Loring Air Force Base Tank Farm

SOIL RX PERFORMANCE TRIAL

MINIMIZING THE ENVIRONMENTAL IMPACT AND REMEDIATING FUEL CONTAMINATED SOILS

Trial Developed in Cooperation With:

www.af.mil
U.S. AIR FORCE

Maine Department of Environmental Protection

OES Industries

3tier™ TECHNOLOGIES

3 Tier Technologies LLC
250 National Place, Suite 142, Longwood, FL 32750
dburdette@3tiertech.com, Phone: 877-226-7498

Loring Air Force Base Tank Farm
Soil Rx Remediation Trial

Site Description:

The Fuel Tank Farm was constructed in the early 1950s for bulk storage of the fuels used at Loring AFB. Originally, the FTF consisted of three large above ground storage tanks (ASTs), but by the late 1950s, two additional large ASTs were added to address the need for increased fuel requirements. The tanks were primarily used to store jet propulsion fuel No. 4 (JP-4) and No. 2 heating oil, but occasionally also contained motor gasoline (mogas) and aviation gasoline (avgas).

Fuel at the site was transported from the tanks through aboveground piping to the pumphouse and was distributed from the pumphouse through underground piping to the end users. Each storage tank is surrounded by a separate earthen berm that is capped with asphalt and a crushed stone surface. Stormwater runoff from within the bermed areas flowed through drains to an oil/water separator. Petroleum product that accumulated in the separator was manually removed and the aqueous portion flowed via underground piping to a settling pond located on the site.

The FTF site also included several support buildings of masonry construction and a rail siding along the northern portion of the site. Numerous fuel spills and leaks from piping and fueling operations reportedly occurred at the FTF site over a period of approximately 50 years of operation. Fuel-related soil contamination occurred in the area of the ASTs and pumphouse.

J:\11175638.00000\WORD\DRAFT\FTF-ND8748 2009 Soil Delineation Report\FTFNDA Report-Text (Client) 2009.doc

Proposal Objectives:

The objective of the proposal is to test the performance characteristics of **Soil RX** with regard to fuel-contaminated soil remediation and to assess and potential negative side-effects associated with the remediation procedures and/or applications. **Soil RX** is a scientifically formulated, environmentally safe Bio Remediation product manufactured by 3 Tier Technologies for hydrocarbon ladened soils. 3 Tier has long been known and respected for their approach in “fixing” soils by taking a holistic approach to enhancing the natural biological system in the soil structure. (See Attached Work Plan)

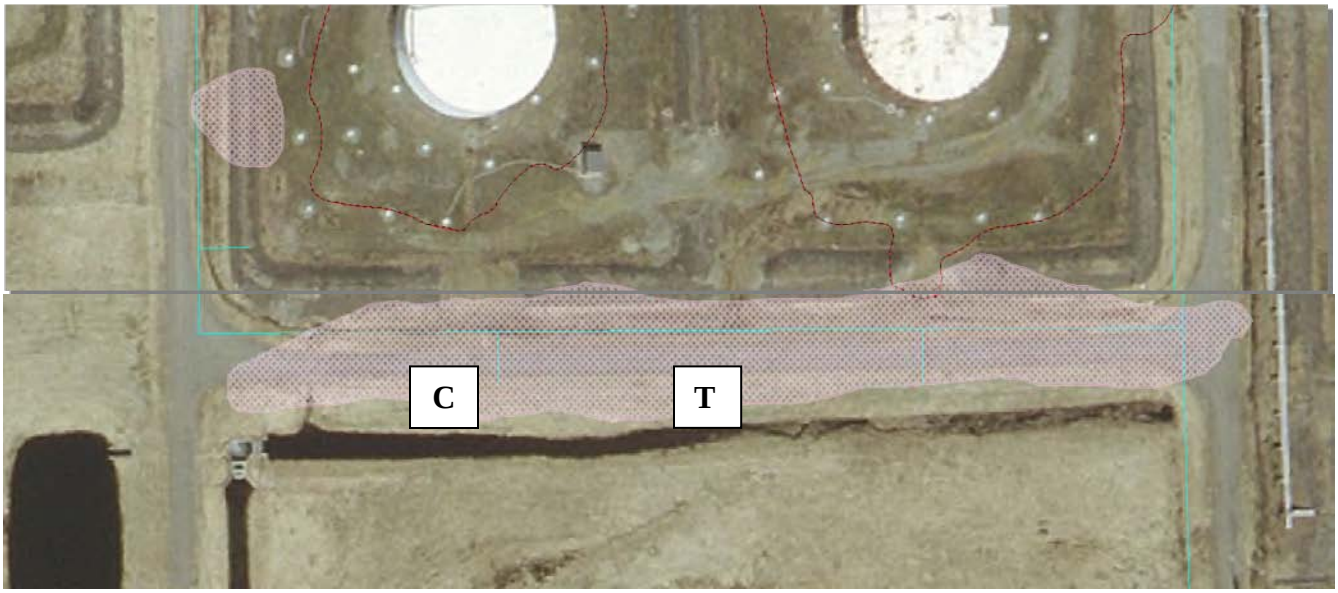
- **Soil Rx** utilizes a special recipe of three distinct yet synergistic components: A highly refined activated Humic acid blend that acts as a “detoxifying agent” in highly contaminated soils to build a soil structure not only capable of sustaining but enhancing biological activity.
- In addition to the humic acid, 3 Tier Technologies includes a highly concentrated blend of micro-organisms specifically chosen for their digestive capability of hydrocarbons in soils. All of the microbial strains included in **Soil Rx** are environmentally friendly and are not genetically modified.
- With the Humic acid & natural blend of microbes, 3 Tier adds a broad spectrum blend of enzymes, coenzymes and amino acids designed to dramatically speed up the degradation of hydrocarbons by catalyzing these complex molecules into more assimilated or soluble forms.

