must be filed by the Buyer with the transportation carrier or other responsible party.

SERVICE

1. Before the equipment is placed in operation, start-up & training service by one of our field service engineers is available & recommended.
   During this start-up, final equipment adjustments are made & the Buyer & his operating & maintenance personnel are instructed. This service is charged at prevailing rates
2. Two Owners Manuals covering Installation, Operating & Maintenance Instructions & Spare & Replacement Parts Lists are furnished with the equipment purchased. Additional manuals may be purchased at the prevailing nominal charge.

GENERAL

1. Electrical components used on the equipment meet ANSI & National Electrical Code requirements & are UL approved. Hydraulic system components used on the equipment comply with National Fluid Power Association & JIC St&ards.
   UL field inspection & approval costs of completed system shall be borne by Buyer as & if required.
   The equipment is constructed in compliance with the intent of the Occupational Safety & Health Act of 1970 (OSHA). & in particular with Title 29, Chapter XVII, Part 1910, of the Occupational Safety & Health St&ards adopted Oct. 18.1972.
2. Additional costs as the result of special components or other special arrangements required by local standards or codes will be the responsibility of the Buyer.
3. The equipment is skidded as is normal to the transportation carrier. Special loading, skidding, crating, export boxing, packing or painting can be provided at an extra charge.
4. We agree to defend litigation brought against the Buyer for alleged U.S. patent infringements. We do not agree to defend infringement suits involving accessories not of our manufacture used in combination with other equipment or to defend suits involving process patents.
5. These terms & conditions supersede & take precedence over all provisions of the Buyer's purchase order or any similar document of the Buyer.
6. These terms & conditions of sale, our written warranty, published current literature & specifications & our acceptance of the Buyers order define our entire obligation with respect to any sale of our equipment.
7. All information in the proposal is confidential, prepared solely for the Buyers consideration to purchase our equipment. Transmissions of all of any part of the proposal information to others or use by the Buyer for other purposes is unauthorized without our written consent

STANDARD EQUIPMENT WARRANTY

1. The seller warrants that the goods to be delivered will be of the kind & quality described in the order or contract & will be free of defects in workmanship or material. Should any failure to conform to this warranty appear within one (1) year after the initial date of delivery or a period of 2500 hours of operation; which ever occurs first, the seller shall, upon prompt notification thereof & substantiation that the goods have been stored, installed, maintained & operated in accordance with the seller's recommendations & st&ard industry practice, correct such defect by suitable repair or replacement at its own expense. It is the seller's sole decision on whether replacement or repair of goods is necessary. Buyer is responsible for freight & labor costs associated with any installation of replacement goods honored under this warranty. This warranty excludes work that is considered by us to be follow-up installation or incidental maintenance of newly installed equipment. This warranty is limited to repairing or replacing products, which our investigation shows, were defective at the time of shipment by the manufacturer. All goods subject to this warranty shall be returned for examination, repair or replacement, freight pre-paid to our factory.
2. This warranty has no application to normal replacement of service parts such as operating oil, paint & drive belts & other parts which may have service life inherently shorter in duration than the warranty period. Customer specified components will carry the component manufacturers warranty only. Electric motor warranty claims should be directed to the local motor manufacturer service center
3. This warranty has no application to wear or damage resulting from accidents, alteration, misuse, abuse, neglect, non-action, improper removal or reinstallation or h&ling of new or defective parts, lack of preventive maintenance, sabotage, tampering, fire, explosion or any other causes not directly attributable defective workmanship or material of the equipment or any part of the equipment.
4. In addition to all of the above, Piian Systems accepts no liability if the system is used to dispense corrosive, flammable, toxic or other non approved agents.

This warranty is exclusive & is in lieu of any warranty or merchant ability, fitness for a particular purpose or other warranty of quality, whether express or implied, except of title & against patent infringement. Correction of non-conformities, in the manner & for the period of time provided above, shall constitute fulfillment of all liabilities of the seller to the purchaser with respect to, or arising out of the goods, whether based on contract negligence, strict tort or otherwise.

LIMITATION OF LIABILITY - Repair or replacement of defective products as provided above is the sole & exclusive remedy provided hereunder & the seller shall not under any circumstances be liable for special or consequential damages such as, but not limited to, damage or loss of other property or equipment, loss of profits, or revenue, cost of capital, cost of purchased or replacement goods, or claims of customers of purchaser for service interruptions. The remedies of the purchaser set forth are exclusive & the liability of seller with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, installation or use of any goods covered by or furnished under this contract whether arising out of contract, negligence, strict tort, or under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the goods upon which such liabilities based. This is the only warranty on any Piian Systems product, no other writing or description in literature shall be construed as a warranty.

Products manufactured by other than Piian Systems bear the following limited warranty:

Seller warrants that the goods manufactured by others will conform to the description herein stated. No other warranty express or implied is made, & warranty of the manufacturer is hereby assigned & transferred to the buyer. Furthermore, except for the manufacturer's warranty, if any, the products sold hereunder are sold as is. Piian Systems is not liable for any incidental or consequential damages in connection with these products.

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
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Material Safety Data Sheet.

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200.
Standard must be consulted for specific requirements

US Department of Labor.
Occupational Safety and Health Administration
(Non mandatory form)
Form Approved, OMB No. 1218-00072

Identity: (As used on label and list)

PIIAN ODOR NEUTRALIZING AGENT

Note:
Blank spaces are not permitted.
If any item is not applicable, or if no information is available, the space must be marked to indicate that.

SECTION I

Manufacturers Name:

PIIAN Systems

Emergency Telephone Number:

(760) 778-4370

Address (Number, Street, City, State and Zip Code.)

1243 South Gene Autry Trail,
Palm Springs, CA 92264.

Telephone Number for Information:

(619) 778-4370

Date Prepared: Jul. 20th, 2002

SECTION II - Hazardous Ingredients/Identity Information

Hazardous Components	CAS#	OSHA PEL	AGGIH TLV	Other Limits

All components are not considered hazardous according to the federal hazard communication standard (29 CFR 1910.1200)

SECTION III - Physical/Chemical Characteristics

Boiling Point: 212 Deg.F	**Specific Gravity(H_2O=1):** 1.0 - 1.08
Vapor Pressure: 0.7psia@100 Deg.F	**Melting Point:** N/A
Vapor Density (Air=1) Approximately the same as water.	**Evaporation Rate (Butyl Acetate=1)** 8
Solubility in Water Soluble	**pH** 6.0
Percent Volatile 0.5%	

SECTION IV - Fire and Explosion Data.

Flash Point (Method Used)	Flammable Limits	LEL	UEL
N/A	N/A	N/A	N/A

Extinguishing Media
Does not burn

Special Fire Fighting Procedure's
None

Unusual Fire and Explosion Hazards
None

SECTION V - Reactivity Data

Stability
Stable

Incompatibility (Materials to avoid)
Strong Oxidizing Agents

Hazardous Decomposition or By-products
None

Hazardous Polymerization
Will not occur

SECTION VI - Health Hazard Data

Route(s) of Entry	Inhalation?	Skin?	Ingestion?
	Yes	Eyes	Yes

Health Hazards (Acute and Chronic)
Eye contact with concentrated (undiluted) solution may cause mild irritation - wash 15 minutes with water. Seek medical attention if symptoms persists

Carcinogenicity:	NTP?	IARC Monographs?	OSHA Regulated
	No	No	No

Signs and Symptoms of Exposure
None

Medical Conditions Generally Aggravated by Exposure
None known

Emergency and First Aid Procedures
Eyes - wash with water 15 minutes.
Ingestion - drink several glasses of water, see physician if symptoms persist.

SECTION VII - Precautions For Safe Handling And Use

Steps to be taken in Case Material is Released or Spilled
Flush to drain with large quantities of water

Waste Disposal Method
Flood with water to drain

Precautions to be Taken in Handling and Storing
Storage of product below 32 deg. F may cause layering

Other precautions
Wash with soap and water if exposed

SECTION VIII - Control Measures

Respiratory Protection (Specify Type)
None required

Ventilation
Good ventilation

Eye Protection
None required

Gloves/Other Protective Clothing or Equipment
None required

Work/Hygienic Practices
Wash with soap and water before eating or smoking

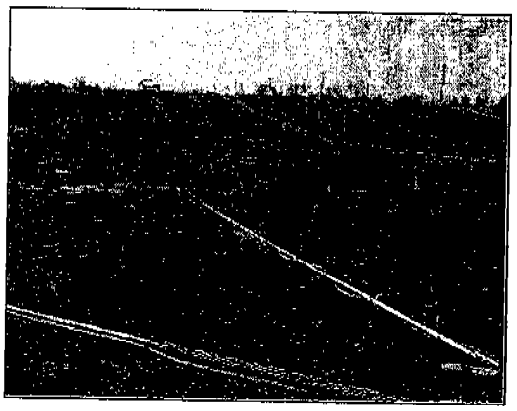
Piian Odor Control Systems

Mega Fog System

The Piian Mega Fog System has been specifically developed to provide a solution to odor problems in large open areas or inside large buildings. Operating at 1000PSI and producing 10 micron sized droplets, the system atomizes a solution of all natural odor neutralizer using anywhere from 10 to 10,000 highly specialized low flow nozzles. The system can be positioned to surround an entire landfill or it can be installed to envelop the entire environment of a large building with odor neutralizing droplets without any wetting, dripping or waste. Each system is custom designed and manufactured using the highest quality industrial rated components then installed according to the unique requirements of each odor control site.

Piian Mega Fog Applications:

- **Sewage and Industrial Waste Water Plants**
- **Landfills**
- **Lagoons / Settling Ponds**
- **Garbage Transfer & Recycling Facilities**
- **Composting Facilities**
- **Petrochemical Refineries**



Large Scale Composting & Waste Disposal/Recycling

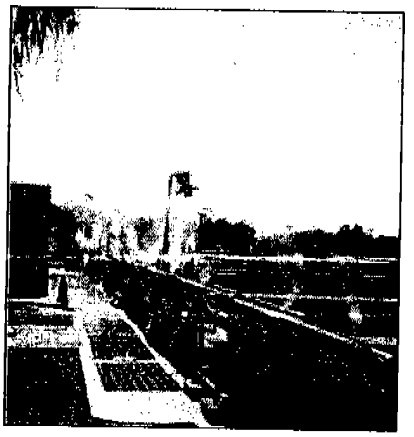
A Piian Mega Fog System dispensing Piian Odor Neutralizing Agent surrounds a compost pile effectively forming an odor neutralizing barrier.

The Piian Odor Neutralizing system is a highly valuable part of a waste disposal operators' odor management program.

The system uniformly delivers odor neutralizer over medium to large-scale areas without any wetting or dripping problems.

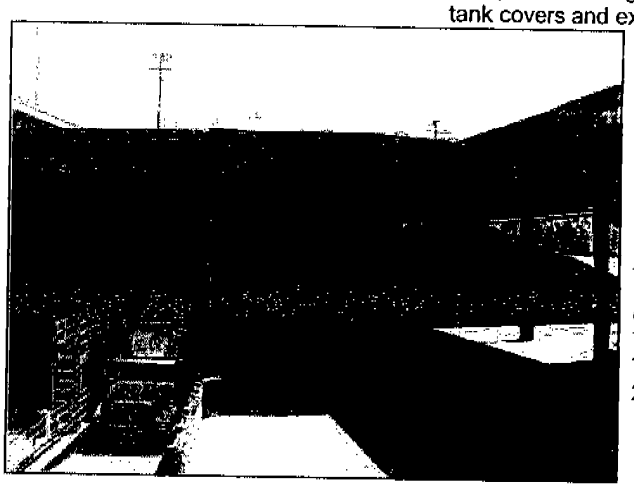
Automated operation with low installation and operating costs.

A Piian Mega Fog System is suspended on cables above a working area. The system is installed to allow machinery to move and operate safely underneath with out interfering with site operations.



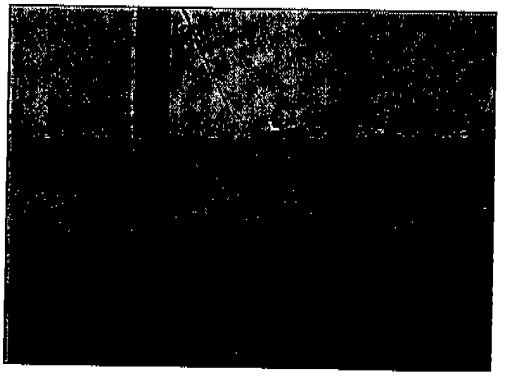
Sewage Treatment

A Piian Mega Fog System dispensing Piian Odor Neutralizing Agent is attached to the perimeter of a large primary clarifier. Odor compounds rising from the tank must pass through the fog barrier to escape. Odorous compounds contacting the fog are instantly and permanently destroyed. The system provides a highly cost effective alternative to tank covers and expensive scrubbing equipment.



Garbage Transfer

A Piian Mega Fog System dispensing Piian Odor Neutralizing Agent is attached to the transfer building structure at roof level. Odor compounds present inside the building are destroyed by the fog. The system does not interfere with the operation of the facility. Timers automatically operate the system at preset intervals over a 24 hour period.



Landfill Perimeters

A Piian Mega Fog System can be used to surround an entire landfill site. Systems have been installed to cover a linear distance of up to 5 miles. By replicating the system at several locations, huge areas can be effectively managed.

SPECIAL FEATURES:

- **Effective odor control over wide areas or large perimeters**
- **1000PSI Operation,**
- **10 Micron Sized Droplets**
- **No Wetting or Dripping**
- **Custom Designed**

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
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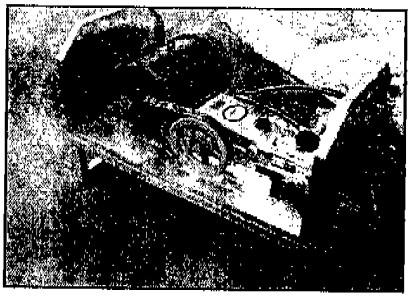
Piian Odor Control Systems

Mega Fog System

The system consists of a "high pressure pump module package" and "atomization nozzles" which are installed into hydraulic hoses or tubes to form an "atomization line". The system injects all natural odor neutralizer solution into a water supply that feeds into the high pressure pump module. The odor neutralizer solution is pressurized to 1000PSI / 70BAR and pumped along hydraulic manifold hose and is finally released into the air through tiny highly specialized low flow atomization nozzles. The released fluid forms a super fine "fog" of 10 micron sized droplets that is suspended in the air. The fog produced by the system is so fine it completely evaporates in the air without any wetting or dripping making the system highly efficient. The molecular sized odor neutralizing droplets produced by the system promote instant and permanent destruction of odorous compounds present in the air upon contact.

Equipment costs are extremely low compared to other odor control alternatives. Energy costs are low; a 10 HP system will drive 500 Nozzles. Compared to compressed air atomization system, a Piian Mega Fog System uses 90% less energy. Installations are fast and simple with the majority of fabrication completed at our factory, no special installation tools are required, 2 men can install a small system in a day. Unattended operation, the pump module may be controlled by optional equipment to activate the system at certain times or according to specific conditions.

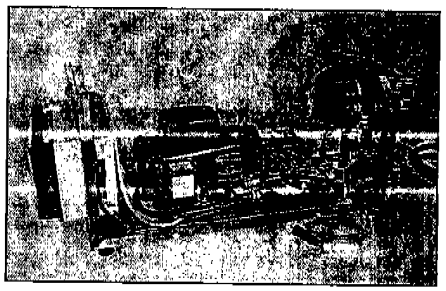
Industrial Pump Module Package



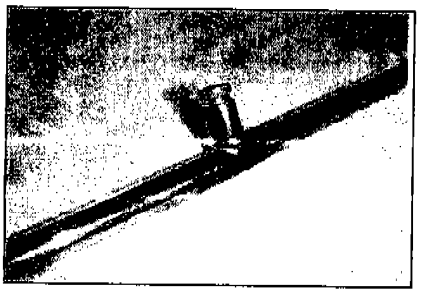
1000PSI Pump Unit

Full Starter Panel

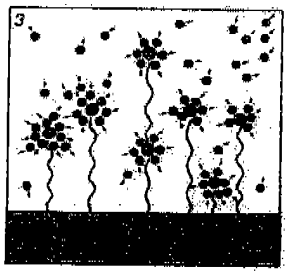
Filter Assembly



Standard Pump Module



Stainless Steel Atomization Line & Nozzle



Harnessing Nature to Solve Odor Problems.

Piian Odor Control Systems use Piian Odor Neutralizer, a completely natural proprietary blend of plant extracts, essential oils and emulsifiers. When sprayed, atomized or vaporized, molecules of this natural solution surround odorous gases causing immediate odor neutralization, followed by complete destruction of the gas through a biodegrading action. This is an entirely natural process, completely safe and environmentally benign.

Independent lab tests, field tests and a long track record have proven Piian Odor Neutralizers ability to destroy common odorous compounds such as Hydrogen Sulfide, Ammonia, Sulfur Dioxide, Mercaptans, Carbon Disulfide, Acetic Acid / Anhydride, Phenols and Styrene.

Further lab tests have verified that Piian Odor Neutralizer is completely safe for dispersion in a workspace environment, manufactured completely from food grade and pharmaceutical grade ingredients; it is non-toxic, non-sensitizing, non-flammable, non-reactive, non-volatile, bio-degradable and ecologically safe.

Three reasons why the Piian Stainless Steel Fog System is the best solution to your cooling requirements:

1. **Performance – Operating at 1000PSI, the system produces 10 micron sized droplets that evaporate completely in the air without any wetting or dripping.**
2. **Quality – Our System contains an array of proprietary features to maximize reliability and minimize maintenance plus we only use proven industrial quality components that will provide years of trouble free operation plus .**
3. **Custom Designed – By engineering the system to meet the exact requirement of the odor control site, performance and ease of operation are maximized.**

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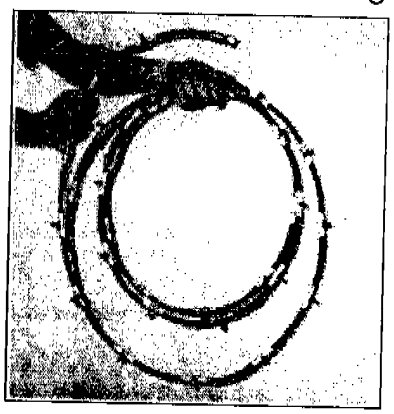
Mega Fog System – Flexible Atomization Lines



Flexible Atomization Line

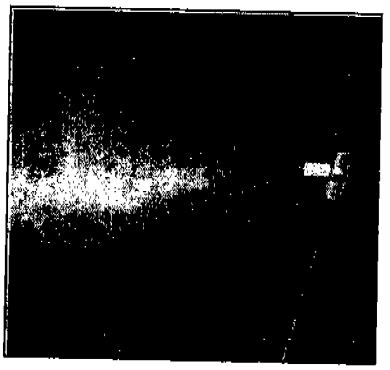
Piian flexible atomization line uses ¼" I.D. high pressure UV resistant thermoplastic hydraulic hose.

Atomization nozzles are factory mounted into hydraulic hoses using a swage type connection.

Nozzles are mounted and spaced at regular intervals, special centering is available.

Flexible fog lines permit quick and simple installation, even in hard to reach areas.

Fog line is attached to structures or equipment using hose clamps or aircraft cable and cable ties.



Atomization Nozzles

Atomization nozzles produce 10-micron fog droplets.

Each nozzle is 360° adjustable.

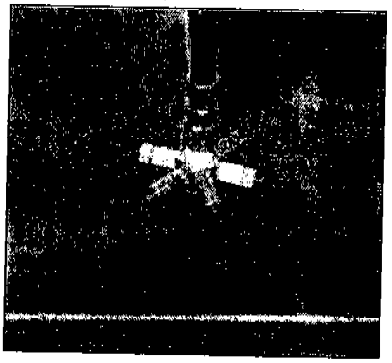
An antidrip mechanism prevents dripping and water damage.

The delivery rate of each is very accurate.

The flow rate of each nozzle is 0.025 GPM at 1000 PSI.

Each nozzle has a 0.008" orifice.

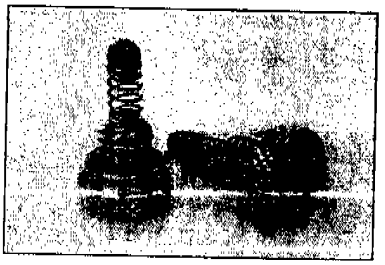
Each system is pressure tested to 2000PSI before shipment.

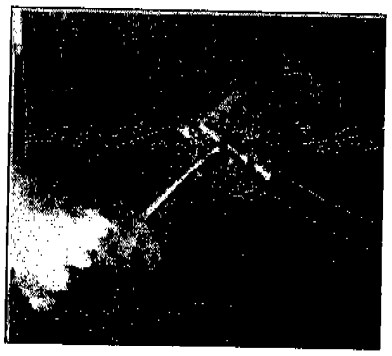


Nozzle Clusters

Nozzle clusters include 3 or 6 nozzles arranged in radial fashion.

Clusters are used for spot treatment.





Re-Usable Hose Fitting Connections

Reusable hose fittings are used to make hose connections

Each fitting has standard pipe threads

Ordinary wrenches are used to make field connections

Each system is shipped fully assembled except for final site connections.

Automatic Drain Valve

Automatically drains residual fluid from system upon shut down.

