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Transmitted by Email (yywong@gw.dec.state.ny.us)

July 9, 2013

Bryan Wong, Project Manager
New York State Department of Environmental Conservation
Division of Environmental Remediation
47-40 21st Street
Long Island City, New York 11101

Re: Revised Full Scale Work Plan for Surfactant Augmented LNAPL Removal
OCA LIC Fifth Street Planned Student Housing Parcel ("Site")
5-20 46th Road, Long Island City
Queens, New York 11101
BCP No C241098, EWMA Project No. 250632

Dear Mr. Wong:

In accordance with NYSDEC BCP requirements, Environmental Waste Management Associates, LLC (EWMA) has prepared the subject Revised Full Scale Work Plan for Surfactant Augmented LNAPL Removal (Work Plan) to enhance LNAPL removal in the Lower Sand Unit beneath this Site. The Work Plan was required by NYSDEC per their review letter dated June 18, 2013 of EWMA's Report of Pilot Testing for Surfactant Augmented LNAPL Removal dated June 5, 2013. EWMA issued the original Work Plan on June 20, 2013. The NYSDEC responded with additional comments to this Work Plan through telephone discussions and Email correspondence between June 20 and July 3, 2013.

This revised Work Plan is organized to facilitate NYSDEC review and approval of EWMA's approach to full scale surfactant augmented LNAPL removal and incorporation of responses to all comments received by NYSDEC. The following letter sections include an introduction, a description of full-scale field procedures, the work sequence and decision-making criteria, performance monitoring and reporting, including a contingency plan. In addition, to support the below Work Plan narrative, the following letter attachments include: **Certification** by Engineer, **Figure 1A** depicting pertinent Lower Sand Unit well locations and LNAPL Removal Area, **Table 1** summarizing the LNAPL Removal Monitoring Schedule, and **Table 2** the target well extraction rates that will be used to record the total fluids removed from each well per weekly event.

INTRODUCTION

Pursuant to the Site Management Plan (SMP), the volunteer has performed periodic vacuum enhanced fluid removal (VEFR) of LNAPL in the LSU since December 2010. After eighteen (18) months of VEFR, the NYSDEC required implementation of the Site Management Plan (SMP) contingency approach

using surfactants. To that end, EWMA submitted a pilot test work plan for surfactant augmented LNAPL removal, performed a field pilot test, and submitted a pilot test report.

The pilot test was performed in accordance with the NYSDEC approved work plan and a USEPA Underground Injection Control (UIC). The test utilized a well proven non-ionic surfactant, Biosolve, and was performed within a monitored LNAPL Removal Area. The test demonstrated removal effectiveness as determined by three specific metrics: 1) 97-98% improvement in LNAPL rebound thicknesses; 2) 80-92% improvement in LNAPL removal volumes; and 3) reduction of LNAPL to sheen around each target well within radial distances ranging from 7 to 15 feet.

The basis for this Work Plan stems from pilot test report recommendations and response to the NYSDEC comment letter dated June 18, 2013. The purpose of the Work Plan is to facilitate compliance with the SMP, with NYSDEC guidance and requirements, and with USEPA UIC requirements. The objectives of the program are to facilitate LNAPL removal to meet NYSDEC remediation program closure requirements, and to obtain NYSDEC approval to cease LNAPL removal in the Lower Sand Unit beneath this Site.

A USEPA Inventory of Injection Wells Notification Form (previously filed 1/10/13) is being updated from three to fifteen wells and will be provided to NYSDEC prior to the start of full scale injections.

All of the work performed under this Work Plan is to be done in compliance with the approved SMP dated December 2010.

FULL SCALE FIELD PROCEDURES

Target Wells – As many as fifteen (15) target wells are to be used for single well injection and extraction in the same manner as described with the pilot test work plan and the pilot test report. The target wells for injection/extraction will be: 1) wells containing measurable LNAPL based on the gauging results (wells RW5, LN2, LN4, LN12, LN16, LN20, LN25, LN26, LN30); and 2) wells within the LNAPL removal area, proximal to wells containing measurable LNAPL, at locations where injection/extraction will expedite completion of the LNAPL removal effort (wells LN8, LN27, LN31, LN32 and two planned wells). Injection/extraction will not be performed at perimeter wells. The target wells are listed on attached **Table 1** and are depicted on attached **Figure 1A**.