3 Tier Technologies LLC
250 National Place, Suite 142, Longwood, FL 32750
dburdette@3tiertech.com, Phone: 877-226-7498

Trial Outline:

The current condition of the site exhibits a variety of contamination levels at various depths. To best demonstrate the performance of Soil Rx without significant mechanical usage, we chose the following treatment strategy:

1. Two locations were determined that had similar contamination characteristic from the 2009 Test Pit Delineation Activities Report at the Fuel Tank Farm Site prepared in April 2010 by URS Group Inc. The two locations are TP-25 as the Control Plot and TP-28 as the Treatment Plot (Locations identified below on the aerial photo as C for the control and T for the treatment area). The test plots were determined after review of the above mentioned report.



2. The two plots are 40' X 40', 12' deep, or an approximate total of 750 cubic yards of material. It was decided to use a 10' on-center grid pattern to establish a Bore-N-Pour, non-excavation, in-situ method of treatment to each plot. Each plot received nine 2" diameter holes, 12'feet deep, bored using a Geo-Probe soil sampling device. See Attachment 2.

3. Each hole was sampled on-site using a standard PID sampling method and Oleophilic Shake Test. In addition to these two on-site tests, a composite sample was retrieved from each 4 foot sampling tube to be sent to the State of Maine DEQ Testing Lab for formal EPH/VPH concentration testing. Each hole received all of the above mentioned tests except for holes C-1 and C-2 on the Treatment Plot. These two holes were sampled for just PID and Oleophalic Shaker Test for a reference for basic contamination levels compared to the rest of the site. These two locations are the center point between four bore-n-pour points and will be used later for performance testing.

4. On each plot, all boring holes had a 1" perforated pipe inserted 12' to the bottom of each hole. All perforated pipe was connected together on the surface using 1" PVC schedule 40 pipe which was then attached to a 275-gallon feed tote. On the Treatment plot, one 275-gallon tote was connected per three boring holes to supply the required product. Since the Control location was only receiving water, all nine boring holes were connected to a single 275-gallon tote.

5. For the purpose of the trial it was determined that 3 Tier's Soil Rx would be used to remediate the Treatment location. Soil Rx is a triple-action hydrocarbon remediation product that must be diluted 10 to 1 before application. The recommended application rate for the product is one diluted gallon of Soil Rx per cubic foot of material. The original calculations for the trial estimated approximately 750 cubic yards which required 750 gallons of diluted material to treat. It was decided that three totes would be connected to three holes each on the treatment plot and received 25 gallons of Soil Rx concentrate and 250 gallons of water per tote to feed the three holes. All products were mixed to the previously mentioned solution and each tote was connected to the PVC pipe connected to three boring holes. Each boring hole was plugged and the product was released into the holes and feed using simple gravity. Each tote required approximately 2 hours for all 275 gallons of material to be accepted by the three holes. The control site received 825 gallons of water (Single 275-gallon tote filled three times) to match the liquid addition on the Treatment Plot.

Product being applied on October 4, 2010

Program Length & Monitoring Controls:

Program Length: The entire remediation process due to weather conditions and official trial start date (October 4, 2010) will be between 6 to nine months. Additional site applications were required and completed during immediately after the spring sampling.

Monitoring Controls: All boring holes were sampled October 4, 2010 during the trial setup (Samples identified as blue in the treated plot and green in the control plot). On October 21, 2010, a spot sampling was taken to monitor initial progress. Four spot samples were taken from the Treatment Plot and two were taken from the Control Plot. These test locations are identified on Attachment 2 in yellow. On June 28th 2011, the entire site was re-sampled at all locations and re-treated using the same rates and methods used for the initial application. These sample locations are identified on Attachment 2 in red.

Trial Summary:

The above described trial is designed to demonstrate a new "Green Technology" that uses significantly less equipment, labor, and fuel to execute while remediating harmful contaminates in-situ. The intent of the early fall sampling was not with the expectation that the site would/could be remediated in 17 days but rather as a spot check to determine product movement through a suspected difficult soil condition and identify any other key indicators of initial product performance.

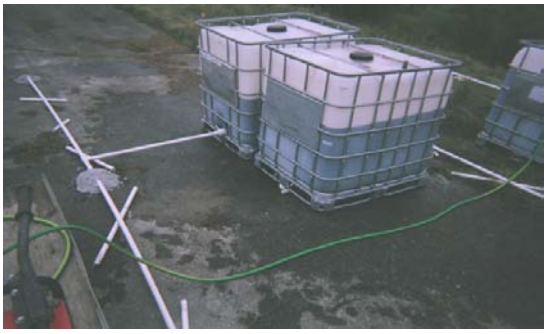
"Green Technology" is a solid movement to identify products and methods to clean up various contamination sites without extensive use of equipment that can emit harmful pollutants to perform the required task and establish systems that allow for material to be recycled and/or re-used after completing the projects. The "Bore-N-Pour" and/or "Excavate, Treat, & Replace" methods offer limited equipment usage resulting in little emission pollution from equipment, reusable treatment equipment that can be recycled after project completion (Bore-N-Pour Method), and is significantly less expensive than other methods while offering targeted and pin-point treatment to various contamination points. The use of these systems offers the client the ability to maximize treatments without re-treating the entire project. The other value is that even after the project has achieved its regulatory threshold, the treatment products will continue to work until all contaminates are eliminated and the soils are regenerated to a healthy state for future viability and safe use.

The following are the observations from the October 21, 2010 sampling (17 Days after treatment):

1. Due to the late start of the treatment program and the onset of cold temperatures, 3 Tier had little expectation of any significant changes in the EPH/VPH data and though there was some change, it was very inconclusive and not unexpected. What we did expect and saw was a change in the PID testing and more importantly the Oleophilic Shaker Test results. Though these two tests are only to be used as progress indicators, we have found that they do provide valuable information that Soil Rx is making an initial impact on the area and that significant changes are beginning. See Attachment 1.