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
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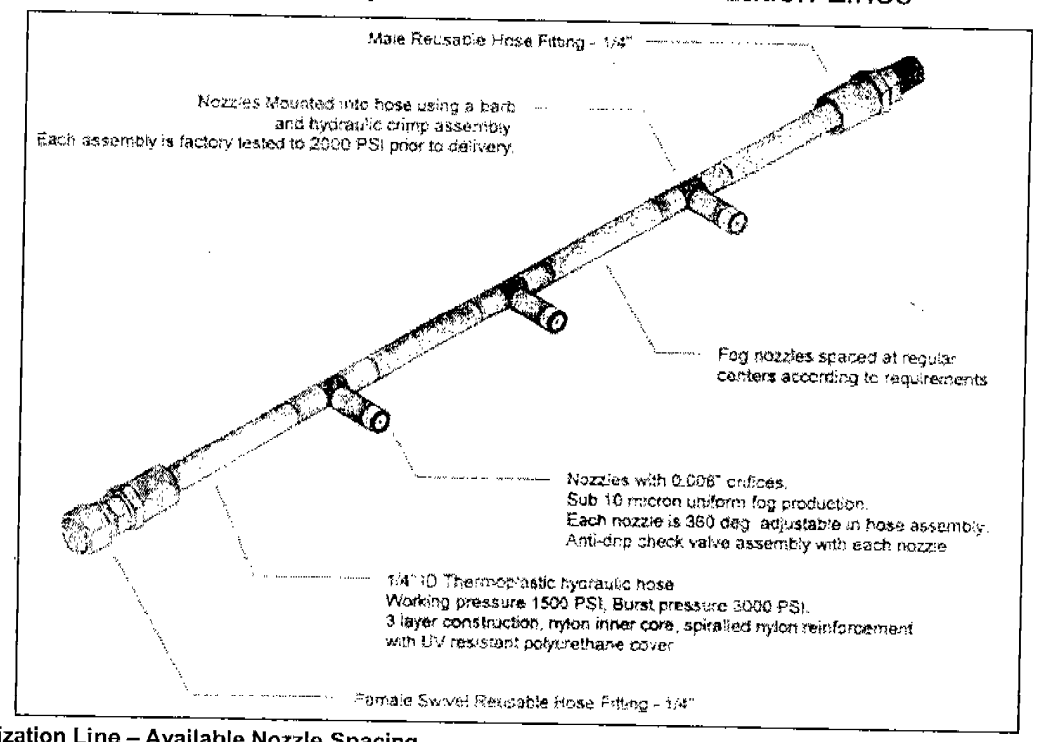
Mega Fog System ~ Flexible Atomization Lines



Flexible Atomization Line – Available Nozzle Spacing

Standard Nozzle Spacing				Metric Nozzle Spacing			
Spacing	Part #	Spacing	Part #	Spacing	Part #	Spacing	Part #
4" o/c	LHSA8004	48" o/c	LHSA8048	0.10M o/c	LHMA8010	1.50M o/c	LHMA8150
6" o/c	LHSA8006	54" o/c	LHSA8054	0.15M o/c	LHMA8015	1.75M o/c	LHMA8175
9" o/c	LHSA8009	60" o/c	LHSA8060	0.20M o/c	LHMA8020	2.00M o/c	LHMA8200
12" o/c	LHSA8012	72" o/c	LHSA8072	0.30M o/c	LHMA8030	2.25M o/c	LHMA8225
18" o/c	LHSA8018	84" o/c	LHSA8084	0.50M o/c	LHMA8050	2.50M o/c	LHMA8250
24" o/c	LHSA8024	96" o/c	LHSA8096	0.60M o/c	LHMA8060	2.75M o/c	LHMA8275
30" o/c	LHSA8030	108" o/c	LHSA8108	0.75M o/c	LHMA8075	2.90M o/c	LHMA8290
36" o/c	LHSA8036	120" o/c	LHSA8120	1.00M o/c	LHMA8100	3.00M o/c	LHMA8300
42" o/c	LHSA8042	180" o/c	LHSA8180	1.25M o/c	LHMA8125	4.00M o/c	LHMA8400

Nozzle Cluster Types (for spot treatment)

Item	Part #
Nozzle Cluster - 3 Nozzle Setup 180° / 360° Adjustable Fog Pattern ¼"/6mm port connection	LPNR0012
Nozzle Cluster - 6 Nozzle Setup 360° Fog Pattern ¼"/6mm port connection	LPNR0018

Reusable Hose Fittings (to connect flexible atomization lines & flexible manifold hoses)

Item		Part #
	1/4" / 6mm Male Re-usable Hose Fitting	FPRM0004
	3/8" / 9mm Male Re-usable Hose Fitting	FPRM0006
	1/2" / 12mm Male Re-usable Hose Fitting	FPRM0008
	1/4" / 6mm Female Swivel Re-usable Hose Fitting	FPRS0004
	3/8" / 9mm Female Swivel Re-usable Hose Fitting	FPRS0006
	1/2" /12mm Female Swivel Re-usable Hose Fitting	FPRS0008
	1/4" / 6mm Female Re-usable Hose Fitting	FPRF0004
	3/8" / 9mm Female Re-usable Hose Fitting	FPRF0006
	1/2" /12mm Female Re-usable Hose Fitting	FPRF0008

High Pressure Manifold Hoses (to connect atomization lines to the high pressure pump module)

Item	Standard	Part #	Metric	Part #
1/4" / 6mm High Pressure Manifold Hose	Per Foot	HPHM0004	Per Meter	HPHM1004
3/8" / 9mm High Pressure Manifold Hose	Per Foot	HPHM0006	Per Meter	HPHM1006
1/2" / 12mm High Pressure Manifold Hose	Per Foot	HPHM0008	Per Meter	HPHM1008

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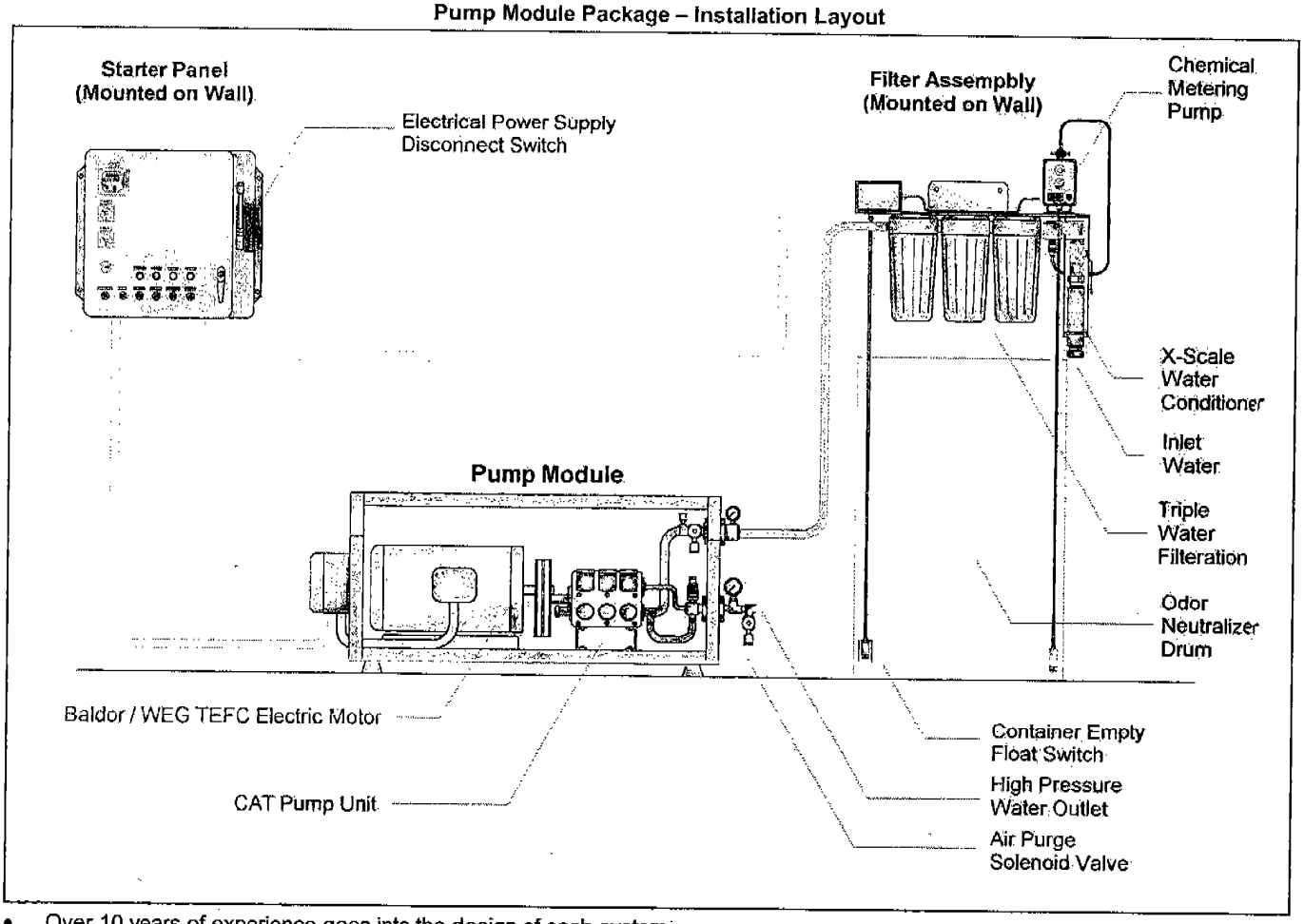
Piian Odor Control Systems

Mega Fog System ~ Industrial Pump Module Packages

A high pressure pump module package is custom designed and manufactured for each system. Piian pump module packages include as standard an inlet water filter and treatment assembly, an industrial high pressure pump module with control equipment and an electric starter panel. The high pressure pump module package filters, treats, injects odor neutralizer concentrate then pressurizes the odor neutralizing solution to 1000 PSI / 70BAR. Built in safety controls on the starter panel protect the pump module from overload and low water pressure conditions. Optional built in sophisticated electrical devices such as thermostats, humidistats and remote switches allow the pump module to cycle on and off, activate the pump module at specified periods over a 24-Hour or 7 Day period etc.

Pump Module Package – Installation Layout



- Over 10 years of experience goes into the design of each system.
- Only the highest quality industrial duty components are used in the construction of a Piian Pump Module Package.
- The pump module package is designed to operate in the toughest dusty and dirty environments.
- A water treatment device is used to adjust hard water characteristics and minimize nozzle maintenance.
- Each system includes triple high capacity filters to minimize servicing requirements.
- Each package includes as standard an air purge mechanism to removes all moisture from the manifold lines and atomization nozzles on each shut down to minimize nozzle maintenance and for freeze protection.
- LMI chemical metering pumps with both injection frequency and volume adjustments are used to dose odor neutralizer.
- The package includes an alarm to alert the operator then the odor neutralizer tank is empty.
- Pump Modules include CAT pumps and Baldor or WEG electric motors which lead their industry in reliability, durability and serviceability.
- The pump module includes a stainless steel frame and cover.
- Each package includes a fully featured wall mounted NEC / IEC electrical approved starter panel.

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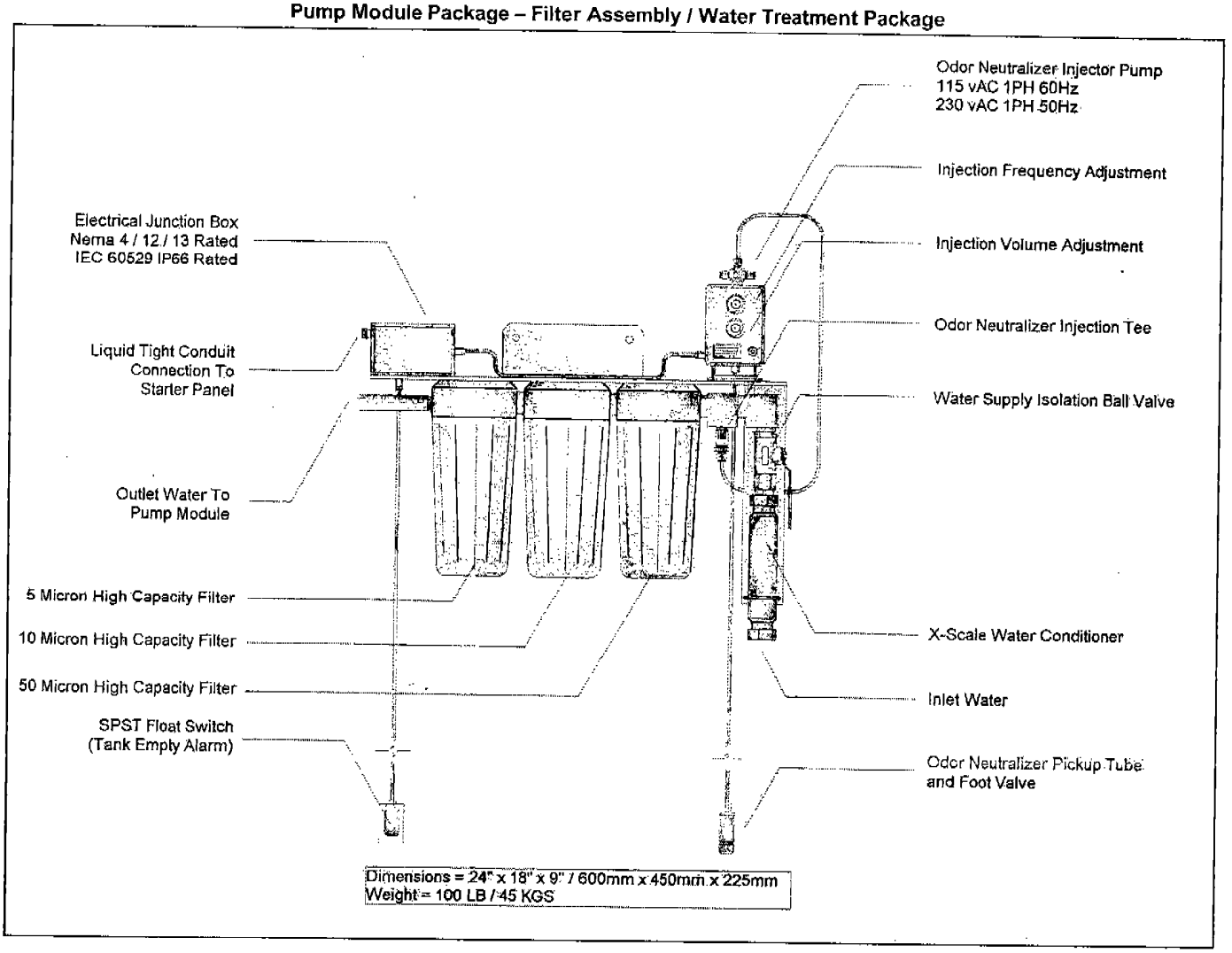
Mega Fog System ~ Industrial Pump Module Packages

Pump Module Package – Filter Assembly / Water Treatment Package



Filter Assembly Specification:

- Triple Water Filtration – 50, 10 & 5 micron inlet water filters remove sediment and particulate matter from inlet water supply.
- Large High Capacity Filters – maximizes filter life and minimizes servicing requirements
- Specialized X-scale Inlet Water Conditioner – adjusts the TDS content of inlet water to minimize nozzle maintenance, requires no servicing or maintenance.
- LMI Chemical Metering Pump – with injection frequency and volume adjustments for flexible and accurate odor neutralizer dosing.
- Float Switch Mechanism and Alarm – Alerts the user when odor neutralizer container is empty.
- Electrical Enclosure – Nema 4x and IP66 approved electrical junction box with terminal strips with liquid tight conduit & cord connections.
- Filter Assembly includes a heavy duty 1/4" thick bracket that will not flex or bend

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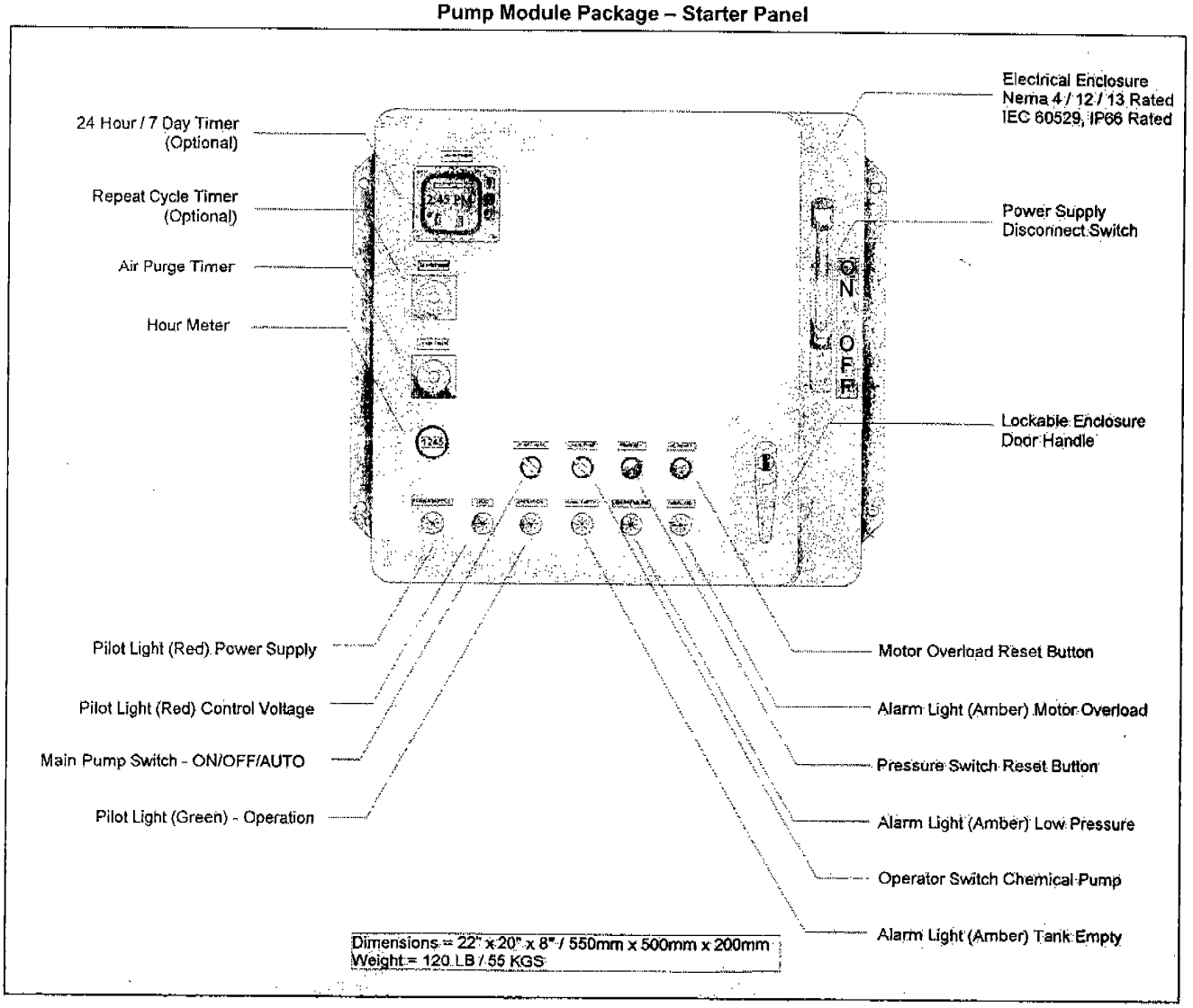
Mega Fog System ~ Industrial Pump Module Packages

Pump Module Package – Starter Panel



Starter Panel Specification:

- Nema 4/12/13, IEC 60529 & IP66 rated metal electrical enclosure **with** lockable enclosure door handle
- 3 Pole, 30AMP electrical power supply disconnect safety switch
- 22mm Pilot lights for power supply, control circuit and system operation
- 22mm Fault lights for motor overload and low inlet water pressure
- Reset buttons for motor overload and low inlet water pressure
- ON/OFF/AUTO Operator switch for system operation
- 22mm Alarm light for odor neutralizer tank empty
- Separate ON/OFF operator switch for chemical metering pump
- Flush mounted adjustable countdown timer for air purge mechanism
- Flush mounted hour meter
- Numbered terminal strip
- Liquid tight conduit and cord connections