Injection – Once every 7 days, on a regularly scheduled week day, from 25 to 50 gallons of 6% Biosolve surfactant mixture will be prepared and injected to each of the target wells. The volume injected to each well will be based on the hydraulic injection/extraction characteristics of that specific well. The injection process will safely feed the mixture into each well in a measured and controlled manner at low flow (less than 2 GPM) and low pressure (less than 10 PSI). No injections will be performed without direct oversight by EWMA personnel closely monitoring this process.

Extraction – After an in-situ residence time of 7 days, a minimum of three times the injected surfactant mixture volume will be extracted from each well where injection has been performed. The volume extracted from each well will be calculated based on extraction time using the measured extraction rate

for each well (see **Table 2** – Target Well Extraction Rates). The total daily extracted volumes will also be measured and recorded. The LNAPL removed from each well will be estimated. The extraction will be performed with VEFR methods. No extractions will be performed without direct oversight by EWMA personnel closely monitoring this process.

Material Handling – The key materials that will be handled during the program are Biosolve surfactant in drum quantities, potable water obtained from a local hydrant under Builder permit, Biosolve mixed with potable at a concentration of 6%, and extracted liquids consisting of ground water, Biosolve mixture, and emulsified LNAPL. The drum quantity Biosolve will be stored on site within a containment area along with the Biosolve mixture before it is injected. The potable water will come directly from the hydrant and will be temporarily stored in on-site poly mixing tanks. The extracted liquid will be conveyed directly from the wells into a vacuum tanker.

Disposal – Disposal will be performed in accordance with the requirements for that activity at the end of each weekly event. The entire extracted liquid volume will be transported off-site by the vacuum tanker to a permitted disposal facility as during past liquid disposal activities at the site.

INJECTION/EXTRACTION WORK SEQUENCE AND DECISION MAKING CRITERIA

The LNAPL removal work, defined by both surfactant injection and total fluid extraction, will be performed once per week over a planned twelve (12) week period. The typical weekly removal work steps to be performed over a single business day will be as follows:

1. Well LNAPL Gauging – Measure detectable (greater than 0.01 ft) of LNAPL in all wells within the LNAPL Removal Area and designated perimeter monitoring wells (see attached **Figure 1A**);
2. Biosolve Visual Sampling - Ensure injected surfactant has not extended to designated perimeter monitoring wells above a critical concentration threshold (see Migration Monitoring Plan below);
3. Extraction – Use enhanced vacuum extraction techniques to remove a minimum of three times the volume of surfactant injected into each well – repeat this for each well where surfactant was injected the week before;
4. Biosolve Visual Sampling - Ensure injected surfactant the week before is below visual detection;
5. Biosolve Mixing and Injection – Mix and inject target surfactant solution and quantity into wells with measurable LNAPL;
6. Secure Site Equipment and Materials – Safely store or equipment and materials before demobilization from the Site.
7. GW Sampling – See **Table 1** and groundwater quality monitoring section below.

Twelve (12) weekly injection/extraction events are planned based on observation of the site remediation conditions. The criteria for termination of the LNAPL removal in the Lower Sand Unit is set forth in the SMP and DER-10 and includes NYSDEC site specific approval. Based on overall LNAPL removal progress, specific well injection/extraction termination measurements will be initiated. The trigger for termination of weekly well treatment and start of rebound testing for each specific well will be no measurable LNAPL thickness in the target well.

We will measure the injected Biosolve volumes to each well with use of a graduated poly tank that will be used to prepare the injected mixture. Wells within the LNAPL Removal Area that have contained LNAPL or currently contain LNAPL and wells that are proximal to LNAPL bearing well locations may be selected for surfactant injection. The decision for specific well injection will be made weekly based on field measurement data.

PERFORMANCE MONITORING AND REPORTING

Recovery Effectiveness Monitoring – The 15 previously identified target wells in the LNAPL Removal Area wells are depicted on **Figure 1A**. They will be measured and gauged for the presence of LNAPL each week at the start of removal operations. These measurements will record LNAPL rebound thickness, and will provide a guide in the selection of target wells for injection/extraction on a week to week basis. In addition, the volume of liquid extracted from each well will be calculated, the total volume of liquid extracted each week will be measured, and the total volume of LNAPL extracted each week will be estimated.