2. During the original boring, each boring sleeve exhibited a distinct fuel odor and the characteristic visual fluorescent hydrocarbon sheen on the tubes. During the re-sampling, the boring in the treated area did not exhibit either trait and actually carried more of the product scent which is a mild citrus scent. This is important because sample boring 140 was removed from the center point between four boring points and clearly identified the movement of the product throughout the treatment area which is approximately 5 feet. Sample boring 139 was taken from immediately outside the outer edge of the treatment area. Both samples 140 (Considered Treated Sample) and 139 (Considered Un-Treated Sample) received not only the prescribed MEDEP state lab testing procedures, a duplicate sample from each location was collected and sent to SPL Inc, a Houston based analytical laboratory for additional screening. Both samples were testing for PAH's by GCMS Single Ion Monitoring Method SW3550C. The results of this specific analysis method clearly showed a significant reduction in the contamination levels within the treated plot to the representative un-treated reference. Attachment 3 shows the independent sample results, the Analyte Histogram, and comparative Analyte Histogram. While you will notice from the MEDEP test data versus the SPL Inc data, the same samples showed a significant reduction in contaminants and as was noted by the lab, the results show an immediate impact on the hydrocarbons and that this effective treatment should be continued for completion.

3. As you can see from the photos below, all treatment equipment remains connected and was re-used for the spring treatment. Once the process is completed, all tubing and tanks will be removed and relocated to another treatment site or will be taken for recycling. No additional equipment was needed other than to supply water for the appropriate dilutions.



The following are the observations from the June 28th, 2011 sampling:

1. Due to an extremely wet spring in Maine, the spring sampling for the site was not conducted until June 28th, 2011. The result of the oversaturation resulted in identifying a challenge not previously noted for the chosen locations: the two plots were previous drainage locations for the tank farm on the up gradient side of the plots and the drainage ditch (which you can see in the above right hand photo) retained water for three months and both plots had continuous flow of water through them with additional contamination from the tank farm itself. This situation explains the less than desired spring data results.
2. The comparative results (See Attachment 1) from this sampling showed elevated levels or similar levels of contaminants on the samples closest to the tank farm and less in the middle samples and marked improvement to the site on the test holes furthest from the tank farm and heavy impacts of the water flow through the test sites. It must also be noted that the MEDEP employee assigned to pull all the samples and deliver them to the state lab misplaced all the samples from the control side which limited our opportunity for a better comparative analysis. The PID tests completed on both plots did confirm that the lower treated areas were significantly improved while the control plot exhibited similar readings to the original fall results.
3. The only other conclusive observation made during the spring sampling was that the treated plot borings did not exhibit the distinct fuel odor and the characteristic visual fluorescent hydrocarbon sheen on the tubes while all the tubes on the control plot did. This key indicator was noted by State's Remedial Project Manager and supported his further approval of Soil Rx as the remediation product of choice for the 2012 remediation of Loring Air Force Base and Searsport Pipeline sites. Naji Akladiss agreed that the conditions chosen by the state did not result in a consistent location with the unexpected weather and even under these extreme conditions, Soil Rx still demonstrated modest reductions of EPH concentrations. Further discussions and experience with the product lead us to recommend the use of the "Excavation, Treat, & Replace" method since the base is closed and work of this nature will be more environmentally friendly than landfarming the material on the runways as originally planned. See Attachment 3 for the formal approval letter.

As with all real world trials, unforeseen situations often create challenges that impact the ideal results. Though a comprehensive positive result was not achieved in this trial the end result identified that Soil Rx is a viable remediation solution and that by changing the application strategy, the results will be improved. 3 Tier is committed to creating cost effective "green solutions" to meet the growing needs in the future. Success will always be driven by insuring Soil Rx achieves direct contact with the contaminant and knowing the best methods of application to apply to each individual project.