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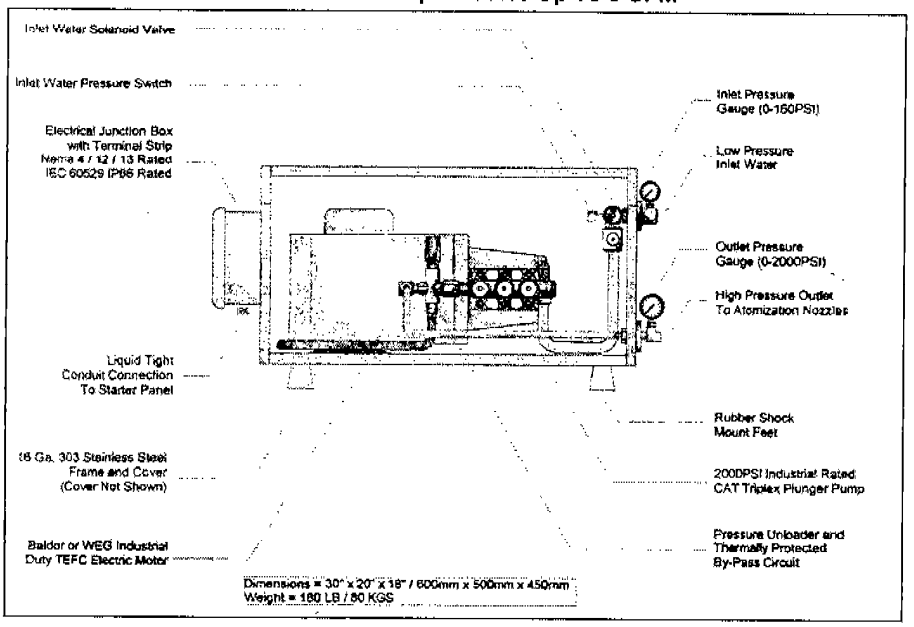
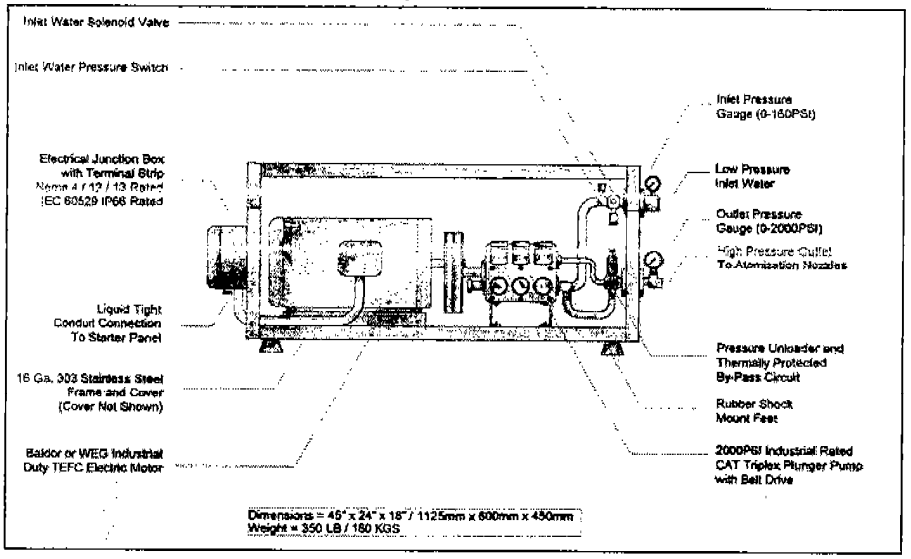
Mega Fog System ~ Industrial Duty Pump Module Packages

Direct Drive Pump Modules Up To 5 GPM



Belt Drive Pump Modules Above 5 GPM



Pump Module Specification:

- 800 to 1200 PSI operating pressure to create 10 micron sized fluid droplets.
- Inlet water solenoid valve to shut off water supply to pump when not in operation.
- CAT triplex plunger pump head 2000 PSI pressure rated with large oil capacity.
- Inlet and outlet water pressure gauge to record water pressure at pump module at all times.
- Pressure regulator. adjusts pressure from 0 to 1200 PSI
- External thermally protected by pass loop. cools & circulates unused pressurized water, drains overheated water if required
- Baldor or WEG TEFC motor, continuous duty rated.
- Nema 4/12/13, IEC 60529 & IP66 rated electrical enclosure with numbered terminal strip with Liquid tight conduit and cord fittings
- Low pressure switch for low inlet water pressure protection – manual reset.
- Vibration damped 303 stainless steel frames with stainless steel weather cover.

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Mega Fog System ~ Industrial Pump Module Packages

Small Industrial Duty Pump Packages (Includes Pump Module, Starter Panel and Filter Assembly)

Electrical Specifications for 60 Hz Power Supplies							
Pump	Flow	Electric	Nozzle	Single phase		Three phase	
Module	Rate	Motor Size	Capacity	115 VAC	230 VAC	230 VAC	460 VAC
ID	GPM / LPM	HP / kW	Min – Max	Part #	Part #	Part #	Part #
PS30S	0.7 / 2.6	0.75 / 0.5	9 – 30	PS030116	PS030216	PS030236	PS030436
PS50S	1.1 / 4.1	1.0 / 0.75	15 – 50	PS050116	PS050216	PS050236	PS050436
PS70S	1.5 / 5.7	1.5 / 1.0	21 – 70	PS070116	PS070216	PS070236	PS070436
PS100S	2.2 / 8.3	2.0 / 1.5	30 – 100	PS100116	PS100216	PS100236	PS100436
PS130S	2.9 / 11.0	2.0 / 1.5	45 – 130	PS130116	PS130216	PS130236	PS130436
PS180S	4.0 / 15.0	3.0 / 2.0	60 – 180	N/A	PS180216	PS180236	PS180436
PS220S	5.0 / 19.0	5.0 / 3.0	70 – 200	N/A	PS220216	PS220236	PS220436
Electrical Specifications for 50 Hz Power Supplies							
Pump	Flow	Electric	Nozzle	Single phase		Three phase	
Module	Rate	Motor Size	Capacity	115 vAC	230VAC	230vAC	460vAC
ID	GPM / LPM	HP / kW	Min - Max	Part #	Part #	Part #	Part #
PS40F	0.9 / 3.4	1.0 / 0.75	12 - 40	N/A	PS040215	PS040235	PS040435
PS55F	1.2 / 4.5	1.5 / 1.0	18 - 55	N/A	PS055215	PS055235	PS055435
PS80F	1.8 / 6.8	2.0 / 1.5	26 - 80	N/A	PS080215	PS080235	PS080435
PS110F	2.4 / 9.1	2.0 / 1.5	36 - 110	N/A	PS110215	PS110235	PS110435
PS150F	3.3 / 12.0	3.0 / 2.0	50 - 150	N/A	PS150215	PS150235	PS150435
PS185F	4.1 / 15.5	5.0 / 3.0	60 – 185	N/A	PS185215	PS185235	PS185435

Large Industrial Duty Pump Packages (Includes Pump Module, Starter Panel and Filter Assembly)

Electrical Specifications for 60 Hz Power Supplies							
Pump	Flow	Electric	Nozzle	Single phase		Three phase	
Module	Rate	Motor Size	Capacity	115 vAC	230 vAC	230 vAC	460 vAC
ID	GPM / LPM	HP / kW	Min – Max	Part #	Part #	Part #	Part #
PS300S	7 / 26.5	7.5 / 5.0	100 – 300	N/A	N/A	PS300236	PS300436
PS500S	11 / 41.5	10.0 / 7.5	170 – 500	N/A	N/A	PS500236	PS500436
PS700S	16 / 60	15 / 10	250 – 700	N/A	N/A	PS700236	PS700436
PS900S	21 / 80	20 / 15	300 – 900	N/A	N/A	PS900236	PS900436
PS1300S	30 / 113	30 / 20	400 – 1300	N/A	N/A	PS1300236	PS1300436
PS2200S	50 / 189	50 / 40	600 – 2000	N/A	N/A	PS2200236	PS2200436
Electrical Specifications for 50 Hz Power Supplies							
Pump	Flow	Electric	Nozzle	Single phase		Three phase	
Module	Rate	Motor Size	Capacity	115 vAC	230VAC	230vAC	460vAC
ID	GPM / LPM	HP / kW	Min - Max	Part #	Part #	Part #	Part #
PS300F	7.0 / 26.5	7.5 / 5.0	100 - 300	N/A	N/A	PS300235	PS300435
PS500F	11.0 / 41.5	10.0 / 7.5	170 - 500	N/A	N/A	PS500235	PS500435
PS700F	16 / 60.0	15 / 10	250 - 700	N/A	N/A	PS700235	PS700435
PS900F	21 / 80	20 / 15	300 - 900	N/A	N/A	PS900235	PS900435
PS1300F	30 / 113	30 / 20	400 - 1300	N/A	N/A	PS1300235	PS1300435
PS2200F	50 / 189	50 / 40	600 - 2000	N/A	N/A	PS2200235	PS2200435

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Mega Fog System ~ Continuous Duty Pump Module Packages

Continuous Duty / Heavy Duty Pump Packages (Includes Pump Module, Starter Panel and Filter Assembly)

Electrical Specifications for 60 Hz Power Supplies

Pump Module ID	Flow Rate GPM / LPM	Electric Motor Size HP / kW	Nozzle Capacity Min – Max	Single Phase 115 vAC Part #	Single Phase 230 vAC Part #	Three Phase 230 vAC Part #	Three Phase 460 vAC Part #
PF75S	1.5 / 5.7	1.5 / 1.25	25 – 75	N/A	N/A	PF075236	PF075436
PF115S	2.5 / 9.5	2.0 / 1.5	40 – 115	N/A	N/A	PF115236	PF115436
PF225S	5.0 / 18.9	5.0 / 3.75	80 – 225	N/A	N/A	PF225236	PF225436
PF340S	7.5 / 28.4	7.5 / 5.0	110 – 340	N/A	N/A	PF340236	PF340436
PF450S	10 / 37.5	10.0 / 7.5	150 – 450	N/A	N/A	PF450236	PF450436
PF590S	13 / 50	15 / 10	200 – 590	N/A	N/A	PF590236	PF590436
PF725S	16 / 60	20 / 15	240 – 725	N/A	N/A	PF725236	PF725436
PF1200S	26 / 98	30 / 20	400 – 1300	N/A	N/A	PF1200236	PF1200436
PF1800S	40 / 151	50 / 40	650 – 2000	N/A	N/A	PF1800236	PF1800436

Electrical Specifications for 50 Hz Power Supplies

Pump Module ID	Flow Rate GPM / LPM	Electric Motor Size HP / kW	Nozzle Capacity Min - Max	Single Phase 115 vAC Part #	Single Phase 230VAC Part #	Three Phase 230vAC Part #	Three Phase 460vAC Part #
PF75F	1.5 / 5.7	1.5 / 1.25	25 – 75	N/A	N/A	PF075235	PF075435
PF115F	2.5 / 9.5	2.0 / 1.5	40 – 115	N/A	N/A	PF115235	PF115435
PF225F	5.0 / 18.9	5.0 / 3.75	80 – 225	N/A	N/A	PF225235	PF225435
PF340F	7.5 / 28.4	7.5 / 5.0	110 – 340	N/A	N/A	PF340235	PF340435
PF450F	10 / 37.5	10.0 / 7.5	150 – 450	N/A	N/A	PF450235	PF450435
PF590F	13 / 50	15 / 10	200 – 590	N/A	N/A	PF590235	PF590435
PF725F	16 / 60	20 / 15	240 – 725	N/A	N/A	PF725235	PF725435
PF1200F	26 / 98	30 / 20	400 – 1300	N/A	N/A	PF1200235	PF1200435
PF1800F	40 / 151	50 / 40	650 – 2000	N/A	N/A	PF1800235	PF1800435

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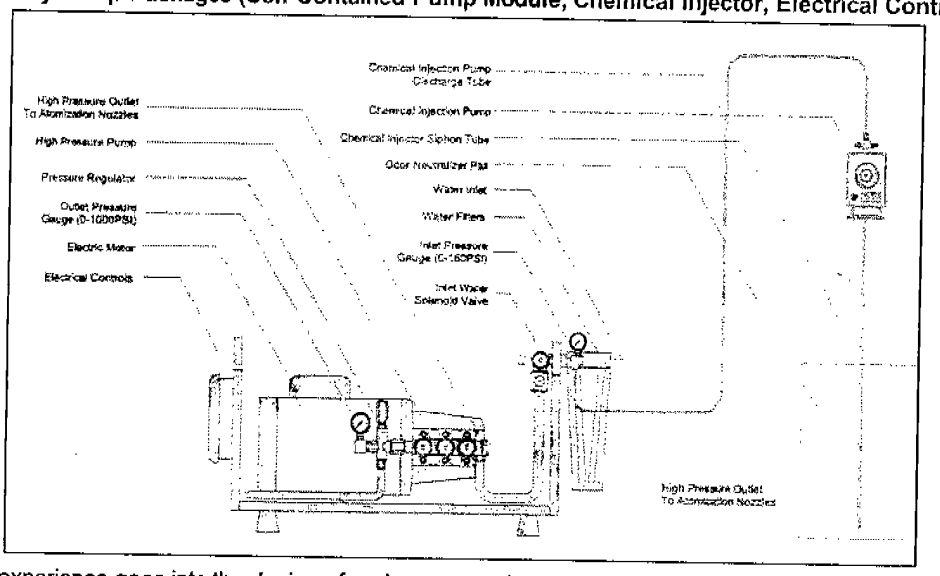
Mega Fog System ~ Standard Duty Pump Modules

Small Standard Duty Pump Packages (Self Contained Pump Module, Chemical Injector, Electrical Controls and Filters)



- Over 10 years of experience goes into the design of each pump module.
- Only the highest quality industrial duty components are used in the construction of a Piian Pump Module.
- The pump module package is designed to operate in the toughest dusty and dirty environments.
- Optional water treatment device is used to adjust hard water characteristics and minimize nozzle maintenance.
- Modules include CAT pumps, Baldor or WEG electric motors, LMI Metering Pumps which lead their industry in reliability, durability and serviceability.
- The pump module includes a stainless steel frame and cover.
- Double Water Filtration – 10 & 5 micron inlet water filters remove sediment and particulate matter from inlet water supply.
- Nema 4 IEC 60529 & IP66 rated poly carbonate electrical enclosure with lockable enclosure
- 22mm Pilot lights / Fault Lights for power supply, system operation, motor overload and low inlet water pressure
- Reset buttons for motor overload and low inlet water pressure
- ON/OFF/AUTO Operator switch for system operation
- Flush mounted hour meter
- Liquid tight conduit and cord connections

Pump	Flow	Electric	Nozzle	Single phase		Three phase	
Module	Rate	Motor Size	Capacity	115 VAC	230 VAC	230 VAC	460 VAC
ID	GPM / LPM	HP / kW	Min – Max	Part #	Part #	Part #	Part #
PK30S	0.7 / 2.6	0.75 / 0.5	9 – 30	PK030116	PK030216	PK030236	PK030436
PK50S	1.1 / 4.1	1.0 / 0.75	15 – 50	PK050116	PK050216	PK050236	PK050436
PK70S	1.5 / 5.7	1.5 / 1.0	21 – 70	PK070116	PK070216	PK070236	PK070436
PK100S	2.2 / 8.3	2.0 / 1.5	30 – 100	PK100116	PK100216	PK100236	PK100436
PK130S	2.9 / 11.0	2.0 / 1.5	45 – 130	PK130116	PK130216	PK130236	PK130436
PK180S	4.0 / 15.0	3.0 / 2.0	60 – 180	N/A	PK180216	PK180236	PK180436
PK220S	5.0 / 19.0	5.0 / 3.0	70 – 200	N/A	PK220216	PK220236	PK220436

Electrical Specifications for 50 Hz Power Supplies

Pump	Flow	Electric	Nozzle	Single phase		Three phase	
Module	Rate	Motor Size	Capacity	115 vAC	230VAC	230vAC	460vAC
ID	GPM / LPM	HP / kW	Min - Max	Part #	Part #	Part #	Part #
PK40F	0.9 / 3.4	1.0 / 0.75	12 - 40	N/A	PK040215	PK040235	PK040435
PK55F	1.2 / 4.5	1.5 / 1.0	18 - 55	N/A	PK055215	PK055235	PK055435
PK80F	1.8 / 6.8	2.0 / 1.5	26 - 80	N/A	PK080215	PK080235	PK080435
PK110F	2.4 / 9.1	2.0 / 1.5	36 - 110	N/A	PK110215	PK110235	PK110435
PK150F	3.3 / 12.0	3.0 / 2.0	50 - 150	N/A	PK150215	PK150235	PK150435
PK185F	4.1 / 15.5	5.0 / 3.0	60 – 185	N/A	PK185215	PK185235	PK185435

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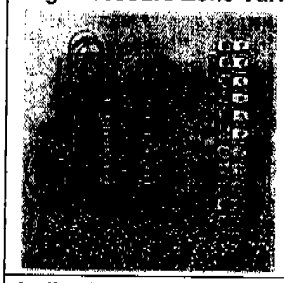
Mega Fog System ~ Control Equipment and Optional Equipment

Item	Part #
Outdoor Skid Frame – Mounts the pump, filters and starter on to a forklift skid frame for outdoor use	CPSF0001
Chemical Injection Pump – injects odor neutralizer into inlet water to pump module for odor control applications	
 115 vAC 5.0 GPD 150 PSI Pump	CECJ0115
230 vAC 5.0 GPD 150 PSI Pump	CECJ0230
115 vAC 10.0 GPD 110 PSI Pump	CECJ1115
230 vAC 10.0 GPD 110 PSI Pump	CECJ1230
115 vAC 14.0 GPD 250 PSI Pump	CECJ2115
230 vAC 14.0 GPD 250 PSI Pump	CECJ2230
115 vAC 24.0 GPD 110 PSI Pump	CECJ3115
230 vAC 24.0 GPD 110 PSI Pump	CECJ3230
115 vAC 38.0 GPD 150 PSI Pump	CECJ4115
230 vAC 38.0 GPD 150 PSI Pump	CECJ4230
115 vAC 60.0 GPD 100 PSI Pump	CECJ5115
230 vAC 60.0 GPD 100 PSI Pump	CECJ5230
High Pressure Zone Valve – splits system in to multiple control zones	
 2 Zone Controller, 3/8" NPT 1200 PSI	LPSN2115
3 Zone Controller, 3/8" NPT 1200 PSI	LPSN3115
4 Zone Controller, 3/8" NPT 1200 PSI	LPSN4115
5 Zone Controller, 3/8" NPT 1200 PSI	LPSN5115
2 Zone Controller, 3/8" NPT 1200 PSI with De-Pressurization Valve	LPSC2115
3 Zone Controller, 3/8" NPT 1200 PSI with De-Pressurization Valve	LPSC3115
4 Zone Controller, 3/8" NPT 1200 PSI with De-Pressurization Valve	LPSC4115
5 Zone Controller, 3/8" NPT 1200 PSI with De-Pressurization Valve	LPSC5115
* Multiple additional zones and other standard voltages available	
In-line Water Conditioner – modifies the TDS content of inlet water to reduce nozzle maintenance. Unit is installed onto inlet plumbing to system, requires no servicing or maintenance.	
 3/8" NPT Unit, Treats Water Flow Rate from 0.1 – 1.1 GPM	CPWC0002
1/2" NPT Unit Treats Water Flow Rate from 0.5 GPM to 2.9 GPM	CPWC0004
3/4" NPT Unit, Treats Water Flow Rate from 2.2 GPM to 5.0 GPM	CPWC0006
1" NPT Unit, Treats Water Flow Rate from 3.5 GPM to 11.0 GPM	CPWC0008
1 1/2" NPT Unit, Treats Water Flow Rate from 7.0 GPM to 20.0 GPM	CPWC0012
2" NPT Unit, Treats Water Flow Rate from 15.0 GPM to 35 GPM	CPWC0024
3" NPT Unit, Treats Water Flow Rate from 30 GPM to 50 GPM	CPWC0036
4" NPT Unit, Treats Water Flow Rate from 40 GPM to 100 GPM	CPWC0048
D-ionization System - treats unsuitable water for use in up to 5 GPM system	CEDI0004
Reverse Osmosis System - treats unsuitable water for use in greater than 5 GPM system	CERS0004
Temperature Controller – provides thermostat switching for system	CETP0001
Humidity Controller – digital humidistat will precise control of humidity levels inside buildings	
Digital Humidistat Panel, 24 vAC, 2 Zone	CEHM0001
Aspirated Humidity Sensor	CEHM0002
Non Aspirated Humidity Sensor	CEHM0003
Timing Controllers – built into the pump module starter panel	
24 Hour Timer – activates the system at specific periods over 24 hours	CETU0001
Repeat Cycle Timer – cycles the system on and off at specific intervals	CETU0002

Other System Options

- Gas / Diesel / Compressed Air power alternatives.
- Outdoor Transport Skid Frame.
- Explosion proof specification.