Migration Monitoring Plan – All wells around the perimeter and within the interior of the LNAPL removal area are depicted on **Figure 1A**. These wells will all be measured and gauged each week for the presence of measurable LNAPL, and will be sampled each week to support visual inspection of ground water for the presence of Biosolve. The visual detection limits for the presence of Biosolve in water are established by the manufacturer at 0.03%. EWMA will prepare site-specific visual standards to correspond with Biosolve concentrations. These standards will be maintained on-site for visual comparison to actual field conditions by trained EWMA field personnel. EWMA will visually confirm Biosolve concentrations are below the critical micelle concentration of 0.08% in monitoring wells. Biosolve is rendered inactive when below this concentration.

Groundwater Quality Monitoring – During the full scale injection program, groundwater samples will be collected with low flow sampling methods twice during the first start-up month of operation and then on a monthly basis. The groundwater monitoring program will use eight (8) wells depicted for this purpose on the attached **Figure 1A**. The samples will be sent to a NYS Certified Analytical Laboratory and will be analyzed in accordance with NYS standards for TCL VOCs, TCL SVOCs, and TAL Metals. Five of the wells will be those screened within the LNAPL impacted depth range, and three of the wells will be those screened to assess groundwater quality directly below the impacted depth range. This sampling will be supplemented by continuation of the existing quarterly GW monitoring program, pursuant to the SMP. Please note that an additional well is planned for installation just south of the 46th Road curb and north of interior wells LN2 and LN31. The subsurface utilities are difficult in this area, additional mark-out work has been performed, and the well location will be vetted for safety reasons with air knife methods. We will not inject surfactants into wells LN2 and LN31 unless we are able to install this well. Also, with regard to well RW5, the capture wall is down-gradient of well RW5 and is believed to be sufficient to protect this location during removal work activities.

Progress Reporting – EWMA will provide the Department with Weekly and Monthly progress reports and with a Final Report that summarizes all of the work performed under this Work Plan. The Weekly Report will be sent to NYSDEC by email on the first Monday of each week. The weekly reports will

include: actual target wells, planned target wells, measurable LNAPL and migration monitoring information. The SMP Monthly O&M Report will be expanded to include injection/extraction data, monitoring data, and ground water quality data. In addition, the quarterly GW monitoring reporting effort will continue.

Contingency Plan – If Biosolve is detected in a perimeter monitoring well pursuant to the Migration Monitoring Plan, or if ground water monitoring results indicate a significant detection of concern above background levels, this Contingency Plan will be activated. The Contingency Plan includes the following steps: (1) Provide timely notice (within one business day) via phone and Email to NYSDEC on planned response actions, and (2) Implement response actions in accordance with the SMP and HASP within two business days of contingent event. The Contingency Plan Response Actions include the following steps: (1) Cease target well injections adjacent to the perimeter monitoring well detection of concern; (2) Initiate hydraulic control by extraction from proximal wells until the perimeter detection of concern is mitigated. As an additional means of protection against unintentional Biosolve migration or groundwater quality concern, the spacing between adjacent wells is being reduced by approximately 50% and the new spacing will range from about 20 to 27 feet (see attached **Figure 1A**). Since hydraulic connection has been documented at 40 foot distances between the site wells, the reduced well spacing will provide increased hydraulic control and ability to quickly respond to a perimeter well detection of surfactant and/or LNAPL if this condition occurs.

If you have any questions or require any additional information please feel free to contact us at our Parsippany, New Jersey office, (973) 560-1400, Richard Arnold, Ext. 174, or Don Richardson, Ext. 186.