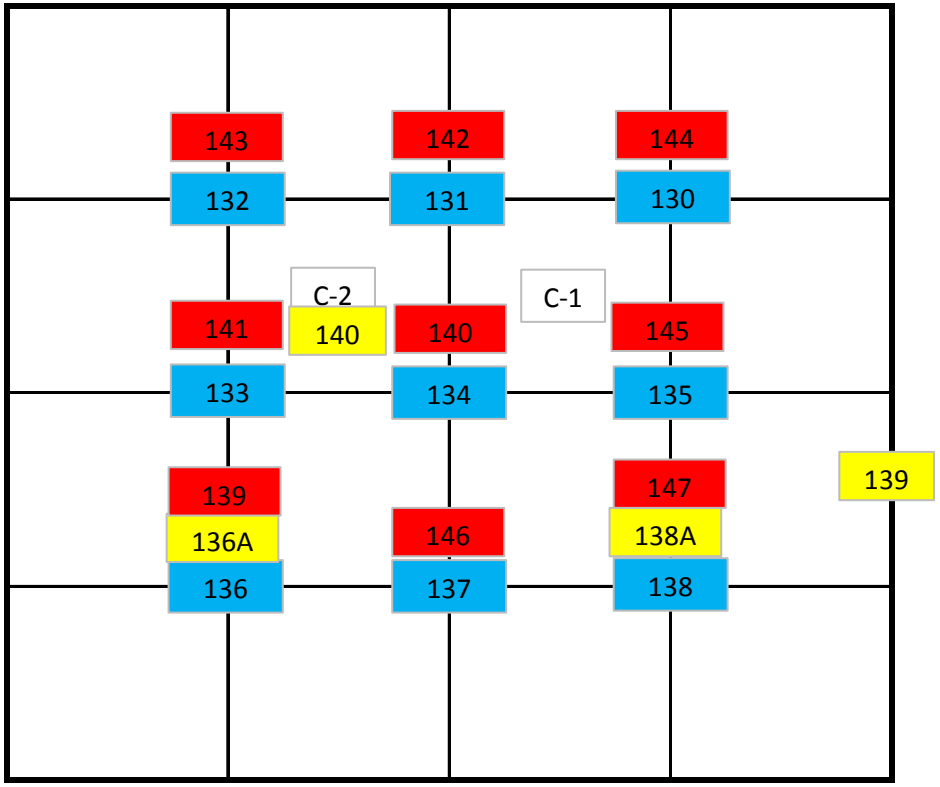
Attachment 1 - Test Results

		Depth	PID	C11-C22 AROMATIC	C19-C36 ALIPHATIC	C5-C8 ALIPHATIC	C9-C10 AROMATIC	C9-C12 ALIPHATIC	C9-C18 ALIPHATIC	Oleophilic shake test
	Leaching to GW guidelines			460		*1600*	*75*			
	Direct contact guidelines			730	10000	*1400*	740	2600	2600	
	Untreated Plot Results = Blue									
9/28/2010	SB-FTF-120	5-6 FT	122	NA	NA	NA	NA	NA	NA	NA
6/29/2011	**SB-FTF-156**	**5-6 FT**	**5.7**	**<20**	**<20**	**NA**	**NA**	**NA**	**<20**	**P**
9/28/2010	SB-FTF-121	5-6 FT	782	100	<100	1300	*140*	700	630	S
6/29/2011	**SB-FTF-153**	**7-8 FT**	**208**	**87**	**<20**	**NA**	**NA**	**NA**	**430**	**S**
9/28/2010	SB-FTF-122	6-7 FT	60.3	<20	<20	38	2.2	23	19	P
6/29/2011	**SB-FTF-155**	**5-6 FT**	**64**	**<20**	**<20**	**NA**	**NA**	**NA**	**<20**	**P**
9/28/2010	SB-FTF-123	5-6 FT	2	<20	<20	5.6	<1	<2.5	<20	N
6/29/2011	**SB-FTF-154**	**8-9 FT**	**4.6**	**<20**	**<20**	**NA**	**NA**	**NA**	**<20**	**U**
9/28/2010	SB-FTF-124	5-6 FT	405	57	<200	600	*100*	430	380	S
6/29/2011	**SB-FTF-151**	**5-6 FT**	**6.5**	**23**	**<20**	**NA**	**NA**	**NA**	**120**	**U**
9/28/2010	SB-FTF-125	5-6 FT	1020	290	<1000	*5300*	*690*	2100	2300	S
6/29/2011	**SB-FTF-152**	**7-8 FT**	**384**	**95**	**<100**	**NA**	**NA**	**NA**	**440**	**P**
9/28/2010	SB-FTF-126	5-6 FT	48.5	<20	<20	16	4.9	22	13	P
6/29/2011	**SB-FTF-148**	**5-6 FT**	**1710**	**240**	**41**	**NA**	**NA**	**NA**	**2200**	**S**
9/28/2010	SB-FTF-127	5-6 FT	249	280	<200	*3000*	*370*	1300	1800	S
6/29/2011	**SB-FTF-149**	**5-6 FT**	**488**	**69**	**<20**	**NA**	**NA**	**NA**	**300**	**S**
9/28/2010	SB-FTF-128	5-6 FT	912	46	<100	*3500*	*740*	1600	320	S
6/29/2011	**SB-FTF-150**	**5-6 FT**	**1470**	**180**	**<200**	**NA**	**NA**	**NA**	**2100**	**S**
	Treated Plot Results = Green									
9/28/2010	SB-FTF-130	5-6 FT	481	NA	NA	NA	NA	NA	NA	NA
6/29/2011	**SB-FTF-144**	**5-6 FT**	**4.7**	**<20**	**<20**	**<2.5**	**3.1**	**<2.5**	**<20**	**U**
9/28/2010	SB-FTF-131	5-6 FT	7.9	NA	NA	NA	NA	NA	NA	NA
6/29/2011	**SB-FTF-142**	**5-6 FT**	**7.4**	**<20**	**<20**	**4.8**	**1.9**	**3.7**	**<20**	**U**
9/28/2010	SB-FTF-132	5-6 FT	2.3	<20	<20	6.2	<1	<2.5	<20	N
6/29/2011	**SB-FTF-143**	**5-6 FT**	**4.4**	**<20**	**<20**	**<2.5**	**1.9**	**<2.5**	**<20**	**U**
9/28/2010	SB-FTF-133	5-6 FT	752	190	<100	77	26	94	740	S
6/29/2011	**SB-FTF-141**	**6-7 FT**	**868**	**71**	**<20**	**350**	***140***	**470**	**360**	**P**
9/28/2010	SB-FTF-134	8-9 FT	401	71	<20	790	*190*	620	220	S
6/29/2011	**SB-FTF-140**	**5-6 FT**	**913**	**60**	**46**	**1100**	***240***	**760**	**360**	**S**
9/28/2010	SB-FTF-135	5-6 FT	391	61	<20	340	*140*	480	210	S
6/29/2011	**SB-FTF-145**	**5-6 FT**	**1620**	**<20**	**<20**	***1700***	***260***	**1000**	**80**	**S**
9/28/2010	SB-FTF-136	5-6 FT	1100	190	<100	1300	*300*	1200	680	S
6/29/2011	**SB-FTF-139**	**5-6 FT**	**848**	**160**	**150**	**1500**	***480***	**1900**	**780**	**S**
9/28/2010	SB-FTF-137	5-6 FT	977	310	<100	870	*220*	650	1200	S
6/29/2011	**SB-FTF-146**	**5-6 FT**	**1170**	**340**	**61**	***1600***	***640***	**1700**	**150**	**S**
9/28/2010	SB-FTF-138	6-7 FT	1150	220	<100	*1800*	*520*	1700	1000	S
6/29/2011	**SB-FTF-147**	**5-6 FT**	**1190**	**140**	**46**	**1400**	***520***	**1500**	**600**	**S**