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Mega Fog System ~ System Fixtures and Fittings

Suspending Equipment & Fixtures for Atomization Lines

Item				Part #
1/16" Diameter Stainless Steel Aircraft Cable – strung between points and atomization lines attached with cable ties.	Per Foot	LSAC0001	Per Meter	LSAC0002
Cable Tightening Unit – Used to stretch aircraft cable.				LSCT0001
Cable Crimp Sleeves – Used to connect cable.				LSCS0116
Rubber Cushioned Hose Mounting Clamps – 1/4" hose dia, attaches atomization lines to walls and surfaces				LSHC0004
Rubber Cushioned Hose Mounting Clamps – 3/8" hose dia, attaches manifold hose / tubes to walls and surfaces				LSHC0006
Rubber Cushioned Hose Mounting Clamps – 1/2" hose dia, attaches manifold hose / tubes to walls and surfaces				LSHC0008

Atomization Nozzles, Nozzle Plugs and Automatic Drain Valves

Item	Part #
Brass / Stainless Steel Atomization Nozzle – Standard 0.008" Orifice with Antidrip Adapter	LPNA0001
Brass / Stainless Steel Atomization Nozzle – Special 0.012" Orifice with Antidrip Adapter	LPNA0002
Brass / Stainless Steel Atomization Nozzle – Special 0.020" Orifice with Antidrip Adapter	LPNA0003
Brass / Stainless Steel Atomization Nozzle – Standard 0.008" Orifice without Antidrip Adapter	LPNA0004
Brass / Stainless Steel Atomization Nozzle – Special 0.012" Orifice without Antidrip Adapter	LPNA0005
Brass / Stainless Steel Atomization Nozzle – Special 0.020" Orifice without Antidrip Adapter	LPNA0006
Stainless Steel Atomization Nozzle – Standard 0.008" Orifice with Antidrip Adapter	LPNS0001
Stainless Steel Atomization Nozzle – Special 0.012" Orifice with Antidrip Adapter	LPNS0002
Stainless Steel Atomization Nozzle – Special 0.020" Orifice with Antidrip Adapter	LPNS0003
Stainless Steel Atomization Nozzle – Standard 0.008" Orifice without Antidrip Adapter	LPNS0004
Stainless Steel Atomization Nozzle – Special 0.012" Orifice without Antidrip Adapter	LPNS0005
Stainless Steel Atomization Nozzle – Special 0.020" Orifice without Antidrip Adapter	LPNS0006
Atomization Line Automatic Drain Valve – Drains fluid from system on shut down	LPDV0004
Atomization Nozzle Plug – Used to plug off a nozzle if required	LPPG0001

Nozzle Extenders

Item	Part #
Flexible Nozzle Extender – 3" / 75 mm	LPNE0003
Flexible Nozzle Extender – 6" / 150 mm	LPNE0006
Flexible Nozzle Extender – 9" / 275 mm	LPNE0009
Flexible Nozzle Extender – 12" / 300 mm	LPNE0012
Flexible Nozzle Extender – 18" / 450 mm	LPNE0018

High Pressure Pipe Fittings

Item		Part #
	Hex Nipple – 1/4" x 1/4" NPT	PFNH0404
	Hex Nipple – 3/8" x 3/8" NPT	PFNH0606
	Hex Nipple – 1/2" x 1/2" NPT	PFNH0808
	Reducing Hex Nipple – 3/8" x 1/4" NPT	PFNR0604
	Reducing Hex Nipple – 1/2" x 1/4" NPT	PFNR0804
	Reducing Hex Nipple – 1/2" x 3/8" NPT	PFNR0806
	Street Tee – 1/4" NPT	PFTS0004
	Street Tee – 3/8" NPT	PFTS0006
	Street Tee – 1/2" NPT	PFTS0008
	Street Elbow – 1/4" NPT	PFES0004
	Street Elbow – 3/8" NPT	PFES0006
	Street Elbow – 1/2" NPT	PFES0008
	Hex Plug – 1/4" NPT	PFPH0004
	Hex Plug – 3/8" NPT	PFPH0006
	Hex Plug – 1/2" NPT	PFPH0008

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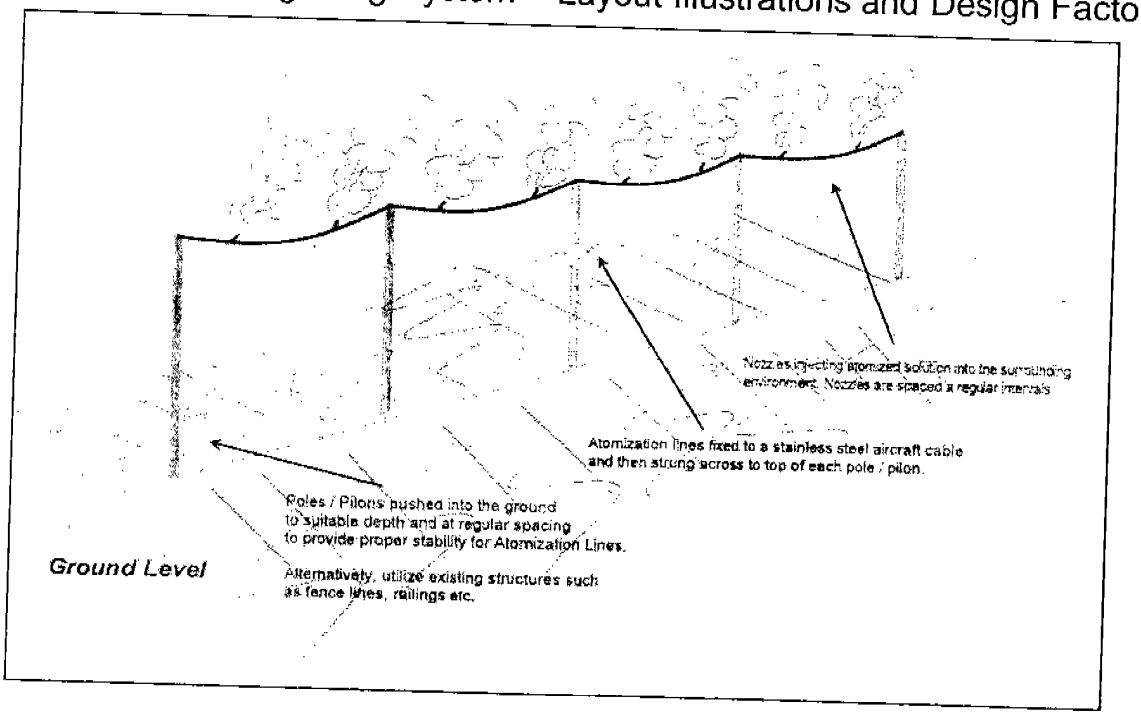
Mega Fog System ~ Layout Illustrations and Design Factors

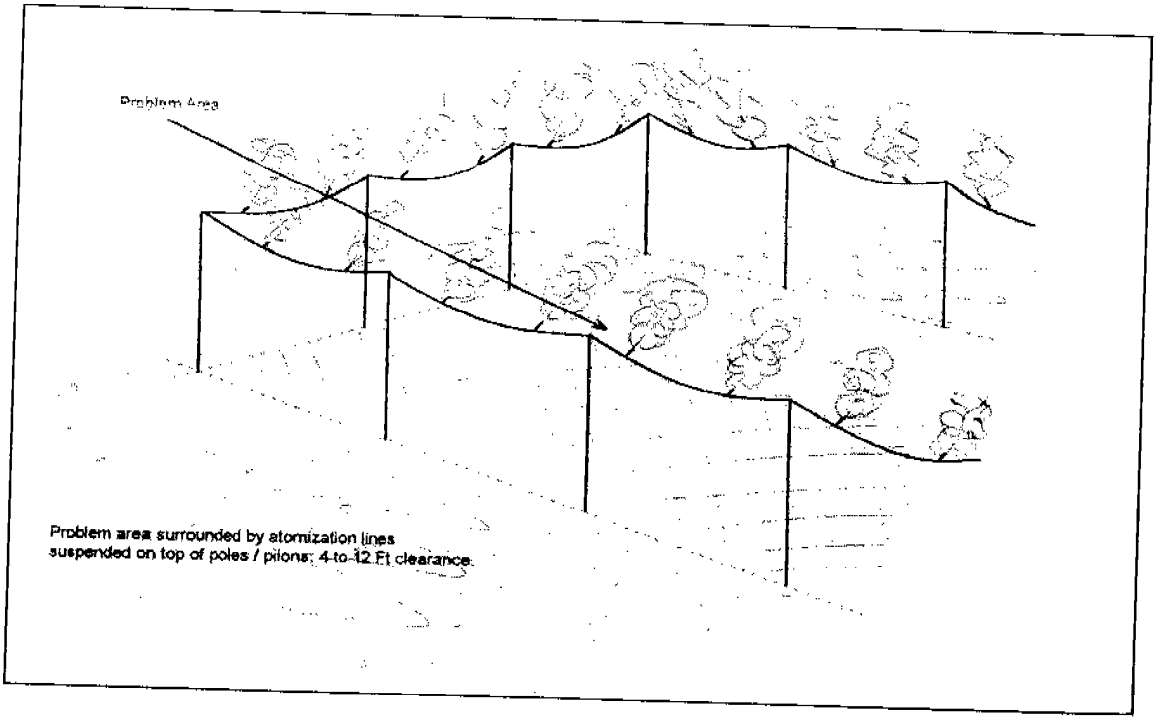


Barrier Layout

For outdoor applications, the system is installed to form a barrier between the source of the odor and the source of the odor complaint. Usually, the atomization lines are suspended on cables that have been strung between poles or posts. Existing structures can be utilized provided they locate the atomization lines in the optimum odor control position.

Perimeter Barrier

To achieve the best possible results, the odor source should be surrounded. The atomization lines should be positioned as close as possible to the odor source without interfering with site operations.



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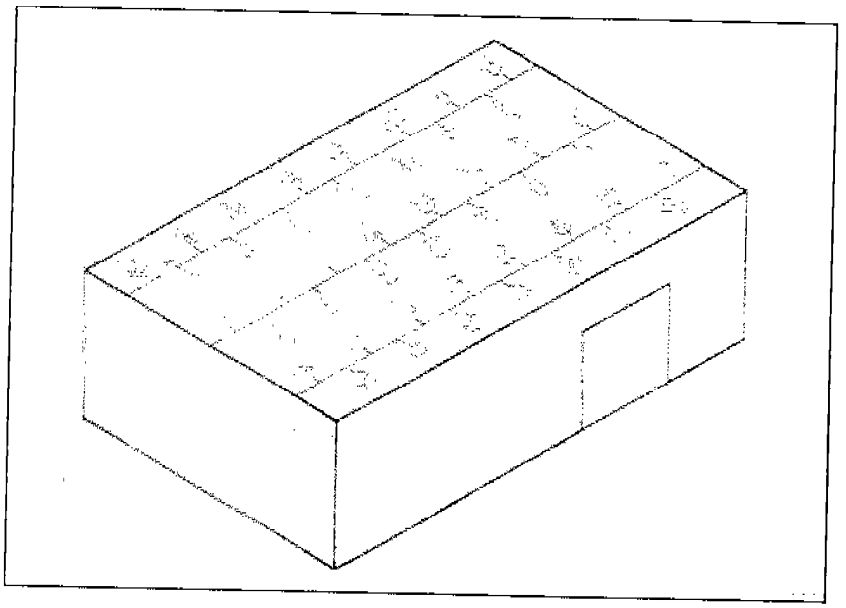
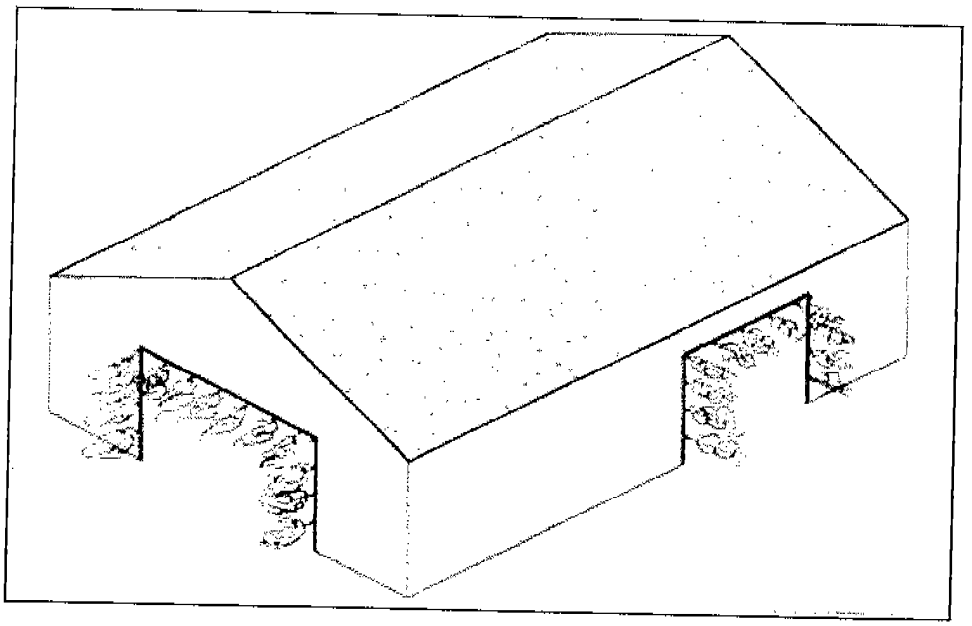
Mega Fog System ~ Layout Illustrations and Design Factors



Process Buildings

In process buildings, the system is best installed at roof level so as not to interfere with activity at ground level. The system will build up odor neutralizer inside the building environment that will act as a large contact chamber.



Building Doors and Openings

If there are large openings in a building, the fog system may be installed around the perimeter of the opening to act as a curtain. As is typical of most installations, there will be a combination of installation methods.

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
Tel: (760) 778-4370 Fax: (760) 778-4368
Email: info@piian.com Web: www.piian.com
Pricing Subject To Change without Notice

Distributed By:

Piian Cooling Systems

Terms, Conditions & Warranties

The following terms & conditions of sale become a part of all proposals & any subsequent sale of equipment manufactured by Piian Systems, its Divisions or Subsidiaries, hereafter referred to as "we", "us", "our", etc. whether the equipment be purchased directly from us or our Agent, Representative or Dealer or from a Leasing Company. "Buyer" as used herein includes not only the purchaser but also the original user & original owner of the equipment.

PRICES

1. Prices are firm for a period of 60 days from date of our published price schedule or proposal, provided shipment will be accepted within six months of price schedule or proposal.
2. Prices are F.O.B. point of manufacture. Shipments are normally made freight collect.
3. Prices are in U.S. currency & do not include any excise, sales, use or properly taxes, export or import duties or other taxes of any taxing authority. Prices are subject to increase equal in amount to any tax we may be required to collect or pay on the sale or use of the equipment Such amount will be payable when invoiced.

TERMS OF PAYMENT

1. Unless otherwise specified by us, the following payment schedule applies to all accepted domestic orders, based on the total value of the order:
   To $20,000 - Net 30 calendar days from date of shipment, subject to credit approval. All orders to be prepaid without credit approval. Visa / Master Card Accepted up to $1000.
   $20,001 up - 50% payable at time of placement of order,40% payable five (5) calendar days prior to shipment, 10% 30 calendar days from date of shipment
   Accounts not paid within 30 days of invoice date will bear a service charge of one & a half percent (1 1/2%) per month on the balance due.
2. Unless otherwise specified by us, the following payment schedule applies to all accepted international orders, based on the total value of the order:
   To $100,000 - Prepaid by wire transfer with purchase order. Visa / MasterCard Accepted up to $1000
   $100,001 up - Prepaid by wire transfer or Irrevocable letter of credit plus $900 processing charge, terms of letter of credit subject to our approval prior to acceptance.

ACCEPTANCE

1. All orders are subject to acceptance in Palm Springs, California in writing by our sales manager or one or our corporate officers. Typographical & clerical errors in quotations & acknowledgements are subject to correction.
2. For credit verification, we may require a financial statement or other financial information from the Buyer. At our option prior to shipment of the equipment, we may require the utilization of a financing statement & security agreement or Irrevocable Letter of Credit. Title to equipment shall pass to Buyer only upon payment in full.
3. Any contract for the sale of equipment by us shall be treated as made & as performed in the State of California.

CHANGES IN DESIGN

1. Specifications are subject to change without notice. We are not obligated to apply any change or improvement on equipment previously manufactured.
2. Changes in design or construction of equipment made at the request of the Buyer after its order has been accepted, or in the case of custom equipment orders after the approval of drawings will be made at the expense of the Buyer under terms to be mutually agreed.

CANCELLATION

Accepted orders cannot be cancelled or assigned without prior written agreement by our sales manager or one of our corporate officers & payment of a charge of not less than 15%, of the purchase price to cover lost time & handling expenses in the case of a cancellation.

SHIPMENT

1. We reserve the right to select a transportation carrier that has equipment to meet the shipping requirements of our equipment & the requirements of our shipping facility.
2. We are not responsible for shipping delays beyond our reasonable control. It is understood that we are free of any & all liability & penalty for delayed shipments caused by transportation delays, inability to obtain necessary labor, components & or materials for fabrication & assembly, labor disturbances, wars, riots, fires, accidents, explosions, floods, epidemics, quarantine, adverse weather, governmental acts or regulations, or acts of God

RISK OF LOSS & DAMAGES

We assume no responsibility for loss or damage to equipment incurred after we load the equipment on the transportation carrier. Risk of loss or damage shall thereafter be borne by the Buyer regardless of whether title has passed to Buyer upon shipment. Claims for such loss or damage must be filed by the Buyer with the transportation carrier or other responsible party.

SERVICE

1. Before the equipment is placed in operation, start-up & training service by one of our field service engineers is available & recommended.
   During this start-up, final equipment adjustments are made & the Buyer & his operating & maintenance personnel are instructed. This service is charged at prevailing rates
2. Two Owners Manuals covering Installation, Operating & Maintenance Instructions & Spare & Replacement Parts Lists are furnished with the equipment purchased. Additional manuals may be purchased at the prevailing nominal charge.

GENERAL

1. Electrical components used on the equipment meet ANSI & National Electrical Code requirements & are UL approved. Hydraulic system components used on the equipment comply with National Fluid Power Association & JIC Standards.
   UL field inspection & approval costs of completed system shall be borne by Buyer as & if required.
   The equipment is constructed in compliance with the intent of the Occupational Safety & Health Act of 1970 (OSHA). & in particular with Title 29, Chapter XVII, Part 1910, of the Occupational Safety & Health Standards adopted Oct. 18,1972.
2. Additional costs as the result of special components or other special arrangements required by local standards or codes will be the responsibility of the Buyer.
3. The equipment is skidded as is normal to the transportation carrier. Special loading, skidding, crating, export boxing, packing or painting can be provided at an extra charge.
4. We agree to defend litigation brought against the Buyer for alleged U.S. patent infringements. We do not agree to defend infringement suits involving accessories not of our manufacture used in combination with other equipment or to defend suits involving process patents.
5. These terms & conditions supersede & take precedence over all provisions of the Buyer's purchase order or any similar document of the Buyer
6. These terms & conditions of sale, our written warranty, published current literature & specifications & our acceptance of the Buyers order define our entire obligation with respect to any sale of our equipment.
7. All information in the proposal is confidential, prepared solely for the Buyers consideration to purchase our equipment. Transmissions of all of any part of the proposal information to others or use by the Buyer for other purposes is unauthorized without our written consent

STANDARD EQUIPMENT WARRANTY

1. The seller warrants that the goods to be delivered will be of the kind & quality described in the order or contract & will be free of defects in workmanship or material. Should any failure to conform to this warranty appear within one (1) year after the initial date of delivery or a period of 2500 hours of operation; which ever occurs first, the seller shall, upon prompt notification thereof & substantiation that the goods have been stored, Installed, maintained & operated in accordance with the seller's recommendations & standard industry practice, correct such defect by suitable repair or replacement at its own expense. It is the seller's sole decision on whether replacement or repair of goods is necessary. Buyer is responsible for freight & labor costs associated with any installation of replacement goods honored under this warranty. This warranty excludes work that is considered by us to be follow-up installation or incidental maintenance of newly installed equipment. This warranty is limited to repairing or replacing products, which our investigation shows, were defective at the time of shipment by the manufacturer. All goods subject to this warranty shall be returned for examination, repair or replacement, freight pre-paid to our factory.
2. This warranty has no application to normal replacement of service parts such as operating oil, paint & drive belts & other parts which may have service life inherently shorter in duration than the warranty period. Customer specified components will carry the component manufacturers warranty only. Electric motor warranty claims should be directed to the local motor manufacturer service center
3. This warranty has no application to wear or damage resulting from accidents, alteration, misuse, abuse, neglect, non-action, improper removal or reinstallation or handling of new or defective parts, lack of preventive maintenance, sabotage, tampering, fire, explosion or any other causes not directly attributable defective workmanship or material of the equipment or any part of the equipment.
4. In addition to all of the above, Piian Systems accepts no liability if the system is used to dispense corrosive, flammable, toxic or other non approved agents.

This warranty is exclusive & is in lieu of any warranty or merchant ability, fitness for a particular purpose or other warranty of quality, whether express or implied, except of title & against patent infringement. Correction of non-conformities, in the manner & for the period of time provided above, shall constitute fulfillment of all liabilities of the seller to the purchaser with respect to, or arising out of the goods, whether based on contract negligence, strict tort or otherwise.

LIMITATION OF LIABILITY - Repair or replacement of defective products as provided above is the sole & exclusive remedy provided hereunder & the seller shall not under any circumstances be liable for special or consequential damages such as, but not limited to, damage or loss of other property or equipment, loss of profits, or revenue, cost of capital, cost of purchased or replacement goods, or claims of customers of purchaser for service interruptions. The remedies of the purchaser set forth are exclusive & the liability of seller with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, installation or use of any goods covered by or furnished under this contract whether arising out of contract, negligence, strict tort, or under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the goods upon which such liabilities based. This is the only warranty on any Piian Systems product, no other writing or description in literature shall be construed as a warranty.

Products manufactured by other than Piian Systems bear the following limited warranty:

Seller warrants that the goods manufactured by others will conform to the description herein stated. No other warranty express or implied is made, & warranty of the manufacturer is hereby assigned & transferred to the buyer. Furthermore, except for the manufacturer's warranty, if any, the products sold hereunder are sold as is. Piian Systems is not liable for any incidental or consequential damages in connection with these products.

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
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Pricing Subject To Change without Notice

Distributed By:

Piian Odor Control Systems

Piian Odor Neutralizer

What is Piian Odor Neutralizer?