Sincerely,
EWMA

Donald W. Richardson, CPG, VP

Cc: Jane O'Connell, NYSDEC BCP
Brett Buehrer, O'Connor Capital Partners
Michael Bogin, Esq., Sive, Paget, Riesel, PC
Christine Leas, Esq., Sive, Paget, Riesel, PC
Richard Arnold, PE, EWMA

Att: Certification by Engineer
Table 1 – LNAPL Removal Monitoring Schedule
Table 2- Target Well Extraction Rates
Figure 1A – Lower Sand Unit Well Location Map

CERTIFICATION

I, Richard D. Arnold, certify that I am currently a New York State Registered Professional Engineer. In accordance with the DER Technical Guidance for Site Remediation (DER-10) Section 1.5 Certification Requirement 1.5(b)1, I certify that this Revised Full Scale Work Plan for Surfactant Augmented LNAPL Removal was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

By: EWMA Engineering Services LLC
NYS Certificate of Authorization No. 0007617

7/9/2013

Richard D. Arnold, NYSPE No. 16076202
EWMA Project Number 250632

Note: It is a violation of Article 145 of New York State Education Law for any person, unless he is acting under the direction of a licensed professional engineer, to alter an item of this Periodic Review Report in any way. If an item is altered, the altering engineer shall affix to the item his seal and the notation "altered by" followed by his signature and the date of such alteration, and a specific description of the alteration.

TABLE 1 - LNAPL REMOVAL MONITORING SCHEDULE

Well Locations Are Displayed On Figure 1 - Well Location Map

Well No.	Location	Monitoring Method	Schedule
LN6	Perimeter Wells	LNAPL Gauging	Weekly*
LN14		Biosolve Visual Sampling	Weekly*
RW3 PW8		GW Sampling	Monthly**
PLN			
LN3	Deeper GW Wells	LNAPL Gauging	Weekly*
LN19		Biosolve Visual Sampling	Weekly*
LN21		GW Sampling	Monthly**
RW5	Interior LNAPL	LNAPL Gauging	Weekly*
LN2	Bearing Target Wells	Biosolve Visual Sampling	Weekly*
LN4		Fluid Removal Calculation	Weekly
LN12		Total Fluids Measurement	Weekly
LN16		LNAPL Removal Estimate	Weekly
LN20			
LN25			
LN26			
LN30			
LN8	Interior non-LNAPL	LNAPL Gauging	Weekly*
LN27	Bearing Target Wells	Biosolve Visual Sampling	Weekly*
LN31		Fluid Removal Calculation	Weekly
LN32		Total Fluids Measurement	Weekly
PLN		LNAPL Removal Estimate	Weekly
PLN			
LN10	Ancillary Monitoring	LNAPL Gauging	Weekly*
RW1	Wells	Biosolve Visual Sampling	Weekly*
LN18 PW9			

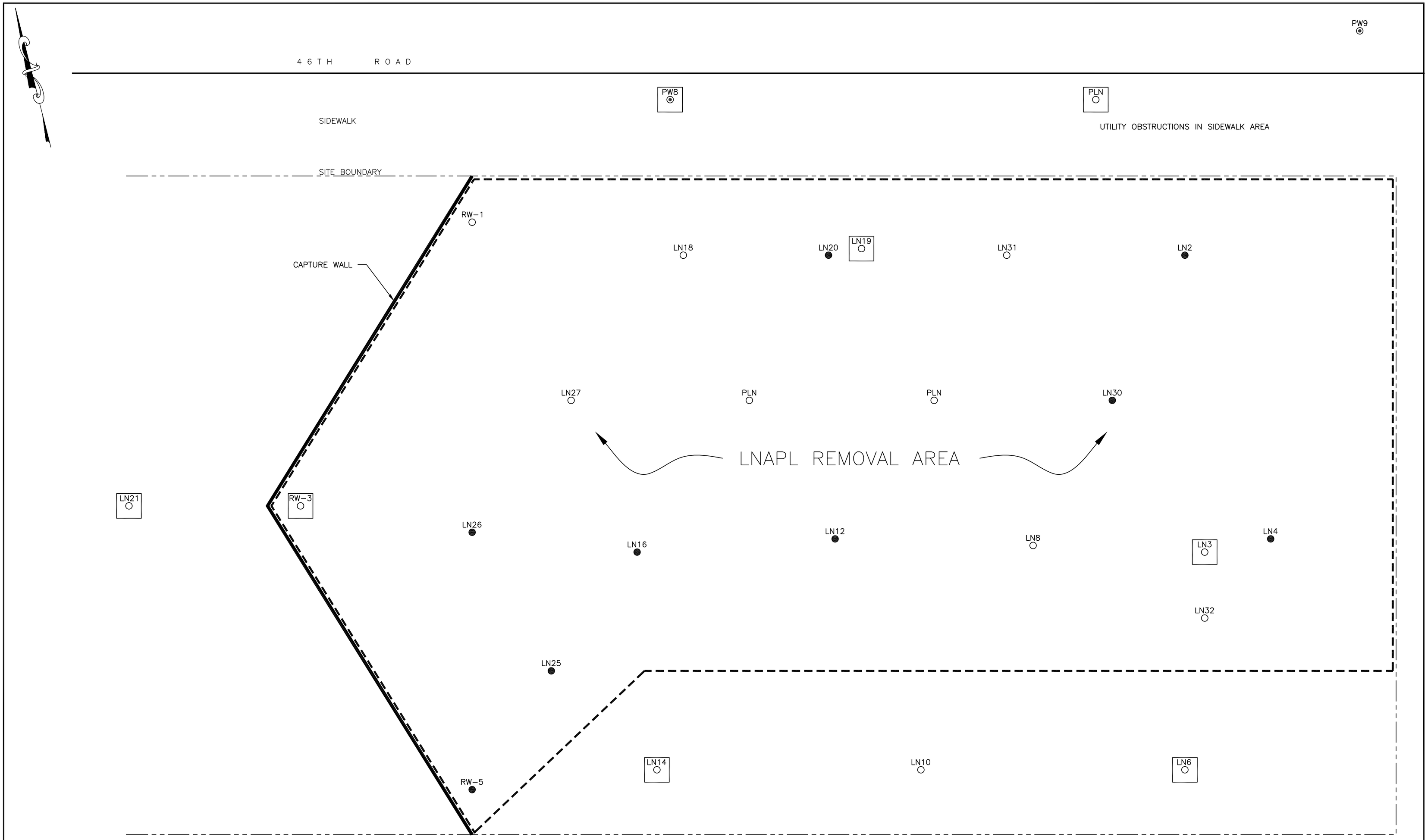
* During first two weeks of operations, all LNAPL gauging and Biosolve visual montioring will be performed 3 days after injection and 7 days after injection. After that all LNAPL gauging and Biosolve monitoring will be performed weekly (7 days after injection).