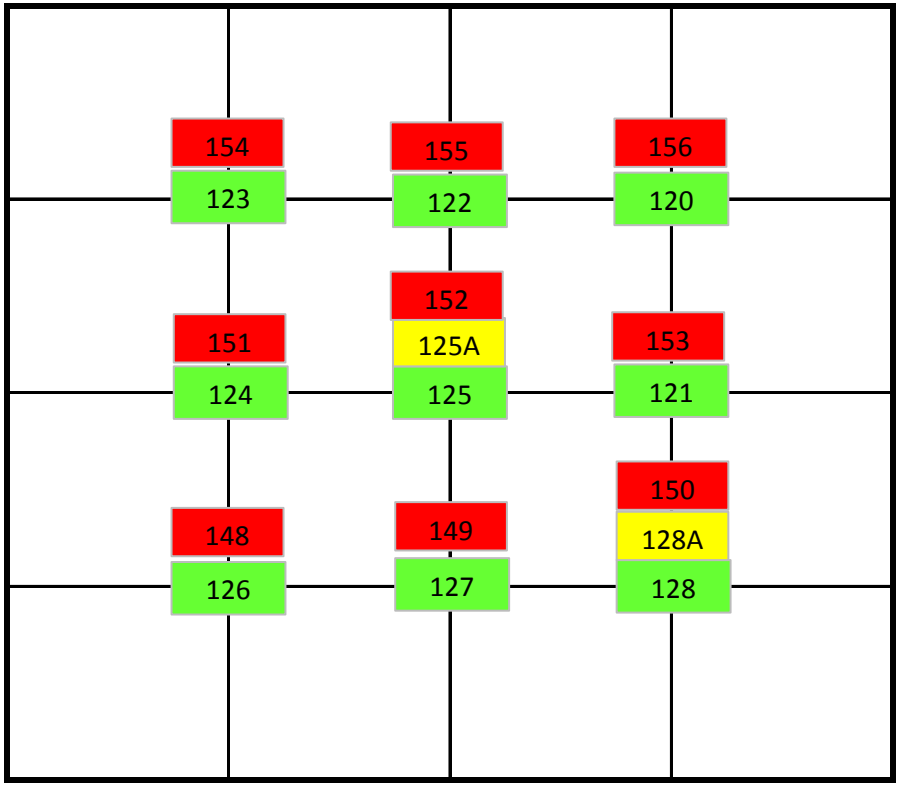
Attachment 2 - Boring Identifier

Creek Side

Treatment Location



Control Location



Tank Side

Notes:

1. Each plot is 40' X 40'.
2. The Bore & Pour grid is setup on 10' centers, 10' inside the outer plot perimeter.
3. Treated plot received 75 gallons Soil Rx diluted in 750 gallons of water. Control received 825 gallons of water only.
4. Each location was Geo-probed to a depth of 12' and were tested for PID and VPH/EPH except locations C-1 & C-2 which were PID only.
5. Yellow squares indicate October 21st follow-up test locations. Each re-sampl should be taken within 12" of the original boring.
6. Red squares indicate June 28th 2011 sampling locations. All locations GPS located by MDEQ.

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

PAUL R. LEPAGE
GOVERNOR

JAMES P. BROOKS
ACTING COMMISSIONER

August 29, 2011

RE: SoilRx product

To Whom It May Concern:

This memo is written for the purpose of allowing the use and the application of the bioremediation humic-acid product "SoilRx" for petroleum-contaminated soil remediation at the former Loring AFB and the Searsport Pipeline sites. This product may be effective when applied correctly.

When this product comes in contact with petroleum-contaminated soil, it helps to break-down the fuel components thereby reducing the concentrations in the soil. This method of remediation can also be cost effective since it is less energy-intensive than the previously used method of soil spreading and because of reduced soil transportation expenses.

A pilot study involving injection of this product into petroleum-contaminated soil has shown modest reduction of EPH concentrations. Based on the difficulties involved in administering the product by injection, we suggest the following methods of application: excavate the petroleum-contaminated soil, mix it with the product, and return the soil/product mixture back to the excavated site; install an infiltration gallery at the target depth; or utilize the product in a soil pile.

Sincerely,

N. Akl

Naji Akladiss, P.E.
Remedial Project Manager
Division of Remediation
Bureau of Remediation & Waste Management

cc: Gail Lipfort, MEDEP
File

AUGUSTA
17 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0017
(207) 287-7688 FAX: (207) 287-7826
RAY BLDG., HOSPITAL ST.

BANGOR
106 HOGAN ROAD, SUITE 6
BANGOR, MAINE 04401
(207) 941-4570 FAX: (207) 941-4584

PORTLAND
312 CANCO ROAD
PORTLAND, MAINE 04103
(207) 822-6300 FAX: (207) 822-6303

PRESQUE ISLE
1235 CENTRAL DRIVE, SKYWAY PARK
PRESQUE ISLE, MAINE 04769-2094
(207) 764-0477 FAX: (207)760-3143

web site: www.maine.gov/dep

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TX 77054
(713) 660-0901

Client Sample ID: Soil Sample NON Treated **Collected:** 10/21/2010 10:45 **SPL Sample ID:** 10110524-01