Piian Odor Neutralizer is a revolution in industrial odor control, developed in our own laboratories and first introduced over 15 years ago, it is the worlds first all natural broad spectrum industrial odor neutralizing agent. Manufactured completely from natural essential oils and plant extracts, Piian Odor Neutralizer is not a perfume or masking agent, when atomized into the air it immediately and permanently destroys common odorous gases by an absorbing and biodegrading action.

Piian Odor Neutralizer is a more effective, safer and lower cost alternative to masking agents and dangerous chemicals typically used for industrial and commercial odor control.

Major Features:

- Neutralizes & Destroys Odors
- Not A Perfume
- All Food or Pharmaceutical Grade Ingredients
- Extensively Tested For Safety
- Performance Tested
- Non-Sensitizing, Non-Volitile, Non-Flammible, Non-Corrosive
- Highly Concentrated
- Water Soluble

Considering the sensitive circumstances in which Piian Odor Neutralizer is used, safety was our first priority in designing & developing the product. For this reason, every ingredient in Piian Odor Neutralizer is either food grade or pharmaceutical grade. It has been extensively tested for safety and toxicity by various independent laboratories and conforms to stringent EPA Guidelines 81-1,2,3,4,5&6.

Piian Odor Neutralizer is broad spectrum is nature meaning it is manufactured with a range of active ingredients that will destroy the complete range of common odorous gases that cause an odor problem. As is the case in most odor situations, there is a combination of odorous gases creating a problem, rather than using several types of gas specific neutralizers, Piian Odor Neutralizer simplifies the odor control process by adjusting its operation to accommodate the odor spectrum in each circumstance.

The performance of Piian Odor Neutralizer has been verified over the past 15 years both by a long series of satisfied customers in a broad range of industries and by several independent laboratory tests. Results are available for your review. No other odor neutralizer currently available possesses the credentials and extensive track record of Piian Odor Neutralizer

How Does Piian Odor Neutralizer Work?

Piian Odor Neutralizer is diluted with water for the desired strength. The solution is then atomized into droplets and introduced into the environment around the odor source.

When atomized into an odorous environment, tiny droplets of Piian Odor Neutralizer attach to and form clusters around the odorous compounds. The attachment and clustering properties of Piian Odor Neutralizer is based upon the Theory of Van Der Walls Forces which states that there is a unique attraction between molecules, based on the momentary uneven distribution of the electron density of the molecule.

Initially the cluster absorbs the odorous compound where upon its odor is quickly neutralized by the essential oil and plant extract components of the formula. The odor absorption and neutralizing properties of Piian Odor Neutralizer is a real world example of the Zwaardemakers Theory, which states that two or more odors (or scents) when bonded can cancel each other out and become imperceptible.

Due to its increased weight, the cluster formed by this process settles to the ground or statically bonds to wall surfaces where a biodegrading process begins.

In a secondary operation, the proprietary components of the Piian Odor Neutralizer formula specifically act as a catalyst to accelerate the natural biodegradation of the odorous compounds into carbon dioxide and water. The components of the formula hold the odorous compound within the cluster until odor degradation process is completed where upon they subsequently bio-degrade.

Effectively Counteracts:

Hydrogen Sulfide	*Ammonia*
Carbon Monoxide	*Sulfur Dioxide*
Methyl Mercaptan	*Ethyl Mercaptan*
Other Mercaptans	*Carbon Disulfide*
Acetic Acid / Anhydride	*Chlorinated Compounds*
Phenols	*Styrene*

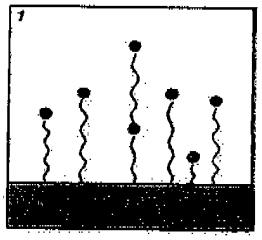
Numerous Other Chemical & Volatile Compounds

Performance Test Results:

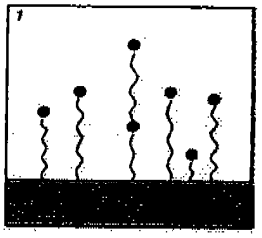
(SPL Laboratories)

Piian Contact with Identified Gases:

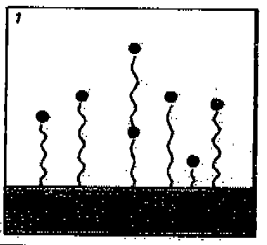
	Ppm/Vol	Contact	5 Min	15 Min
Hydrogen Sulfide	48	40	7	0
Ammonia	97	68	5	0
Sulfur Dioxide	26	0	0	0
Methyl Mercaptan	3.2	0	0	0
Ethyl Mercaptan	3.9	0	0	0



Odors present in environment as a result of biological or chemical process.



Millions of ultra small droplets of Piian are atomized into the environment.



Piian Odor Neutralizer Droplets form clusters around the odorous gas molecules.

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
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Pricing Subject To Change without Notice

Distributed By:

Piian Odor Control Systems

Piian Odor Neutralizer – Formulations, Packaging and Pricing

Piian Odor Neutralizer - Industrial Concentrate

Piian Odor Neutralizer – Industrial Concentrate is our strongest formula and is designed for intense odor problems or large scale odor control.

Application	Dispersion Equipment	Dilution Rate	Dispersion Method
Sewage and Industrial Waste Water Plants **Landfills** **Lagoons / Settling Ponds** **Garbage Transfer & Recycling Facilities** **Composting Facilities** **Petrochemical Refineries**	High Pressure Fog System	1:5000	Constant Spray
Sewage Tanks, Lagoons and Process Equipment **Pig Housing, Poultry Barns and Cattle Paddocks** **Farm Manure** **Rendering Plants / Abattoirs**	Mid Pressure Mist System	1:5000	Constant Spray
Grease Processing Equipment Rooms **Sewage Headworks, Wells and Tanks** **Wastewater Processing Equipment**	Mini System	1:10	Interval Sprays

Part #	Product	Packaging	Price
PNSC0103	Industrial Concentrate	Case of 6 x 1/2-gallon bottles	$349.00 / case
PNSC0105-1	Industrial Concentrate	1 ea x 5-gallon pail	$565.00 / pail
PNSC0155	Industrial Concentrate	55-gallon drum	$4995.00 / drum

Piian Odor Neutralizer - Commercial Concentrate

Piian Odor Neutralizer – Commercial Concentrate designed for less intensive odor control situations.

Application	Dispersion Equipment	Dilution Rate	Dispersion Method
Garbage Compactors	Mini System	1:10	Interval Sprays
Dumpsters	Micro System	1:10	Interval Sprays
Multi Storey Garbage Chutes			
Large Public Restrooms			
Air Handling Systems / Building Ventilation Systems			
Hotel Rooms			
Smoke and Fire Damaged Rooms			
Gyms and Locker Rooms			
Kindergartens			

Part #	Product	Description	Price
PNCC0101	Commercial Concentrate	Case of 12 x 12-oz. bottles	$100.65
PNCC0103	Commercial Concentrate	Case of 6 x 1/2-gallon bottles	$245.00
PNCC0105	Commercial Concentrate	5-gallon pail	$395.00
PNCC0155	Commercial Concentrate	55-gallon drum	$3915.00

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Pricing Subject To Change without Notice

Distributed By:

Piian Odor Control Systems

Piian Odor Neutralizer – Industrial Concentrate Product Label

PIIAN ODOR NEUTRALIZER - INDUSTRIAL CONCENTRATE

GENERAL

Product Description:

Piian Odor Neutralizer - Industrial Concentrate is an oil based broad spectrum water soluble odor neutralizing agent produced from natural essential oils & other plant extracts & emulsified with purified water.

Mode Of Operation:

When Atomized / Sprayed into the atmosphere around odor source, Piian Odor Neutralizer - Industrial Concentrate absorbs & biodegrades odors or converts odors into non-odorous compounds. This effect is permanent. Piian Odor Neutralizer - Industrial Concentrate is not a perfume.

Physical Specifications:

TEST	MIN	MAX	AVG
1. Initial Boiling Point (°F)	180 °F	190 °F	185 °F
2. Viscosity - Zahn Flow Cup #1	21	24	22.5
3. Specific Gravity	0.98	1.09	1.02
4. Water Content (%)	22.0	22.5	23.0
5. Odor - Olfactory	Floral		
6. Color	White-		
7. pH of 1% Solution	5.5	6.5	6.0

Chemical Composition / Ingredients:

Natural essential oils of plant origin, food grade carriers of food grade origin, emulsifier USP BP food & pharmaceutical grade, purified water.

HEALTH HAZARD INFORMATION

GENERAL PHYSIOLOGICAL PROPERTIES - Detergent effect.

ACUTE ORAL TOXICITY - Will cause diarrhea in copious amounts.

EFFECT ON EYES - No effect.

EFFECT ON SKIN - No effect.

INHALATION TOXICITY - No effect.

CHRONIC EFFECTS - None.

CARCINOGENIC EFFECTS - No carcinogens present.

WARNING PROPERTIES - None required completely safe food grade contents.

HANDLING INFORMATION

STORAGE & TRANSPORTATION - This product can be stored in stainless steel, aluminum & most plastics (Polyurethane for a limited time without detriment).

SPILLS - Hose with water.

DISPOSAL - Hose to drain.

FIRE/EXPLOSION HAZARD - Non-Flammable

NOTES TO PHYSICIAN

INHALATION - Remove to fresh air.

EYE CONTACT - Flush with water.

SKIN CONTACT - Wash off with water.

PRECAUTIONS FOR USE

All Natural, Non-Toxic, Bio-degradable & Ecologically Safe.

Non Flammable, Non Volatile, Non-Corrosive

All contents G.R.A.S. Listed (generally regarded as safe) by the US EPA.

No personal protection required.

ENVIRONMENTAL INFORMATION

TOXICITY - Non Toxic, Non Irritant & Non Sensitizing, EPA guidelines 81-1, 81-2, 81-3, 81-4, 81-5 & 81-6.

BIODEGRADABLE - Emulsifier is biodegradable as per NHMRC procedure AS1792-1776. Essential oils & carriers are bio-degradable

POTENTIAL POLLUTION HAZARD - Not applicable.

POTENTIAL ENVIRONMENTAL HAZARD - Not applicable

MARINE TOXICITY - Nil.

EFFECT ON PLANT LIFE - Nil

EFFECT ON ANIMAL LIFE - Nil.

G.R.A.S. LISTED.

I.F.R.A. - All ingredients have FEMA numbers.

NOTE: ALL INGREDIENTS USED CONSTANTLY IN COSMETIC & FOOD INDUSTRIES

APPLICATION DATA

PREPARATION FOR APPLICATION - Dilute concentrate at a rate of up 1:5000 with clean water. *See special instructions below.*

APPLICATION EQUIPMENT - Dispense Piian Odor Neutralizer - Industrial Concentrate into surrounding atmosphere a constant spray using any low temperature Atomization or Vaporization process. Examples include:

Piian High Pressure Fog Systems

Piian Mid Pressure Mist Systems

Piian Mini Systems

PRODUCT COVERAGE - Apply in air at a rate suitable to situation.

CLEAN UP INSTRUCTIONS - All equipment may be washed in clean water.

PRODUCT SHELF LIFE - As Sold, 2 - 5 years.

SPECIAL INSTRUCTIONS

For dispersion via a Piian High Pressure Fog System or Piian Mid Pressure Mist System, inject Piian Odor Neutralizer – Industrial Concentrate into water supply feeding into system at up 1:5000 ratio using a chemical metering / injector pump.

For dispersion via a Piian Mini System, dilute ½ gallon bottles of Piian Odor Neutralizer – Industrial Concentrate with 4 ½ Gallons of clean water in a 5 gallon pail.

For dispersion via a Piian Mini System with 55 gallon drum option, dilute 5 gallon pail of Piian Odor Neutralizer – Industrial Concentrate with 50 gallons of clean water in a 55 gallon drum .

BATCH#	USE BY	A/C REF#

SHAKE WELL BEFORE USE

NON FLAMMABLE

NO HAZARDOUS INGREDIENTS PRESENT

WASH SPILLS TO DRAIN

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
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Distributed By:

Piian Odor Control Systems

Piian Odor Neutralizer – Commercial Concentrate Product Label

PIIAN ODOR NEUTRALIZER - COMMERCIAL CONCENTRATE

GENERAL

Product Description:

Piian Odor Neutralizer - Commercial Concentrate is an oil based broad spectrum water soluble odor neutralizing agent produced from natural essential oils & other plant extracts & emulsified with purified water.

Mode Of Operation:

When Atomized / Sprayed into the atmosphere around odor source, Piian Odor Neutralizer - Commercial Concentrate absorbs & biodegrades odors or converts odors into non-odorous compounds. This effect is permanent. Piian Odor Neutralizer - Commercial Concentrate is not a perfume.

Physical Specifications:

TEST	MIN	MAX	AVG
1. Initial Boiling Point (°F)	180 °F	190 °F	185 °F
2. Viscosity - Zahn Flow Cup #1	21	24	22.5
3. Specific Gravity	0.98	1.09	1.02
4. Water Content (%)	17.25	17.75	18.25
5. Odor - Olfactory	Floral		
6. Color	White-		
7. pH of 1% Solution	5.5	6.5	6.0

Chemical Composition / Ingredients:

Natural essential oils of plant origin, food grade carriers of food grade origin, emulsifier USP BP food & pharmaceutical grade, purified water.

HEALTH HAZARD INFORMATION

GENERAL PHYSIOLOGICAL PROPERTIES - Detergent effect.

ACUTE ORAL TOXICITY - Will cause diarrhea in copious amounts.

EFFECT ON EYES - No effect.

EFFECT ON SKIN - No effect.

INHALATION TOXICITY - No effect.

CHRONIC EFFECTS - None.

CARCINOGENIC EFFECTS - No carcinogens present.

WARNING PROPERTIES - None required completely safe food grade contents.

HANDLING INFORMATION

STORAGE & TRANSPORTATION - This product can be stored in stainless steel, aluminum & most plastics (Polyurethane for a limited time without detriment).

SPILLS - Hose with water.

DISPOSAL - Hose to drain.

FIRE/EXPLOSION HAZARD - Non-Flammable

NOTES TO PHYSICIAN

INHALATION - Remove to fresh air.

EYE CONTACT - Flush with water.

SKIN CONTACT - Wash off with water.

PRECAUTIONS FOR USE

All Natural, Non-Toxic, Bio-degradable & Ecologically Safe.

Non Flammable, Non Volatile, Non-Corrosive

All contents G.R.A.S. Listed (generally regarded as safe) by the US EPA.

No personal protection required.

ENVIRONMENTAL INFORMATION

TOXICITY - Non Toxic, Non Irritant & Non Sensitizing, EPA guidelines 81-1, 81-2, 81-3, 81-4, 81-5 & 81-6.

BIODEGRADABLE - Emulsifier is biodegradable as per NHMRC procedure AS1792-1776. Essential oils & carriers are bio-degradable

POTENTIAL POLLUTION HAZARD - Not applicable.

POTENTIAL ENVIRONMENTAL HAZARD - Not applicable

MARINE TOXICITY - Nil.

EFFECT ON PLANT LIFE - Nil

EFFECT ON ANIMAL LIFE - Nil.

G.R.A.S. LISTED.

I.F.R.A. - All ingredients have FEMA numbers.

NOTE: ALL INGREDIENTS USED CONSTANTLY IN COSMETIC & FOOD INDUSTRIES

APPLICATION DATA

PREPARATION FOR APPLICATION - Dilute concentrate at a rate of 1:10 with clean water. *See special instructions below.*

APPLICATION EQUIPMENT - Dispense Piian Odor Neutralizer - Commercial Concentrate into surrounding atmosphere in cycles / intervals using any low temperature Atomization or Vaporization process. Examples include:

Piian Mini Systems

Piian Micro Systems

PRODUCT COVERAGE - Apply in air at a rate suitable to situation.

CLEAN UP INSTRUCTIONS - All equipment may be washed in clean water.

PRODUCT SHELF LIFE - As Sold, 2 - 5 years.

SPECIAL INSTRUCTIONS

Dilute ½ gallon bottles of Piian Odor Neutralizer – Commercial Concentrate with 4 ½ Gallons of clean water in a 5 gallon pail for dispersion via Piian Mini or Piian Micro Systems.

Dilute 5 gallon pail of Piian Odor Neutralizer – Commercial Concentrate with 50 gallons of clean water in a 55 gallon drum for dispersion via Piian Mini or Piian Micro Systems.

BATCH# | USE BY | A/C REF#

SHAKE WELL BEFORE USE

NON FLAMMABLE

NO HAZARDOUS INGREDIENTS PRESENT

WASH SPILLS TO DRAIN

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Piian Odor Control Systems

Piian Odor Neutralizer – M.S.D.S

Material Safety Data Sheet. May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements	US Department of Labor. Occupational Safety and Health Administration (Non mandatory form) Form Approved, OMB No. 1218-00072
Identity: (As used on label and list) PIIAN ODOR NEUTRALIZING AGENT	Note: Blank spaces are not permitted. If any item is not applicable, or if no information is available, the space must be marked to indicate that.

SECTION I			
Manufacturers Name: PIIAN Systems		Emergency Telephone Number: (760) 778-4370	
Address (Number, Street, City, State and Zip Code.) 1243 South Gene Autry Trail, Palm Springs, CA 92264.		Telephone Number for Information: (760) 778-4370 Date Prepared: Jul. 20th, 2002	
SECTION II - Hazardous Ingredients/Identity Information			
Hazardous Components	CAS#	OSHA PEL	AGGIH TLV Other Limits
All components are not considered hazardous according to the federal hazard communication standard (29 CFR 1910.1200)			
SECTION III - Physical/Chemical Characteristics			
Boiling Point: 212 Deg.F		Specific Gravity(H2O=1): 1.0 - 1.08	
Vapor Pressure: 0.7psia@100 Deg.F		Melting Point: N/A	
Vapor Density (Air=1): Approximately the same as water.		Evaporation Rate (Butyl Acetate=1): 8	
Solubility in Water: Soluble		pH: 6.0	
Percent Volatile: 0.5%			
SECTION IV - Fire and Explosion Data.			
Flash Point (Method Used) N/A	Flammable Limits N/A	LEL N/A	UEL N/A
Extinguishing Media Does not burn			
Special Fire Fighting Procedure's None			
Unusual Fire and Explosion Hazards None			
SECTION V - Reactivity Data			
Stability Stable			
Incompatibility (Materials to avoid) Strong Oxidizing Agents			
Hazardous Decomposition or By-products None			
Hazardous Polymerization Will not occur			
SECTION VI - Health Hazard Data			
Route(s) of Entry Inhalation? Yes Skin? Eyes Ingestion? Yes			
Health Hazards (Acute and Chronic) Eye contact with concentrated (undiluted) solution may cause mild detergent effect - wash 15 minutes with water. Seek medical attention if symptoms persists			
Carcinogenicity: NTP? No IARC Monographs? No OSHA Regulated? No			
Signs and Symptoms of Exposure None			
Medical Conditions Generally Aggravated by Exposure None known			
Emergency and First Aid Procedures Eyes - wash with water 15 minutes. Ingestion - drink several glasses of water, see physician if symptoms persist.			
SECTION VII - Precautions For Safe Handling And Use.			
Steps to be taken in Case Material is Released or Spilled Flush to drain with large quantities of water			
Waste Disposal Method Flood with water to drain			
Precautions to be Taken in Handling and Storing Storage of product below 32 deg. F may cause layering			
Other precautions Wash with soap and water if exposed			
SECTION VIII -Control Measures			
Respiratory Protection (Specify Type) None required			
Ventilation Good ventilation			
Eye Protection None required			
Gloves/Other Protective Clothing or Equipment None required			
Work/Hygienic Practices Wash with soap and water before eating or smoking			

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
Tel: (760) 778-4370 Fax: (760) 778-4368
Email: info@piian.com Web: www.piian.com
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Distributed By:

Piian Odor Control Systems

Toxicity Report (Summary) – Tox Monitor Laboratories

Tox Monitor Laboratories, Inc.
33 West Chicago Avenue
Oak Park, Illinois 60302
(708) 345-6970

REPORT NO. TM 91-104

CLIENT: Odor Management, Inc., of Plymouth, Minnesota.

SAMPLE: Piian

TESTS PERFORMED:

Acute Eye Irritation - EPA Guideline 81-4
Primary Dermal Irritation - EPA Guideline 81-5
Acute Oral Toxicity: EPA Guideline 81-1
Acute Inhalation Toxicity: EPA Guideline 81-3
Acute Dermal Toxicity: EPA Guideline 81-2
Sensitization: EPA Guideline 81-6

SUMMARY AND CONCLUSION:

Odor Management, Inc., sample of Piian, was tested for toxicity in accordance with EPA Regulations. Listed below are brief summaries of the results of these studies.

EYE IRRITATION:

There were no positive eye irritation reactions in any of the test subjects, classifying the sample in Toxicity Category III for eye effects.

PRIMARY DERMAL IRRITATION:

The maximum primary dermal irritation score was found to be 0, classifying the sample in Toxicity IV for skin effects.

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Toxicity Report (Summary) – Tox Monitor Laboratories

ACUTE ORAL TOXICITY:

The acute oral LD50 of sample was found to be greater than 5 g/kg body weight, indicating that the sample is not toxic by oral ingestion at this dosage level. Classifying the sample in Toxicity Category IV.

ACUTE INHALATION TOXICITY:

The acute inhalation of the test article at 5.30 mg/L of air for a 4 hour period, produced no toxic effects in the test subjects, classifying the sample in Toxicity Category IV.