** During the first month of operations, GW sampling will be performed every two weeks. After that, GW sampling will be performed monthly at regular ~4 week intervals.

TABLE 2 - TARGET WELL EXTRACTION RATES
Well Locations Are Displayed On Figure 1 - Well Location Map

Target Well No.	Average of Rdgs 5/28-7/10 2013			
	Liquid Extracted (gal)	Elapsed Time (min)	Extraction Flow Rate (gpm)	Calculate Extract Time (min) for 3x Inj Vol *
RW-5	126	30	4.2	
LN-2	116	40	2.9	
LN-4	144	45	3.2	
LN-12	78	30	2.6	
LN-16	60	30	2.0	
LN-20	130	50	2.6	
LN-25	90	30	3.0	
LN-26	90	30	3.0	
LN-30	25	30	0.8	
LN-8	15	30	0.5	
LN-27	100	30	3.3	
LN-31	70	30	2.3	
LN-32	60	30	2.0	
PLN				
PLN				

* the extraction time needed for removal of three times the injected volume will be calculated using the above measured extraction rate for each target well. for example - at well RW5 extraction rate of 4.2 gpm, the extraction time needed to remove three times an injected volume of 50 gallons would be 36 minutes.



LEGEND

- LN12 — WELL WITH LNAPL CONTENT – TYP.
- LN10 — MONITORING AND RECOVERY WELL – TYP.
- PLN — WELL INSTALLATION PLANNED FOR JULY 2013
- PW8 — PERIMETER MONITORING WELL – TYP.
- GROUNDWATER MONITORING LOCATION
- LNAPL REMOVAL AREA

GRAPHIC SCALE

10 0 5 10 20

(IN FEET)

An Environmental Consulting & Remediation Firm
100 Misty Lane
P.O. Box 5430
Parsippany, NJ 07054

SCALE: AS SHOWN	PROJECT# 250632
DATE: 7/9/13	
DRAWN BY: RR	
CHECKED BY: RA	

A: k:\drawings\250000\250632\2013\250632F1.dwg

LOWER SAND UNIT WELL LOCATION MAP
OCA LIC, LLC
5-11 47TH AVENUE
LONG ISLAND CITY, NEW YORK

FIGURE# 1A