Site: Loring, AFB

Analyses/Method	Result	QUAL	Rep.Limit	Dil. Factor	Date Analyzed	Analyst	Seq. #
PAHS BY GCMS SINGLE ION MONITORING				**MCL STM D7363/CLP**	**Units: ug/kg**		
1-Methylphenanthrene	ND		3.3	1	12/07/10 17:36	SJM	5672146
Benzo(b)thiophene	56.1	E	3.3	1	12/07/10 17:36	SJM	5672146
C-10	143	E	3.3	1	12/07/10 17:36	SJM	5672146
C-11	242	E	3.3	1	12/07/10 17:36	SJM	5672146
C-12	388	E	3.3	1	12/07/10 17:36	SJM	5672146
C-13	324	E	3.3	1	12/07/10 17:36	SJM	5672146
C-14	537	E	3.3	1	12/07/10 17:36	SJM	5672146
C-15	78.4	E	3.3	1	12/07/10 17:36	SJM	5672146
C-16	39.4	E	3.3	1	12/07/10 17:36	SJM	5672146
C-17	12.4		3.3	1	12/07/10 17:36	SJM	5672146
C-18	6.75		3.3	1	12/07/10 17:36	SJM	5672146
C-19	7.98		3.3	1	12/07/10 17:36	SJM	5672146
C1-Benzo(b)thiophenes	464	E	3.3	1	12/07/10 17:36	SJM	5672146
C1-Decalins	2070		330	100	12/09/10 16:58	SJM	5672151
C1-Dibenzothiophenes	ND		3.3	1	12/07/10 17:36	SJM	5672146
C-20	6.68		3.3	1	12/07/10 17:36	SJM	5672146
C-21	4.67		3.3	1	12/07/10 17:36	SJM	5672146
C-22	4.27		3.3	1	12/07/10 17:36	SJM	5672146
C-23	4.13		3.3	1	12/07/10 17:36	SJM	5672146
C-24	4.86		3.3	1	12/07/10 17:36	SJM	5672146
C-25	5.14		3.3	1	12/07/10 17:36	SJM	5672146
C-26	5.68		3.3	1	12/07/10 17:36	SJM	5672146
C-27	6.15		3.3	1	12/07/10 17:36	SJM	5672146
C-28	5.51		3.3	1	12/07/10 17:36	SJM	5672146
C-29	4.44		3.3	1	12/07/10 17:36	SJM	5672146
C2-Benzo(b)thiophenes	126	E	3.3	1	12/07/10 17:36	SJM	5672146
C2-Decalins	2990		330	100	12/09/10 16:58	SJM	5672151
C2-Dibenzothiophenes	ND		3.3	1	12/07/10 17:36	SJM	5672146
C-30	4.2		3.3	1	12/07/10 17:36	SJM	5672146
C-31	ND		3.3	1	12/07/10 17:36	SJM	5672146
C-32	ND		3.3	1	12/07/10 17:36	SJM	5672146
C-33	ND		3.3	1	12/07/10 17:36	SJM	5672146
C-34	ND		3.3	1	12/07/10 17:36	SJM	5672146
C-35	ND		16.7	1	12/07/10 17:36	SJM	5672146
C-36	ND		16.7	1	12/07/10 17:36	SJM	5672146
C-37	ND		16.7	1	12/07/10 17:36	SJM	5672146
C-38	ND		16.7	1	12/07/10 17:36	SJM	5672146
C-39	ND		16.7	1	12/07/10 17:36	SJM	5672146
C3-Benzo(b)thiophenes	33.7	E	3.3	1	12/07/10 17:36	SJM	5672146

Qualifiers:
ND/U - Not Detected at the Reporting Limit
B - Analyte Detected In The Associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated value between MDL and PQL
E - Estimated Value exceeds calibration curve
TNTC - Too numerous to count
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TX 77054
(713) 660-0901

Client Sample ID: Soil Sample NON Treated **Collected:** 10/21/2010 10:45 **SPL Sample ID:** 10110524-01

Site: Loring, AFB

Analyses/Method	Result	QUAL	Rep.Limit	Dil. Factor	Date Analyzed	Analyst	Seq. #
C3-Decalins	2440		330	100	12/09/10 16:58	SJM	5672151
C3-Dibenzothiophenes	ND		3.3	1	12/07/10 17:36	SJM	5672146
C-40	ND		16.7	1	12/07/10 17:36	SJM	5672146
C4-Benzo(b)thiophenes	19.9		3.3	1	12/07/10 17:36	SJM	5672146
C4-Decalins	1480	B	330	100	12/09/10 16:58	SJM	5672151
C4-Dibenzothiophenes	ND		3.3	1	12/07/10 17:36	SJM	5672146
C-8	13.4	B	3.3	1	12/07/10 17:36	SJM	5672146
C-9	26.1		3.3	1	12/07/10 17:36	SJM	5672146
Dibenzofuran	64.8	E	3.3	1	12/07/10 17:36	SJM	5672146
Dibenzothiophene	ND		3.3	1	12/07/10 17:36	SJM	5672146
Hopanes (191 Family)	ND		3.3	1	12/07/10 17:36	SJM	5672146
Steranes (217 Family)	ND		3.3	1	12/07/10 17:36	SJM	5672146
Steranes (218 Family)	ND		3.3	1	12/07/10 17:36	SJM	5672146
Naphthalene	374		330	100	12/09/10 16:58	SJM	5672151
2-Methylnaphthalene	1190		330	100	12/09/10 16:58	SJM	5672151
1-Methylnaphthalene	1160		330	100	12/09/10 16:58	SJM	5672151
C2-Naphthalenes	2530		330	100	12/09/10 16:58	SJM	5672151
C3-Naphthalenes	825		330	100	12/09/10 16:58	SJM	5672151
C4-Naphthalenes	180	BE	3.3	1	12/07/10 17:36	SJM	5672146
Acenaphthylene	ND		3.3	1	12/07/10 17:36	SJM	5672146
Acenaphthene	ND		3.3	1	12/07/10 17:36	SJM	5672146
Fluorene	31.5		3.3	1	12/07/10 17:36	SJM	5672146
C1-Fluorenes	30.5		3.3	1	12/07/10 17:36	SJM	5672146
C2-Fluorenes	21		3.3	1	12/07/10 17:36	SJM	5672146
C3-Fluorenes	12.8		3.3	1	12/07/10 17:36	SJM	5672146
Phenanthrene	10.2		3.3	1	12/07/10 17:36	SJM	5672146
C1-Phenanthrenes/Anthracenes	23.1		3.3	1	12/07/10 17:36	SJM	5672146
C2-Phenanthrenes/Anthracenes	15.7		3.3	1	12/07/10 17:36	SJM	5672146
C3-Phenanthrenes/Anthracenes	5.79		3.3	1	12/07/10 17:36	SJM	5672146
C4-Phenanthrenes/Anthracenes	ND		3.3	1	12/07/10 17:36	SJM	5672146
Anthracene	ND		3.3	1	12/07/10 17:36	SJM	5672146
Fluoranthene	ND		3.3	1	12/07/10 17:36	SJM	5672146
Pyrene	ND		3.3	1	12/07/10 17:36	SJM	5672146
C1-Fluoranthenes/Pyrenes	4.1		3.3	1	12/07/10 17:36	SJM	5672146
C2-Fluoranthenes/Pyrenes	ND		3.3	1	12/07/10 17:36	SJM	5672146
C3-Fluoranthenes/Pyrenes	ND		3.3	1	12/07/10 17:36	SJM	5672146
Benzo(a)anthracene	ND		3.3	1	12/07/10 17:36	SJM	5672146
Chrysene	ND		3.3	1	12/07/10 17:36	SJM	5672146
C1-Chrysenes	ND		3.3	1	12/07/10 17:36	SJM	5672146
C2-Chrysenes	ND		3.3	1	12/07/10 17:36	SJM	5672146