ACUTE DERMAL TOXICITY:

The acute dermal LD50 of sample was found to be greater than 2 g/kg body weight, indicating that the sample is not toxic by dermal application. Classifying the sample in Toxicity Category IV.

SKIN SENSITIZATION:

Application of sample by dermal contact using a modified Buehler test, produced no positive reactions, indicating that the sample is not a skin sensitizing agent.

Michael Kukulinski
Study Director

Distributed By:

Piian Odor Control Systems

Terms, Conditions & Warranties

The following terms & conditions of sale become a part of all proposals & any subsequent sale of equipment manufactured by Piian Systems, its Divisions or Subsidiaries, hereafter referred to as "we", "us", "our", etc. whether the equipment be purchased directly from us or our Agent, Representative or Dealer or from a Leasing Company. "Buyer" as used herein includes not only the purchaser but also the original user & original owner of the equipment.

PRICES

1. Prices are firm for a period of 60 days from date of our published price schedule or proposal, provided shipment will be accepted within six months of price schedule or proposal.
2. Prices are F.O.B. point of manufacture. Shipments are normally made freight collect.
3. Prices are in U.S. currency & do not include any excise, sales, use or properly taxes, export or import duties or other taxes of any taxing authority. Prices are subject to increase equal in amount to any tax we may be required to collect or pay on the sale or use of the equipment Such amount will be payable when invoiced.

TERMS OF PAYMENT

1. Unless otherwise specified by us, the following payment schedule applies to all accepted domestic orders, based on the total value of the order:
   To $20,000 - Net 30 calendar days from date of shipment, subject to credit approval. All orders to be prepaid without credit approval. Visa / Master Card Accepted up to $1000.
   $20,001 up - 50% payable at time of placement of order,40% payable five (5) calendar days prior to shipment, 10% 30 calendar days from date of shipment
   Accounts not paid within 30 days of invoice date will bear a service charge of one & a half percent (1 1/2%) per month on the balance due.
2. Unless otherwise specified by us, the following payment schedule applies to all accepted international orders, based on the total value of the order:
   To $100,000 - Prepaid by wire transfer with purchase order. Visa / MasterCard Accepted up to $1000
   $100,001 up - Prepaid by wire transfer or Irrevocable letter of credit plus $900 processing charge, terms of letter of credit subject to our approval prior to acceptance.

ACCEPTANCE

1. All orders are subject to acceptance in Palm Springs, California in writing by our sales manager or one or our corporate officers. Typographical & clerical errors in quotations & acknowledgements are subject to correction.
2. For credit verification, we may require a financial statement or other financial information from the Buyer. At our option prior to shipment of the equipment, we may require the utilization of a financing statement & security agreement or Irrevocable Letter of Credit. Title to equipment shall pass to Buyer only upon payment in full.
3. Any contract for the sale of equipment by us shall be treated as made & as performed in the State of California.

CHANGES IN DESIGN

1. Specifications are subject to change without notice. We are not obligated to apply any change or improvement on equipment previously manufactured.
2. Changes in design or construction of equipment made at the request of the Buyer after its order has been accepted, or in the case of custom equipment orders after the approval of drawings will be made at the expense of the Buyer under terms to be mutually agreed.

CANCELLATION

Accepted orders cannot be cancelled or assigned without prior written agreement by our sales manager or one of our corporate officers & payment of a charge of not less than 15%, of the purchase price to cover lost time & handling expenses in the case of a cancellation.

SHIPMENT

1. We reserve the right to select a transportation carrier that has equipment to meet the shipping requirements of our equipment & the requirements of our shipping facility.
2. We are not responsible for shipping delays beyond our reasonable control. It is understood that we are free of any & all liability & penalty for delayed shipments caused by transportation delays, inability to obtain necessary labor, components & or materials for fabrication & assembly, labor disturbances, wars, riots, fires, accidents, explosions, floods, epidemics, quarantine, adverse weather, governmental acts or regulations, or acts of God

RISK OF LOSS & DAMAGES

We assume no responsibility for loss or damage to equipment incurred after we load the equipment on the transportation carrier. Risk of loss or damage shall thereafter be borne by the Buyer regardless of whether title has passed to Buyer upon shipment. Claims for such loss or damage must be filed by the Buyer with the transportation carrier or other responsible party.

SERVICE

1. Before the equipment is placed in operation, start-up & training service by one of our field service engineers is available & recommended.
   During this start-up, final equipment adjustments are made & the Buyer & his operating & maintenance personnel are instructed. This service is charged at prevailing rates
2. Two Owners Manuals covering Installation, Operating & Maintenance Instructions & Spare & Replacement Parts Lists are furnished with the equipment purchased. Additional manuals may be purchased at the prevailing nominal charge.

GENERAL

1. Electrical components used on the equipment meet ANSI & National Electrical Code requirements & are UL approved. Hydraulic system components used on the equipment comply with National Fluid Power Association & JIC Standards.
   UL field inspection & approval costs of completed system shall be borne by Buyer as & if required.
   The equipment is constructed in compliance with the intent of the Occupational Safety & Health Act of 1970 (OSHA). & in particular with Title 29, Chapter XVII, Part 1910, of the Occupational Safely & Health Standards adopted Oct. 18.1972.
2. Additional costs as the result of special components or other special arrangements required by local standards or codes will be the responsibility of the Buyer.
3. The equipment is skidded as is normal to the transportation carrier. Special loading, skidding, crating, export boxing, packing or painting can be provided at an extra charge.
4. We agree to defend litigation brought against the Buyer for alleged U.S. patent infringements. We do not agree to defend infringement suits involving accessories not of our manufacture used in combination with other equipment or to defend suits involving process patents.
5. These terms & conditions supersede & take precedence over all provisions of the Buyer's purchase order or any similar document of the Buyer
6. These terms & conditions of sale, our written warranty, published current literature & specifications & our acceptance of the Buyers order define our entire obligation with respect to any sale of our equipment.
7. All information in the proposal is confidential, prepared solely for the Buyers consideration to purchase our equipment. Transmissions of all of any part of the proposal information to others or use by the Buyer for other purposes is unauthorized without our written consent

STANDARD EQUIPMENT WARRANTY

1. The seller warrants that the goods to be delivered will be of the kind & quality described in the order or contract & will be free of defects in workmanship or material. Should any failure to conform to this warranty appear within one (1) year after the initial date of delivery or a period of 2500 hours of operation; which ever occurs first, the seller shall, upon prompt notification thereof & substantiation that the goods have been stored, installed, maintained & operated in accordance with the seller's recommendations & standard industry practice, correct such defect by suitable repair or replacement at its own expense. It is the seller's sole decision on whether replacement or repair of goods is necessary. Buyer is responsible for freight & labor costs associated with any installation of replacement goods honored under this warranty. This warranty excludes work that is considered by us to be follow-up installation or incidental maintenance of newly installed equipment. This warranty is limited to repairing or replacing products, which our investigation shows, were defective at the time of shipment by the manufacturer. All goods subject to this warranty shall be returned for examination, repair or replacement, freight pre-paid to our factory.
2. This warranty has no application to normal replacement of service parts such as operating oil, paint & drive belts & other parts which may have service life inherently shorter in duration than the warranty period. Customer specified components will carry the component manufacturers warranty only. Electric motor warranty claims should be directed to the local motor manufacturer service center
3. This warranty has no application to wear or damage resulting from accidents, alteration, misuse, abuse, neglect, non-action, improper removal or reinstallation or handling of new or defective parts, lack of preventive maintenance, sabotage, tampering, fire, explosion or any other causes not directly attributable defective workmanship or material of the equipment or any part of the equipment.
4. In addition to all of the above, Piian Systems accepts no liability if the system is used to dispense corrosive, flammable, toxic or other non approved agents.

This warranty is exclusive & is in lieu of any warranty or merchant ability, fitness for a particular purpose or other warranty of quality, whether express or implied, except of title & against patent infringement. Correction of non-conformities, in the manner & for the period of time provided above, shall constitute fulfillment of all liabilities of the seller to the purchaser with respect to, or arising out of the goods, whether based on contract negligence, strict tort or otherwise.

LIMITATION OF LIABILITY - Repair or replacement of defective products as provided above is the sole & exclusive remedy provided hereunder & the seller shall not under any circumstances be liable for special or consequential damages such as, but not limited to, damage or loss of other property or equipment, loss of profits, or revenue, cost of capital, cost of purchased or replacement goods, or claims of customers of purchaser for service interruptions. The remedies of the purchaser set forth are exclusive & the liability of seller with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, installation or use of any goods covered by or furnished under this contract whether arising out of contract, negligence, strict tort, or under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the goods upon which such liabilities based. This is the only warranty on any Piian Systems product, no other writing or description in literature shall be construed as a warranty.

Products manufactured by other than Piian Systems bear the following limited warranty:

Seller warrants that the goods manufactured by others will conform to the description herein stated. No other warranty express or implied is made, & warranty of the manufacturer is hereby assigned & transferred to the buyer. Furthermore, except for the manufacturer's warranty, if any, the products sold hereunder are sold as is. Piian Systems is not liable for any incidental or consequential damages in connection with these products.

Manufactured by Piian Systems, Palm Springs, CA 92264, U.S.A.
Tel: (760) 778-4370 Fax: (760) 778-4368
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APPENDIX G

WATER/VAPOR BARRIER INSTALLATION SPECIFICATIONS AND PRODUCT INFORMATION

SECTION 07130

FOUNDATION WATERPROOFING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The work of this Section includes, but is not necessarily limited to, the following:

1. Below-grade foundation waterproofing of horizontal (pile caps including pile penetrations, foundation mats and slabs) and vertical surfaces (foundation walls), as indicated.

2. Installation accessories, including sealers, flashings, fasteners, tapes, reglets, liquid membranes and similar accessories.

3. Installation of concrete working surface below horizontal surfaces.

B. Related Work Specified Elsewhere

1. Excavation, Filling and Grading - Section 02200

2. Cast-in-Place Concrete - Section 03300.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide waterproofing that prevents the passage of water under hydrostatic pressure and complies with requirements as demonstrated by testing performed by an independent testing agency of manufacturer's current sheet membrane.

1.3 REFERENCES

A. Latest version of the American Society for Testing and Materials (ASTM) Standards:

ASTM C 836	Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
ASTM D 412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
ASTM D 570	Standard Test Method for Water Absorption of Plastics
ASTM D 903	Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM D 1876	Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
ASTM D 1970	Self-Adhering Polymer Modified Bituminous Sheet Material Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 3767	Standard Practice for Rubber-Measurement of Dimensions
ASTM D 5385	Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes

ASTM E 96 Water Vapor Transmission of Materials
ASTM E 154 Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

1.4 SUBMITTALS

A. Submit the following information for review by the Architect and Engineer:

1. Manufacturer's product data, specifications, installation instructions, product samples;

2. Laboratory test results demonstrating the properties of the product meet or exceed the required values in Part 2.02 of this Section;

3. Written certification that the Installer has been actively installing the submitted product (or similar product) for at least three years; and the names, addresses and contact names for three previous waterproofing projects completed by the installer (both supervisor and lead technician);

4. Project-specific shop drawings containing:

a. Penetrations, curbs, drains, and projections.

b. Flashing details, including inside and outside corner reinforcement and terminations.

c. Crack and joint treatments, including expansion joints.

d. Interface with contiguous materials.

B. Prior to commencing work, submit the following:

1. Contractor's Review: Before commencing work submit written statement signed by the Contractor and the Installer stating that the Contract Documents have been reviewed with a qualified representative of the Manufacturer of the waterproofing system, and that he is in agreement that the selected materials are proper, compatible with contiguous materials and adequate for the application shown. Indicate by transmittal form that a copy of the statement has been sent to the Manufacturer.

2. Substrate Acceptability: Submit a certified statement issued by the Manufacturer of the waterproofing materials, and countersigned by the Installer, attesting that all areas and surfaces designated to receive waterproofing have been inspected and found satisfactory for the reception of the Work covered under this Section; and are not in conflict with the "Warranty" requirements. Installation of materials will be construed as acceptance of surfaces.

C. Upon project closeout, submit the following:

1. Statement of Supervision: Upon completion of Work submit a written statement signed by the Manufacturer stating that the field supervision by the Manufacturer's representative was sufficient to insure proper application of the materials, that the Work was installed in accordance with the Contract Documents and that the installation is acceptable to the Manufacturer.

2. Warranty: Submit Manufacturer's and Installer's five-year warranty upon acceptance of completed work, further described later in this Part.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer, who is certified in writing by waterproofing manufacturer as qualified, to install specified waterproofing systems.

B. Single-Source Responsibility: Obtain waterproofing materials from a single manufacturer regularly engaged in manufacturing waterproofing.

C. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings".

1. Before installing waterproofing, meet with owner, architect, consultants, independent testing agency, waterproofing manufacturer, waterproofing subcontractor, and other concerned entities.

2. Review requirements for waterproofing, including surface preparation specified under other Sections waterproofing manufacturer's requirements, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, inspection and testing procedures, and protection and repairs.

3. Notify participants at least 7 days before pre-installation conference.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packaging with seals unbroken, labeled with manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. The general subsurface conditions consist of 20 ft of surficial fill underlain by 10 to 15 ft of organic materials of Building Code Class 11-65, overlying soil materials of

Building Code Class 7-65 to Class 4-65 and finally bedrock. In the southeast quadrant of the site, there is 10 to 15 ft of very dense Building Code class 4-65 and 5-65 soil materials directly overlying the sound rock. The thickness of very dense overburden soil is reduced to less than 5 ft to the westerly half of the site.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

A. Special Warranty: Submit a written warranty signed by waterproofing manufacturer and installer agreeing to repair or replace waterproofing that does not meet requirements or that does not remain watertight during the specified warranty period. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1.6 mm in width.

1. Warranty Period: 10 years after date of "Substantial Completion".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Product: Provide foundation waterproofing systems, as manufactured by W. R. Grace & Co. Construction Products, Inc. or approved equivalent subject to compliance with the requirements herein.

1. Horizontal Application: "Preprufe 300"

2. Vertical Applications, "Blind side" Conditions: "Preprufe 160".

3. Vertical Applications to constructed walls: "Bituthene 4000" Waterproofing Membrane.

2.2 HIGH DENSITY POLYETHYLENE (HDPE) COMPOSITE SHEET

A. Adhesive-Coated HDPE Composite Sheet, Horizontal Applications: 1.42-mm-thick (nominal), uniform, flexible sheet consisting of 0.75-mm-thick high density polyethylene sheet coated with a pressure sensitive rubber adhesive, a protective adhesive coating, a detackifying surface treatment, an undercoated self-adhering side lap strip and a release liner.

B. Adhesive-Coated HDPE Composite Sheet, Vertical Applications: 1.07-mm-thick (nominal), uniform, flexible sheeting consisting of 0.4-mm-thick high-density polyethylene sheet coated with pressure sensitive rubber adhesive, a protective coating, and a release liner.

C. Physical Properties: Provide waterproofing complying with the following:

1. Tensile Strength, Film: 4,000 psi minimum; ASTM D412
2. Low-Temperature Flexibility: Unaffected at minus –10 deg F; MOAT 31:6D.
3. Peel Adhesion to Concrete: 5 lbs/in; MOAT 27:5.1.3.
4. Lap Adhesion: 2.5 lbs/in minimum; ASTM D1876, modified.
5. Hydrostatic-Head Resistance: 231 feet; ASTM D5385, modified.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with waterproofing sheet membrane.

1. Auxiliary materials shall be compatible with hydrocarbon-contaminated soils.

B. Furnish liquid-type auxiliary materials that meet VOC limits of authority having jurisdiction.

C. Primer: Liquid primer recommended by manufacturer of sheet waterproofing material for substrate.

D. Sheet Flashing: Self-adhering, rubberized asphalt composite sheet of same material, construction and thickness as waterproofing sheet membrane.

E. Liquid Membrane: Elastomeric, 2-component, liquid, cold fluid applied, trowel grade or low viscosity, as recommended by waterproofing manufacturer for application.

F. Patching Membrane: Low-viscosity, 2-component, asphalt modified coating.

G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

H. Penetration Seal: Self-adhering reinforced membrane, 2 ½-inches wide, with a tack-free protective adhesive coating on one side and release film on self-adhering side.

I. Metal Termination Bars: Aluminum bars, approximately 1-inch by 1/8-inch thick, predrilled at 22-mm-centers.

J. Joint Tape: 1/16 inches felt reinforced self-adhesive tape, 6-inches wide, with a release film on adhesive side.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which waterproofing systems will be applied, with installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Do not proceed with installation until after minimum concrete curing period recommended by waterproofing manufacturer.

C. Verify substrate is visibly dry and free of moisture. Test for capillary moisture for plastic sheet method according to ASTM D4263.

D. Notify Architect in writing of anticipated problems using waterproofing over substrate.

3.2 CONCRETE SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage affecting other construction.

C. Remove grease, oil, form release agents, and other penetrating contaminants from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrate. Remove dust and dirt from joints and cracks according to ASTM D4258.

F. Install membrane strip and center over construction and control joints and cracks exceeding a width of 1/16-inch.

G. Inside Corners: Prepare, prime, and treat inside corners according to waterproofing manufacturer's written instructions.

H. Install membrane strip centered over vertical inside corners. Install 19-mm-fillets of liquid membrane on horizontal inside corners as follows:

1. All footing-to-wall intersections extend liquid membrane each direction from corner or install membrane strip centered over corner.

2. All deck-to-wall intersections extend liquid membrane or sheet membrane flashing onto deck waterproofing and to finished height of sheet flashing.

I. Outside Corners: Prepare and treat outside corners according to waterproofing manufacturer's written instructions.

1. Install strip of membrane 12-inches-wide, centered over corner.

J. Prepare, treat, and seal horizontal and vertical surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to waterproofing manufacturer's written instructions.

1. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge and cover with sheet membrane strips.

3.3 PREPARATION FOR VERTICAL BLIND-SIDE APPLICATIONS

A. Provide a continuous smooth rigid vertical facing to receive the waterproofing material. The material may consist of plywood or rigid insulation.

B. Steel sheet piles must be treated with a rigid facing.

C. Timber lagging may be used, but it must be close-butted to provide support and to be more than 0.5 inch out of plumb.

3.4 SOIL SUBGRADE PREPARATION

A. Install a minimum 3-inch-thick concrete working slab beneath all building slabs.

B. Prepare surface of concrete working slab in accordance with paragraph 3.02 above.

C. Place membrane waterproofing directly on top of concrete working slab, in accordance with paragraph 3.04, herein.

3.5 INSTALLATION

A. Install adhesive-coated HDPE composite sheet according to waterproofing manufacturer's written instructions. The Bituthene Edgeguard hydrocarbon resistant tape shall be used to cover all exposed edges.

B. Place and secure drainage panels over substrates. Lap edges and ends of geotextile to maintain continuity.

C. Install sheet membrane with high density polyethylene face against substrate and fasten in accordance with the manufacturer's recommendations.

1. Walls: Accurately align sheets and maintain uniform 6 inch minimum lap widths and end laps, unless otherwise recommended by the manufacturer. Overlap and seal seams and stagger and tape end laps to ensure watertight installation.

2. Slabs: Accurately align sheets and maintain uniform 6 inches minimum lap widths and end laps, unless otherwise recommended by manufacturer. Overlap and seal seams and stagger and tape end laps to ensure watertight installation.

D. Securely fasten top termination of wall-mounted sheet membrane with continuous metal termination bar anchored into concrete substrate. Comply with the details indicated and the manufacturer" written instructions.

E. Seal penetrations through membrane to provide watertight seal with penetration seal patches or wrapping and liquid membrane fillet as recommended by the waterproofing system manufacturer.

F. Install sheet membrane and auxiliary materials to tie in adjacent waterproofing.

G. Repair tears, voids, and lapped seams in waterproofing not meeting requirements. Tape perimeter of damaged or non-confirming area extending 6 inches beyond repaired areas in all directions. Firmly apply a patch of sheet membrane.

3.6 PROTECTING AND CLEANING

A. Protect waterproofing from damage and wear during application and remainder of construction period, according to manufacturer's written instructions.

1. Horizontal Application: Protect top surface of membrane from punctures, tears, or burns prior to placement of slab concrete.

2. Vertical Applications: Protect membrane waterproofing from damage during backfilling operations. This includes placement of a rigid barrier such as a plywood or rigid insulation between the membrane waterproofing and the soil backfill material.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07175

Below Grade Waterproofing

web www.graceconstruction.com
■ PRODUCT DATA ■ UPDATES ■ TECH LETTERS ■ DETAILS ■ MSDS ■ CONTACTS ■ FAQS

Preprufe® 300R & 160R

Pre-applied waterproofing membranes that bond integrally to poured concrete for use below slabs or behind basement walls on confined sites.

Advantages

- Forms a unique integral seal to concrete poured against it – prevents water migration and makes it unaffected by ground settlement beneath slabs
- Fully-adhered watertight laps and detailing
- Provides a barrier to water, moisture and gas – physically isolates the structure from the surrounding ground
- BBA Certified for basement Grades 2, 3, & 4 to BS 8102:1990
- Zero permeance to moisture
- Solar reflective – reduced temperature gain
- Simple and quick to install – requiring no priming or fillets
- Can be applied to permanent formwork – allows maximum use of confined sites
- Self protecting – can be trafficked immediately after application and ready for immediate placing of reinforcement
- Unaffected by wet conditions – cannot activate prematurely
- Inherently waterproof, non-reactive system:
  - not reliant on confining pressures or hydration
  - unaffected by freeze/thaw, wet/dry cycling
- Chemical resistant – effective in all types of soils and waters, protects structure from salt or sulphate attack

Description

Preprufe® 300R & 160R membranes are unique composite sheets comprising a thick HDPE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating.