Qualifiers:
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B - Analyte Detected In The Associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated value between MDL and PQL
E - Estimated Value exceeds calibration curve
TNTC - Too numerous to count
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TX 77054
(713) 660-0901

Client Sample ID: Soil Sample NON Treated **Collected:** 10/21/2010 10:45 **SPL Sample ID:** 10110524-01

Site: Loring, AFB

Analyses/Method	Result	QUAL		Rep.Limit	Dil. Factor	Date Analyzed	Analyst	Seq. #
C3-Chrysenes	ND			3.3	1	12/07/10 17:36	SJM	5672146
C4-Chrysenes	ND			3.3	1	12/07/10 17:36	SJM	5672146
Benzo(b)fluoranthene	ND			3.3	1	12/07/10 17:36	SJM	5672146
Benzo(k)fluoranthene	ND			3.3	1	12/07/10 17:36	SJM	5672146
Benzo(e)pyrene	ND			3.3	1	12/07/10 17:36	SJM	5672146
Benzo(a)pyrene	ND			3.3	1	12/07/10 17:36	SJM	5672146
Perylene	ND			3.3	1	12/07/10 17:36	SJM	5672146
Indeno(1,2,3-cd)pyrene	ND			3.3	1	12/07/10 17:36	SJM	5672146
Dibenz(a,h)anthracene	ND			3.3	1	12/07/10 17:36	SJM	5672146
Benzo(g,h,i)perylene	ND			3.3	1	12/07/10 17:36	SJM	5672146
cis-Decalin	113			3.3	1	12/07/10 17:36	SJM	5672146
trans-Decalin	589			330	100	12/09/10 16:58	SJM	5672151
Surr: Acenaphthylene-d8	137		%	60-140	1	12/07/10 17:36	SJM	5672146
Surr: Acenaphthylene-d8	D	*	%	60-140	100	12/09/10 16:58	SJM	5672151
Surr: Anthracene-d10	64.1		%	60-140	1	12/07/10 17:36	SJM	5672146
Surr: Anthracene-d10	D	*	%	60-140	100	12/09/10 16:58	SJM	5672151
Surr: Pyrene-d10	67.6		%	60-140	1	12/07/10 17:36	SJM	5672146
Surr: Pyrene-d10	D	*	%	60-140	100	12/09/10 16:58	SJM	5672151
Surr: Benzo(a)pyrene-d12	D	*	%	60-140	100	12/09/10 16:58	SJM	5672151
Surr: Benzo(a)pyrene-d12	57.1 MI	*	%	60-140	1	12/07/10 17:36	SJM	5672146

Prep Method	Prep Date	Prep Initials	Prep Factor
SW3550C	12/01/2010 9:20	QMT	1.00

Qualifiers:
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E - Estimated Value exceeds calibration curve
TNTC - Too numerous to count
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TX 77054
(713) 660-0901

Client Sample ID: Soil Sample Treated (Loving AFB) **Collected:** 10/21/2010 10:45 **SPL Sample ID:** 10110524-02

Site: Loring, AFB

Analyses/Method	Result	QUAL	Rep.Limit	Dil. Factor	Date Analyzed	Analyst	Seq. #
PAHS BY GCMS SINGLE ION MONITORING				**MCL STM D7363/CLP**		**Units: ug/kg**	
1-Methylphenanthrene	ND		16.5	5	12/09/10 19:15	SJM	5672152
Benzo(b)thiophene	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-10	27.1		16.5	5	12/09/10 19:15	SJM	5672152
C-11	50.4		16.5	5	12/09/10 19:15	SJM	5672152
C-12	84.9		16.5	5	12/09/10 19:15	SJM	5672152
C-13	137		16.5	5	12/09/10 19:15	SJM	5672152
C-14	113		16.5	5	12/09/10 19:15	SJM	5672152
C-15	35.7		16.5	5	12/09/10 19:15	SJM	5672152
C-16	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-17	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-18	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-19	ND		16.5	5	12/09/10 19:15	SJM	5672152
C1-Benzo(b)thiophenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C1-Decalins	302		16.5	5	12/09/10 19:15	SJM	5672152
C1-Dibenzothiophenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-20	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-21	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-22	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-23	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-24	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-25	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-26	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-27	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-28	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-29	ND		16.5	5	12/09/10 19:15	SJM	5672152
C2-Benzo(b)thiophenes	22.7		16.5	5	12/09/10 19:15	SJM	5672152
C2-Decalins	297		16.5	5	12/09/10 19:15	SJM	5672152
C2-Dibenzothiophenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-30	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-31	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-32	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-33	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-34	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-35	ND		83.5	5	12/09/10 19:15	SJM	5672152
C-36	ND		83.5	5	12/09/10 19:15	SJM	5672152
C-37	ND		83.5	5	12/09/10 19:15	SJM	5672152
C-38	ND		83.5	5	12/09/10 19:15	SJM	5672152
C-39	ND		83.5	5	12/09/10 19:15	SJM	5672152
C3-Benzo(b)thiophenes	ND		16.5	5	12/09/10 19:15	SJM	5672152