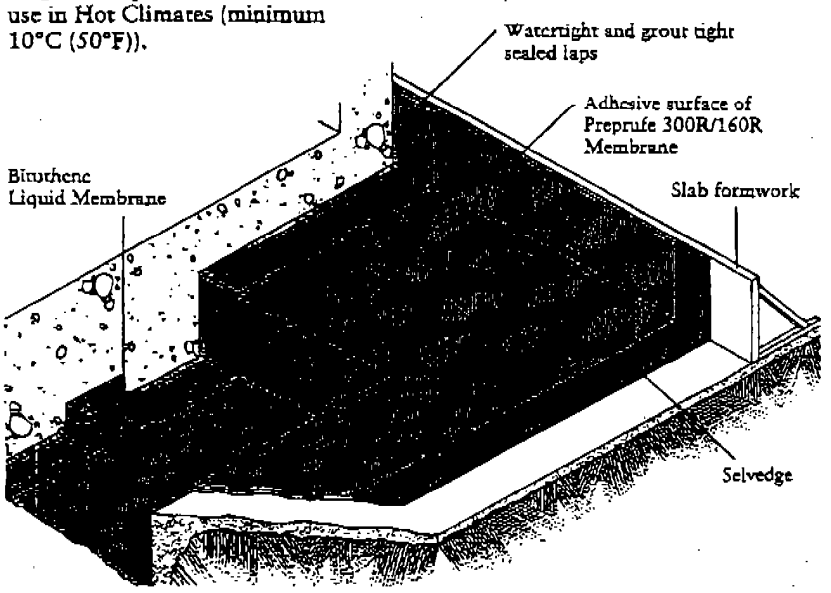
Unlike conventional non-adhering membranes, which are vulnerable to water ingress tracking between the unbonded membrane and structure, the unique Preprufe seal to concrete prevents any ingress or migration of water around the structure.

The Preprufe R System includes:

- Preprufe 300R – heavy-duty grade for use below slabs and on rafts (i.e. mud slabs). Designed to accept the placing of heavy reinforcement using conventional concrete spacers.
- Preprufe 160R – thinner grade for lighter applications and blindside, zero property line applications against soil retention systems.
- Preprufe Tape LT – for covering cut edges, roll ends, penetrations and detailing (temperatures between -4°C (25°F) and +30°C (86°F)).
- Preprufe Tape HC – as above for use in Hot Climates (minimum 10°C (50°F)).
- Bituthene® Liquid Membrane – for sealing around penetrations, etc.

Preprufe 300R & 160R membranes are applied either horizontally to smooth prepared concrete or well rolled and compacted sand or crushed stone blinding; or vertically to permanent formwork or adjoining structures. Concrete is then cast directly against the adhesive side of the membranes. The specially developed Preprufe adhesive layers work together to form a continuous and integral seal to the structure.

Preprufe can be returned up the inside face of slab formwork but is not recommended for conventional twin-sided formwork on walls, etc. Use Bituthene self-adhesive membrane or Procor® fluid applied membrane to walls after removal of formwork for a fully bonded system to all structural surfaces.



BBA BRITISH BOARD OF AGREEMENT CERTIFICATE No. 97/3006

GRACE Construction Products

Installation

Preprufe 300R & 160R membranes are supplied in rolls 1.2 m (4 ft) wide, with a selvedge on one side to provide self-adhered laps for continuity between rolls. The rolls of Preprufe Membrane and Preprufe Tape are interwound with a disposable plastic release liner which must be removed before placing reinforcement and concrete.

Substrate Preparation

All surfaces – It is essential to create a sound and solid substrate to eliminate movement during the concrete pour. Substrates must be regular and smooth with no gaps or voids greater than 12 mm (0.5 in.). Grout around all penetrations such as utility conduits, etc. for stability.

Horizontal – The substrate must be free of loose aggregate and sharp protrusions. An angular profiled blinding is recommended rather than a sloping or rounded substrate. The surface does not need to be dry, but standing water must be removed.

Vertical – Use concrete, plywood, insulation or other approved facing to sheet piling to provide support to the membrane. Board systems such as timber lagging must be close butted to provide support and not more than 12 mm (0.5 in.) out of alignment.

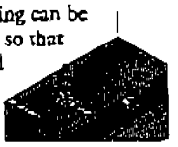
Membrane Installation

Preprufe can be applied at temperatures of -4°C (25°F) or above. When installing Preprufe in cold or marginal weather conditions (<13°C) the use of Preprufe Tape LT is recommended at all laps and detailing. Preprufe Tape LT should be applied to clean, dry surfaces and the release liner must be removed immediately after application.

Horizontal substrates – Place the membrane HDPE film side to the substrate with printed coated side up facing towards the concrete pour. End laps should be staggered to avoid a build up of layers. Leave plastic release liner in position until overlap procedure is completed.

Accurately position succeeding sheets to overlap the previous sheet 75 mm (3 in.) along the marked selvedge. Ensure the underside of the succeeding sheet is clean, dry and free from contamination before attempting to overlap. Peel back the plastic release liner from between the overlaps as the two layers are bonded together. Ensure a continuous bond is achieved without creases and roll firmly with a heavy roller. Completely remove the plastic liner to expose the protective coating. Any initial tack will quickly disappear.

Vertical substrates – Mechanically fasten the membrane vertically using fasteners appropriate to the substrate with the printed coated side facing towards the concrete pour. The membrane may be installed in any convenient length. Secure the top of the membrane using a batten such as a termination bar or similar 50 mm (2 in.) below the top edge. Fastening can be made through the selvedge so that the membrane lays flat and allows firmly rolled overlaps. Immediately remove the plastic release liner. Any additional fasteners must be covered with a patch of Preprufe Tape.

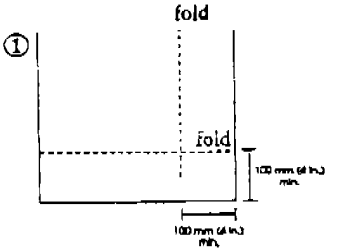


Ensure the underside of the succeeding sheet is clean, dry and free from contamination before attempting to overlap. Roll firmly to ensure a watertight seal.

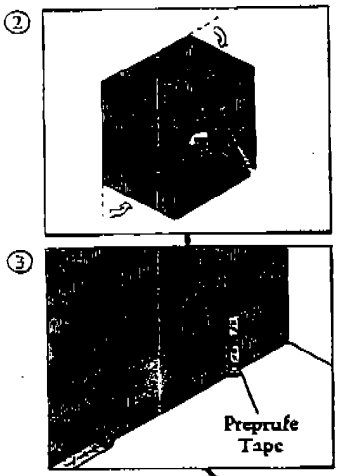
Roll ends and cut edges – Overlap all roll ends and cut edges by a minimum 75 mm (3 in.) and ensure the area is clean and free from contamination, wiping with a damp cloth if necessary. Allow to dry and apply Preprufe Tape LT (or HC in hot climates) centered over the lap and roll firmly. Immediately remove printed plastic release liner from the tape.

Corners

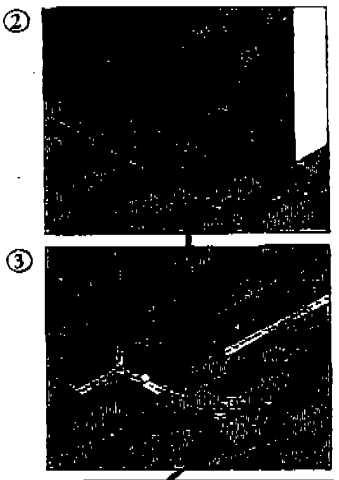
Internal and external corners should be formed as shown in the diagrams returning the membrane a minimum of 100 mm (4 in.) and sealing with Preprufe Tape. Ensure that the apex of the corner is covered and sealed with tape and roll firmly. Crease and fold the membrane to ensure a close fit to the substrate profile and avoid hollows.



Internal



External



Penetrations

Use the following steps to seal around penetrations such as service pipes, piles, lightning conductors, etc.

Grout around the penetration if the penetration is not stable. Scribe membrane tight to the penetration. If the membrane is not within 12 mm (0.5 in.) of the penetration, apply Preprufe Tape to cover the gap.

Wrap the penetration with Preprufe Tape by positioning the tape 12 mm (0.5 in.) above the membrane.

Mix and apply Bituthene Liquid Membrane around the penetrations using a fillet to provide a watertight seal between the Preprufe Membrane and Preprufe Tape.

Membrane Repair

Inspect the membrane before installation of reinforcement steel, formwork and final placement of concrete. The membrane can be easily cleaned by jet washing if required. Repair damage by wiping the area with a damp cloth to ensure the area is clean and free from dust, and allow to dry. Apply Preprufe Tape centered over the damaged area and roll firmly. Any areas of damaged adhesive should be covered with Preprufe Tape. Remove printed plastic release liner from tape. Where exposed selvedge has lost adhesion or laps have not been sealed, ensure the area is clean and dry and cover with fresh Preprufe Tape, rolling firmly. Alternatively, use a hot air gun or similar to activate adhesive and firmly roll lap to achieve continuity.

Pouring of Concrete

Ensure the plastic release liner is removed from all areas of Preprufe R Membrane and Tape.

It is recommended that concrete be poured within 56 days (42 days in hot climates) of application of the membrane. Concrete must be placed and compacted carefully to avoid damage to the membrane. Never use a sharp object to consolidate the concrete.

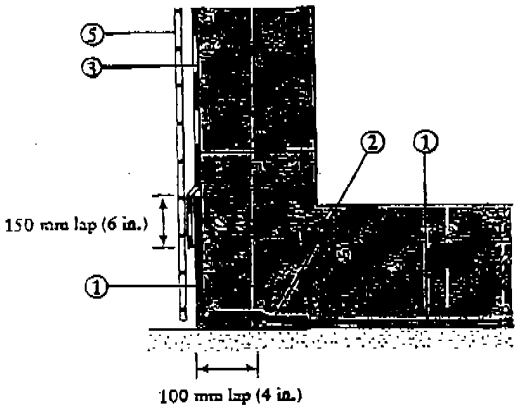
Removal of Formwork

Preprufe membranes can be applied to removable formwork, such as slab perimeters, elevator and lift pits, etc. Once the concrete is poured the formwork must remain in place until the concrete has gained sufficient compressive strength to develop the surface bond. Preprufe membranes are not recommended for conventional twin-sided wall forming systems.

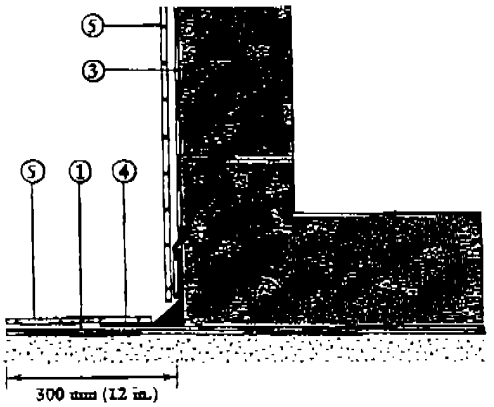
A minimum concrete compressive strength of 10 N/mm^2 (1500 psi) is recommended prior to stripping formwork supporting Preprufe membranes. Premature stripping may result in displacement of the membrane and/or spalling of the concrete.

As a guide, to reach the minimum compressive strength stated above, a structural concrete mix with an ultimate strength of 40 N/mm^2 (6000 psi) will typically require a cure time of approximately 6 days at an average ambient temperature of -4°C (25°F), or 2 days at 21°C (70°F).

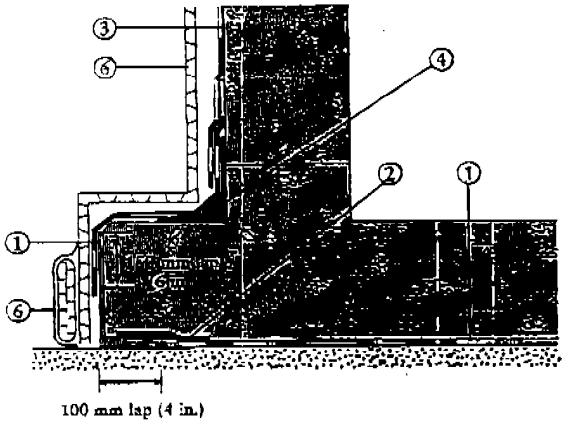
Wall base detail



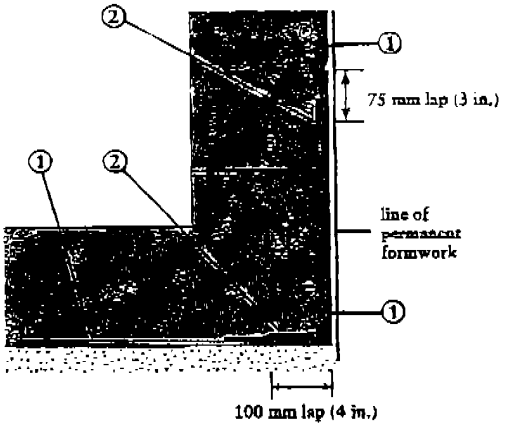
Alternative wall base detail for early form removal



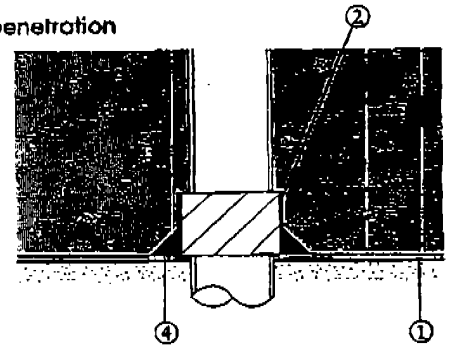
Wall base with toe detail showing drainage option



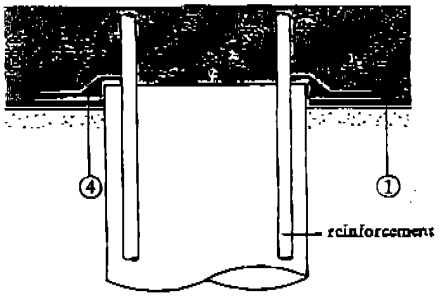
Wall base detail against permanent shutter



Pipe penetration



Pile detail



1 Preprufe
2 Preprufe Tape
3 Procor® (use Preprufe Tape to tie-in) or Bituthene® 4000
4 Bituthene Liquid Membrane
5 Protection
6 Hydroduct®

Details shown are typical illustrations and not working details. For assistance with detailing and problem solving please contact Grace Technical Department at 866-333-3SBM (3726).

Supply

Physical Properties

Property	Typical Value 300R	Typical Value 160R	Test Method
Color	white	white	
HDPE Thickness	0.75 mm (0.030 in.)	0.4 mm (0.016 in.)	
Peel Adhesion to Concrete	144 N per 50 mm 880 N/m (5 lbs/in.)	144 N per 50 mm 880 N/m (5 lbs/in.)	MOAT 27:5.1.3 ASTM D903 Modified[3]
Shear Strength of Joints	476 N per 50 mm	476 N per 50 mm	MOAT 27:5.2.2/3/4
Methane Permeability	9.1 mls/m²/day	N/A	University of London, QMW College[3]
Resistance to Hydrostatic Head	>6 m (>20 ft) >70 m (>230 ft)	>6 m (>20 ft) >70 m (>230 ft)	MOAT 27:5.1.4[5] ASTM D5385 Modified[2]
Low Temperature Flexibility	<-20°C (<0°F)	<-20°C (<0°F)	MOAT 31:6D
Puncture Resistance	990 N	445N	ASTM E154
Elongation (strain %)	long 826 trans 756	long 753 trans 825	BS 2782:320A (test speed 100 mm min.)
Elongation	300% minimum	300% minimum	ASTM D412 Modified[4]
Tensile Strength, Film	27.6 MPa (4000 lbs/in.)	27.6 MPa (4000 lbs/in.)	ASTM D412
Crack Cycling at -23°C (-10°F)	pass	pass	ASTM C836
Moisture Vapor Transmission	0 gm^{-2} per day	0 gm^{-2} per day	BBA Laboratories BS 3177:1959 (1995) (75% RH/25°C)
Permeability[1] (hydraulic conductivity)	$K=<1.4 \times 10^{-11} cm.s^{-1}$	$K=<1.4 \times 10^{-11} cm.s^{-1}$	ASTM D5084-90

Footnotes:
1. Result is lower limit of apparatus. Membrane therefore considered impermeable.
2. Hydrostatic head tests are performed by casting concrete against the membrane with a lap. The cured block is cracked and then placed in a chamber where water is introduced to the membrane surface including the lap up to a maximum of 70 m (231 ft) head.
3. Concrete is cast against the protective coating surface of the membrane and allowed to properly cure (7 days min.). Peel adhesion of membrane to concrete is measured at a rate of 50 mm (2 in.) per minute at room temperature.
4. Elongation of membrane is run at 50 mm (2 in.) per minute.
5. Tested at laps. Result is limit of test.

Specification Clauses

Preprufe 300R or 160R shall be applied with its adhesive face presented to receive fresh concrete to which it will integrally bond. Only Grace Construction Products approved membranes shall be bonded to Preprufe 300R/160R. All Preprufe 300R/160R system materials shall be supplied by Grace Construction Products, and applied strictly in accordance with their instructions. Specimen performance and formatted clauses are also available.

NOTE: Use Preprufe Tape to tie-in Procor with Preprufe.

Health and Safety

Refer to relevant Material Safety data sheet. Complete rolls should be handled by a minimum of two persons.

For Technical Assistance call us toll free at 866-333-3SBM (3726).

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Below Grade Waterproofing

web www.graceconstruction.com
■ PRODUCT DATA ■ UPDATES ■ TECH LETTERS ■ DETAILS ■ MSDS ■ CONTACTS ■ FAQS

Bituthene® System 4000

Self-adhesive HDPE waterproofing membrane with super tacky compound for use with patented, water-based System 4000 Surface Conditioner

Advantages

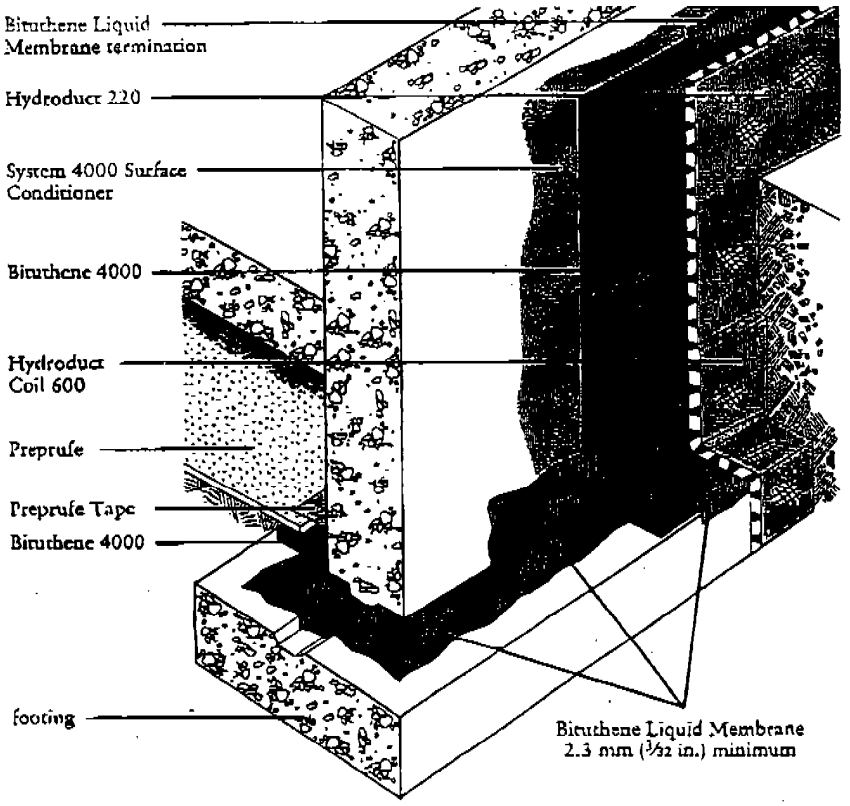
- **Excellent adhesion** – special adhesive compound engineered to work with high tack System 4000 Surface Conditioner
- **Cold applied** – simple application to substrates, especially at low temperatures
- **Reduced inventory and handling costs** – System 4000 Surface Conditioner is included with each roll of membrane
- **Wide application temperature range** – excellent bond to self and substrate from -4°C (25°F) and above
- **Overlap security** – minimizes margin for error under site conditions
- **Cross laminated, high density polyethylene carrier film** – provides high tear strength, puncture and impact resistance
- **Flexible** – accommodates minor structural movements and will bridge shrinkage cracks
- **RIPCORD™** - This "split release on demand" feature allows the splitting of the membrane into two (2) pieces for ease of installation in detailed areas

Description

Bituthene® System 4000 is a 1.5 mm (1/16 in.) flexible, pre-formed waterproof membrane which combines a high performance, cross laminated, HDPE carrier film with a unique, super tacky, rubberized asphalt compound.

System 4000 Surface Conditioner is a unique, water-based, latex surface treatment which imparts an aggressive, high tack finish to the treated substrate. It is specifically formulated to bind site dust and concrete efflorescence, thereby providing a suitable surface for the Bituthene System 4000 Waterproofing Membrane.

Conveniently packaged in each roll of membrane, System 4000 Surface Conditioner promotes good initial adhesion and, more importantly, excellent permanent adhesion of the Bituthene System 4000 Waterproofing Membrane. The VOC (Volatile Organic Compound) content is 125 g/L.



GRACE
Construction Products

Use

Bituthene is ideal for waterproofing concrete, masonry and wood surfaces where in-service temperatures will not exceed 57°C (135°F). It can be applied to foundation walls, tunnels, earth sheltered structures and split slab construction, both above and below grade. (For above grade applications, see "Above Grade Waterproofing Bituthene System 4000.")

Bituthene is 1.5 mm (1/16 in.) thick, 0.9 m (3 ft) wide and 20 m (66.7 ft) long and is supplied in rolls. It is unrolled sticky side down onto concrete slabs or applied onto vertical concrete faces primed with System 4000 Surface Conditioner. Continuity is achieved by overlapping a minimum 50 mm (2 in.) and firmly rolling the joint.

Bituthene is extremely flexible. It is capable of bridging shrinkage cracks in the concrete and will accommodate minor differential movement throughout the service life of the structure.

Application Procedures

Safety, Storage and Handling Information

Bituthene products must be handled properly. Vapors from solvent-based primers and mastic are harmful and flammable. Grace Protection Board Adhesive is extremely flammable. For these products, the best available information on safe handling, storage, personal protection, health and environmental considerations has been gathered. Material Safety Data Sheets (MSDS) are available at www.graceconstruction.com and users should acquaint themselves with this information. Carefully read detailed precaution statements on product labels and the MSDS before use.

Surface Preparation

Surfaces should be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Concrete must be properly dried (minimum 7 days for normal structural concrete and 14 days for lightweight structural concrete).

If time is critical, Bituthene Primer B2 may be used to allow priming and installation of membrane on damp surfaces or "green" concrete. Priming may begin in this case as soon as the concrete will maintain structural integrity. Use form release agents which will not transfer to the concrete. Remove forms as soon as possible from below horizontal slabs to prevent entrapment of excess moisture. Excess moisture may lead to blistering of the membrane. Cure concrete with clear, resin-based curing compounds which do not contain oil, wax or pigment. Except with Primer B2, allow concrete to thoroughly dry following rain. Do not apply any products to frozen concrete.

Repair defects such as spalled or poorly consolidated areas. Remove sharp protrusions and form match lines. On masonry surfaces, apply a parge coat to rough concrete block and brick walls or trowel cut mortar joints flush to the face of the concrete blocks.

Temperature

- Apply Bituthene System 4000 Membrane and Conditioner only in dry weather and when air and surface temperatures are -4°C (25°F) or above.
- Apply Bituthene Primer B2 in dry weather above -4°C (25°F). (See separate product information sheet.)

Conditioning

Bituthene System 4000 Surface Conditioner is ready to use and can be applied by spray or roller. For best results, use a pump-type air sprayer with fan tip nozzle, like the Bituthene System 4000 Surface Conditioner Sprayer, to apply the surface conditioner.

Apply Bituthene System 4000 Surface Conditioner to clean, dry, frost-free surfaces at a coverage rate of 7.4 m^2/L (300 ft^2/gal). Coverage should be uniform. Surface conditioner should not be applied so heavily that it puddles or runs. **Do not apply conditioner to Bituthene membrane.**

Allow Bituthene System 4000 Surface Conditioner to dry one hour or until substrate returns to its original color. At low temperatures or in high humidity conditions, dry time may be longer.

Bituthene System 4000 Surface Conditioner is clear when dry and may be slightly tacky. In general, conditioning should be limited to what can be covered within 24 hours. In situations where long dry times may prevail, substrates may be conditioned in advance. Substrates should be reconditioned if significant dirt or dust accumulates.

Before surface conditioner dries, tools should be cleaned with water. After surface conditioner dries, tools should be cleaned with mineral spirits. Mineral spirits is a combustible liquid which should be used only in accordance with manufacturer's recommendations. **Do not use solvents to clean hands or skin.**

Corner Details

The treatment of corners varies depending on the location of the corner. For detailed information on Bituthene Liquid Membrane, see separate product information sheet.

- At wall to footing inside corners –
  Option 1:
  Apply membrane to within 25 mm (1 in.) of base of wall. Treat the inside corner by installing a 20 mm (¾ in.) fillet of Bituthene Liquid Membrane. Extend Bituthene Liquid Membrane at least 65 mm (2½ in.) onto footing, and 65 mm (2½ in.) onto wall membrane.
  Option 2:
  Treat the inside corner by installing a 20 mm (¾ in.) fillet of Bituthene Liquid Membrane. Apply 300 mm (12 in.) wide strip of sheet membrane centered over fillet. Apply wall membrane over inside corner and extend 150 mm (6 in.) onto footing. Apply 25 mm (1 in.) wide troweling of Bituthene Liquid Membrane over all terminations and seams within 300 mm (12 in.) of corner.
- At footings where the elevation of the floor slab is 150 mm (6 in.) or more above the footing, treat the inside corner either by the above two methods or terminate the membrane at the base of the wall. Seal the termination with Bituthene Liquid Membrane.

Joints

Properly seal all joints with waterstop, joint filler and sealant as required. Bituthene membranes are not intended to function as the primary joint seal. Allow sealants to fully cure. Pre-strip all slab and wall cracks over 1.5 mm (1/16 in.) wide and all construction and control joints with 230 mm (9 in.) wide sheet membrane strip.

Application on Horizontal Surfaces

(Note: Preprufe® pre-applied membranes are strongly recommended for below slab or for any application where the membrane is applied before concreting. See Preprufe product information sheets.)

Apply membrane from the low point to the high point so that laps shed water. Overlap all seams at least 50 mm (2 in.). Stagger all end laps. Roll the entire membrane firmly and completely as soon as possible. Use a linoleum roller or standard water-filled garden roller less than 760 mm (30 in.) wide, weighing a minimum of 34 kg (75 lbs) when filled. Cover the face of the roller with a resilient material such as a 13 mm (½ in.) plastic foam or two wraps of indoor-outdoor carpet to allow the membrane to fully contact the primed substrate. Seal all T-joints and membrane terminations with Bituthene Liquid Membrane at the end of the day.

Protrusions and Drains

Apply membrane to within 25 mm (1 in.) of the base of the protrusion. Apply Bituthene Liquid Membrane 2.5 mm (0.1 in.) thick around protrusion. Bituthene Liquid Membrane should extend over the membrane a minimum of 65 mm (2½ in.) and up the penetration to just below the finished height of the wearing course.

Vertical Surfaces

Apply membrane in lengths up to 2.5 m (8 ft). Overlap all seams at least 50 mm (2 in.). On higher walls apply membrane in two or more sections with the upper overlapping the lower by at least 50 mm (2 in.). Roll all membrane with a hand roller.

Terminate the membrane at grade level. Press the membrane firmly to the wall with the butt end of a hardwood tool such as a hammer handle or secure into a reglet. Failure to use heavy pressure at terminations can result in a poor seal. A termination bar may be used to ensure a tight seal. Terminate the membrane at the base of the wall if the bottom of the interior floor slab is at least 150 mm (6 in.) above the footing. Otherwise, use appropriate inside corner detail where the wall and footing meet.

Membrane Repairs

Patch tears and inadequately lapped seams with membrane. Clean membrane with a damp cloth and dry. Slit fishmouths and repair with a patch extending 150 mm (6 in.) in all directions from the slit and seal edges of the patch with Bituthene Liquid Membrane. Inspect the membrane thoroughly before covering and make any repairs.

Drainage

Hydroduct® drainage composites are recommended for both active drainage and protection of the membrane. See Hydroduct product information sheets.

Protection of Membrane

Protect Bituthene membranes to avoid damage from other trades, construction materials or backfill. Place protection immediately in temperatures above 25°C (77°F) to avoid potential for blisters.

- On vertical applications, use Hydroduct 220 Drainage Composite. Adhere Hydroduct 220 Drainage Composite to membrane with Hydroduct Tape. Alternative methods of protection are to use 25 mm (1 in.) expanded polystyrene or 6 mm (¼ in.) extruded polystyrene that has a minimum compressive strength of 55 kN/m^2 (8 lbs/in.^{2}). Such alternatives do not provide positive drainage to the system.

If 6 mm (¼ in.) extruded polystyrene protection board is used, backfill should not contain sharp rock or aggregate over 50 mm (2 in.) in diameter. Adhere polystyrene protection board with Bituthene® Protection Board Adhesive or Hydroduct Tape.

- In mud slab waterproofing, or other applications where positive drainage is not desired and where reinforced concrete slabs are placed over the membrane, the use of 6 mm (¼ in.) hardboard or 2 layers of 3 mm (⅛ in.) hardboard is recommended.

Insulation

Always apply Bituthene membrane directly to primed or conditioned structural substrates. Insulation, if used, must be applied over the membrane. Do not apply Bituthene membranes over lightweight insulating concrete.

Backfill

Place backfill as soon as possible. Use care during backfill operation to avoid damage to the waterproofing system. Follow generally accepted practices for backfilling and compaction. Backfill should be added and compacted in 150 mm (6 in.) to 300 mm (12 in.) lifts.

For areas which cannot be fully compacted, a termination bar is recommended across the top termination of the membrane.

Placing Steel

When placing steel over properly protected membrane, use concrete bar supports (dobies) or chairs with plastic tips or rolled feet to prevent damage from sharp edges. Use special care when using wire mesh, especially if the mesh is curled.

Approvals

- City of Los Angeles Research Report RR 24386
- U.S. Department of Housing and Urban Development (HUD) HUD Materials Release 628E

Warranty

Five year material warranties covering Bituthene and Hydroduct products are available upon request. Contact your Grace sales representative for details.

Technical Services

Support is provided by full time, technically trained Grace representatives and technical service personnel, backed by a central research and development staff.

System 4000 Surface Conditioner Sprayer

The Bituthene System 4000 Surface Conditioner Sprayer is a professional grade, polyethylene, pump-type, compressed air sprayer with a brass fan tip nozzle. It has a 7.6 L (2 gal) capacity. The nozzle orifice and spray pattern have been specifically engineered for the optimum application of Bituthene System 4000 Surface Conditioner.

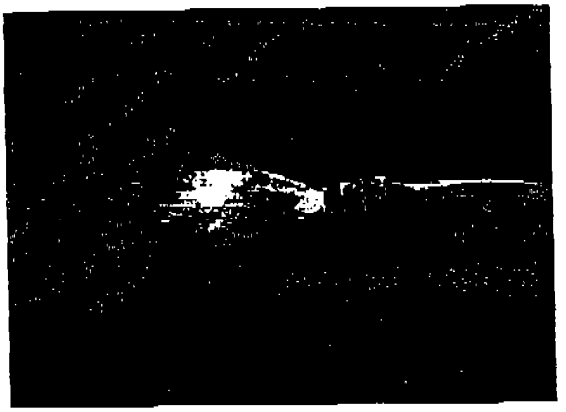
Hold nozzle 450 mm (18 in.) from substrate and squeeze handle to spray. Spray in a sweeping motion until substrate is uniformly covered.

Sprayer should be repressurized by pumping as needed. For best results, sprayer should be maintained at high pressure during spraying.

To release pressure, invert the sprayer and spray until all compressed air is released.

Maintenance

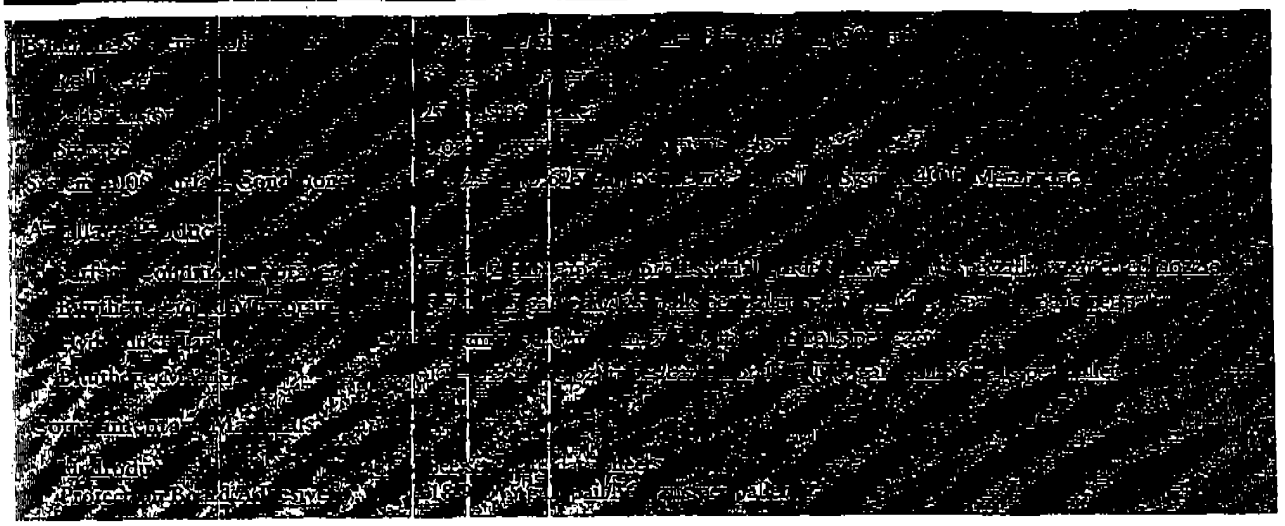
The Bituthene System 4000 Surface Conditioner Sprayer should perform without trouble for an extended period if maintained properly.



Sprayer should not be used to store Bituthene System 4000 Surface Conditioner. The sprayer should be flushed with clean water immediately after spraying. For breaks in the spray operation of one hour or less, invert the sprayer and squeeze the spray handle until only air comes from the nozzle. This will avoid clogging.

Should the sprayer need repairs or parts, call the maintenance telephone number on the sprayer tank (800-323-0620).

Supply



Equipment by Others: Soft broom, utility knife, brush or roller for priming

Physical Properties for Bituthene 4000 Membrane

Property	Typical Value	Test Method
Color	Dark gray-black	
Thickness	1.5 mm (1/16 in.) nominal	ASTM D3767 – Method A
Flexibility, 180° bend over 25 mm (1 in.) mandrel at -32°C (-25°F)	Unaffected	ASTM D1970
Tensile Strength, Membrane, Die C	2240 kPa (325 lbs/in.^{2}) minimum	ASTM D412 Modified[1]
Tensile Strength, Film	34.5 MPa (5,000 lbs/in.^{2}) minimum	ASTM D882 Modified[1]
Elongation, Ultimate Failure of Rubberized Asphalt	300% minimum	ASTM D412 Modified[1]
Crack Cycling at -32°C (-25°F), 100 Cycles	Unaffected	ASTM C836
Lap Adhesion at Minimum Application Temperature	880 N/m (5 lbs/in.)	ASTM D1876 Modified[2]
Peel Strength	1576 N/m (9 lbs/in.)	ASTM D903 Modified[3]
Puncture Resistance, Membrane	222 N (50 lbs) minimum	ASTM E154
Resistance to Hydrostatic Head	70 m (210 ft) of water	ASTM D5385
Permeance	2.9 ng/m^{2}sPa (0.05 perms) maximum	ASTM E96, Section 12 – Water Method
Water Absorption	0.1% maximum	ASTM D570

Footnotes:
1. The test is run at a rate of 50 mm (2 in.) per minute.
2. The test is conducted 15 minutes after the lap is formed and run at a rate of 50 mm (2 in.) per minute at 5°C (40°F).
3. The 180° peel strength is run at a rate of 300 mm (12 in.) per minute.

Physical Properties for System 4000 Surface Conditioner

Property	Typical Value
Solvent Type	Water
Flash Point	>60°C (>140°F)
VOC* Content	125 g/L
Application Temperature	-4°C (25°F) and above
Freeze Thaw Stability	5 cycles (minimum)
Freezing Point (as packaged)	-10°C (14°F)
Dry Time (hours)	1 hour**

* Volatile Organic Compound
** Dry time will vary with weather conditions

For Technical Assistance call toll free at 866-333-3SBM (3726).

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GRACE Construction Products

TECH LETTER 4

Chemical Resistance

Several series of tests have been conducted to define the chemical resistance of Preprufe® and Bituthene® waterproofing membranes. Both Preprufe and Bituthene membranes are highly resistant to normal ground water conditions which may range from alkaline to acidic. In addition, Preprufe and Bituthene waterproofing membranes are unaffected by exposure to salt water.

Occasionally, Preprufe and Bituthene membranes may be used in applications which will be subjected to intermittent or even continuous exposure to chemicals. The following guidelines can be used to evaluate the applicability of the Preprufe and Bituthene membrane system.

Exposure to:	Preprufe® and Bituthene® membrane Resistance rating
Sea water, de-icing salt	Excellent
Acids in solution e.g. sulfuric, acetic, hydrochloric, and nitric acid	Excellent
Alkalis e.g. Sodium hydroxide, ammonium hydroxide	Excellent
Alcohols	Very Good
Organic or fuel oils, solvents	Variable (see note below)

Note: Most solvents and fuels will not significantly affect the polyethylene film but may soften or dissolve the adhesive compounds exposed at the edge laps. Detailed information on the type of exposure is necessary to make recommendations.
For below slab and blind side applications, a concrete mud-slab or continuous soil retention system will reduce the exposure of the Preprufe membrane laps. For Bituthene wall applications, the use of Bituthene Edgeguard® or a solvent resistant tape, should be used over the membrane edges to protect the rubberized asphalt from prolonged exposure.

For Technical Assistance call us at 800-444-6459 (Option 3).

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GRACE Construction Products

POLY-FLEX, INC.
Geomembrane Lining Systems

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CHEMICAL RESISTANCE INFORMATION

CHEMICAL CLASS	CHEMICAL EFFECT	PRIMARY CONTAINMENT (LONG TERM CONTACT) HDPE	PRIMARY CONTAINMENT (LONG TERM CONTACT) LLDPE	SECONDARY CONTAINMENT (SHORT TERM CONTACT) HDPE	SECONDARY CONTAINMENT (SHORT TERM CONTACT) LLDPE
CARBOXYLIC ACID	1				
- Unsubstituted (e.g. Acetic acid)		B	C	A	C
- Substituted (e.g. Lactic acid)		A	B	A	A
- Aromatic (e.g. Benzoic acid)		A	B	A	A
ALDEHYDES	3				
- Aliphatic (e.g. Acetaldehyde)		B	C	B	C
- Hetrocyclic (e.g. Furfural)		C	C	B	C
AMINE	3				
- Primary (e.g. Ethylamine)		B	C	B	C
- Secondary (e.g. Diethylamine)		C	C	B	C
- Aromatic (e.g. Aniline)		B	C	B	C
CYANIDES (e.g. Sodium Cyanide)	1	A	A	A	A
ESTER (e.g. Ethyl acetate)	3	B	C	B	C
ETHER (e.g. Ethyl ether)		C	C	B	C
HYDROCARBONS	3				
- Aliphatic (e.g. Hexane)		C	C	B	C
- Aromatic (e.g. Benzene)		C	C	B	C
- Mixed (e.g. Crude oil)		C	C	B	C
HALOGENATED HYDROCARBONS	3				
- Aliphatic (e.g. Dichloroethane) +A4		C	C	B	C
- Aromatic (e.g. Chlorobenzene)		C	C	B	C
ALCOHOLS	1				
- Aliphatic (e.g. Ethyl alcohol)		A	A	A	A
- Aromatic (e.g. Phenol)		A	C	A	B
INORGANIC ACID					
- Non-Oxidizers (e.g. Hydrocloric acid)	1	A	A	A	A
- Oxidizers (e.g. Nitric Acid)	2	C	C	B	C
INORGANIC BASES (e.g. Sodium hydroxide)	1	A	A	A	A
SALTS (e.g. Calcium chloride)	1	A	A	A	A
METALS (e.g. Cadmium)	1	A	A	A	A
KETONES (e.g. Methyl ethyl ketone)	3	C	C	B	C

OXIDIZERS (e.g. Hydrogen Peroxide)	2	C	C	C	C

Chemical effect (see discussion on Chemical Resistance)

1. No Effect–Most chemicals of this class have no or minor effect.
2. Oxidizer–Chemicals of this class will cause irreversible degradaton.
3. Plasticizer–Chemicals of this class will cause a reversible change in physical properties.

Chart Rating

A. Most chemicals of this class have little or no effect on the liner.
Recommended regardless of concentration or temperature (below 150° F).

B. Chemicals of this class will effect the liner to various degrees.
Recommendations are based on the specific chemical, concentration and temperature.
Consult with Poly-Flex, Inc.

C. Chemicals of this class at high concentrations will have significant effect on the physical properties of the liner.
Generally not recommended but may be acceptable at low concentrations and with special design considerations.
Consult with Poly-Flex, Inc.

This data is provided for informational purposes only and is not intended as a warranty or guarantee. Poly-Flex, Inc. assumes no responsibility in connection with the use of this data. Consult with Poly-Flex, Inc. for specific chemical resistance information and liner selection.

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