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D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TX 77054
(713) 660-0901

Client Sample ID: Soil Sample Treated (Loving AFB) **Collected:** 10/21/2010 10:45 **SPL Sample ID:** 10110524-02

Site: Loring, AFB

Analyses/Method	Result	QUAL	Rep.Limit	Dil. Factor	Date Analyzed	Analyst	Seq. #
C3-Decalins	416		16.5	5	12/09/10 19:15	SJM	5672152
C3-Dibenzothiophenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-40	ND		83.5	5	12/09/10 19:15	SJM	5672152
C4-Benzo(b)thiophenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C4-Decalins	292	B	16.5	5	12/09/10 19:15	SJM	5672152
C4-Dibenzothiophenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-8	ND		16.5	5	12/09/10 19:15	SJM	5672152
C-9	ND		16.5	5	12/09/10 19:15	SJM	5672152
Dibenzofuran	ND		16.5	5	12/09/10 19:15	SJM	5672152
Dibenzothiophene	ND		16.5	5	12/09/10 19:15	SJM	5672152
Hopanes (191 Family)	ND		16.5	5	12/09/10 19:15	SJM	5672152
Steranes (217 Family)	ND		16.5	5	12/09/10 19:15	SJM	5672152
Steranes (218 Family)	ND		16.5	5	12/09/10 19:15	SJM	5672152
Naphthalene	ND		16.5	5	12/09/10 19:15	SJM	5672152
2-Methylnaphthalene d-10	ND		16.5	5	12/09/10 19:15	SJM	5672152
2-Methylnaphthalene	71.1		16.5	5	12/09/10 19:15	SJM	5672152
1-Methylnaphthalene	73.3		16.5	5	12/09/10 19:15	SJM	5672152
C2-Naphthalenes	236		16.5	5	12/09/10 19:15	SJM	5672152
C3-Naphthalenes	119		16.5	5	12/09/10 19:15	SJM	5672152
C4-Naphthalenes	28.9	B	16.5	5	12/09/10 19:15	SJM	5672152
Acenaphthylene	ND		16.5	5	12/09/10 19:15	SJM	5672152
Acenaphthene	ND		16.5	5	12/09/10 19:15	SJM	5672152
Fluorene	ND		16.5	5	12/09/10 19:15	SJM	5672152
C1-Fluorenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C2-Fluorenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C3-Fluorenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
Phenanthrene	ND		16.5	5	12/09/10 19:15	SJM	5672152
C1-Phenanthrenes/Anthracenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C2-Phenanthrenes/Anthracenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C3-Phenanthrenes/Anthracenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C4-Phenanthrenes/Anthracenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
Anthracene	ND		16.5	5	12/09/10 19:15	SJM	5672152
Fluoranthene	ND		16.5	5	12/09/10 19:15	SJM	5672152
Pyrene	ND		16.5	5	12/09/10 19:15	SJM	5672152
C1-Fluoranthenes/Pyrenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C2-Fluoranthenes/Pyrenes	ND		16.5	5	12/09/10 19:15	SJM	5672152
C3-Fluoranthenes/Pyrenes	18.3		16.5	5	12/09/10 19:15	SJM	5672152
Benzo(a)anthracene	ND		16.5	5	12/09/10 19:15	SJM	5672152
Chrysene	ND		16.5	5	12/09/10 19:15	SJM	5672152
C1-Chrysenes	ND		16.5	5	12/09/10 19:15	SJM	5672152

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MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TX 77054
(713) 660-0901

Client Sample ID: Soil Sample Treated (Loving AFB) **Collected:** 10/21/2010 10:45 **SPL Sample ID:** 10110524-02

Site: Loring, AFB

Analyses/Method	Result	QUAL		Rep.Limit	Dil. Factor	Date Analyzed	Analyst	Seq. #
C2-Chrysenes	ND			16.5	5	12/09/10 19:15	SJM	5672152
C3-Chrysenes	ND			16.5	5	12/09/10 19:15	SJM	5672152
C4-Chrysenes	ND			16.5	5	12/09/10 19:15	SJM	5672152
Benzo(b)fluoranthene	ND			16.5	5	12/09/10 19:15	SJM	5672152
Benzo(k)fluoranthene	ND			16.5	5	12/09/10 19:15	SJM	5672152
Benzo(e)pyrene	ND			16.5	5	12/09/10 19:15	SJM	5672152
Benzo(a)pyrene	ND			16.5	5	12/09/10 19:15	SJM	5672152
Perylene	ND			16.5	5	12/09/10 19:15	SJM	5672152
Indeno(1,2,3-cd)pyrene	ND			16.5	5	12/09/10 19:15	SJM	5672152
Dibenz(a,h)anthracene	ND			16.5	5	12/09/10 19:15	SJM	5672152
Benzo(g,h,i)perylene	ND			16.5	5	12/09/10 19:15	SJM	5672152
cis-Decalin	ND			16.5	5	12/09/10 19:15	SJM	5672152
trans-Decalin	74.2			16.5	5	12/09/10 19:15	SJM	5672152
Surr: Acenaphthylene-d8	60.8		%	60-140	5	12/09/10 19:15	SJM	5672152
Surr: Anthracene-d10	52.03 MI	*	%	60-140	5	12/09/10 19:15	SJM	5672152
Surr: Pyrene-d10	77.2		%	60-140	5	12/09/10 19:15	SJM	5672152
Surr: Benzo(a)pyrene-d12	63.8		%	60-140	5	12/09/10 19:15	SJM	5672152

Prep Method	Prep Date	Prep Initials	Prep Factor
SW3550C	12/01/2010 9:20	QMT	1.00

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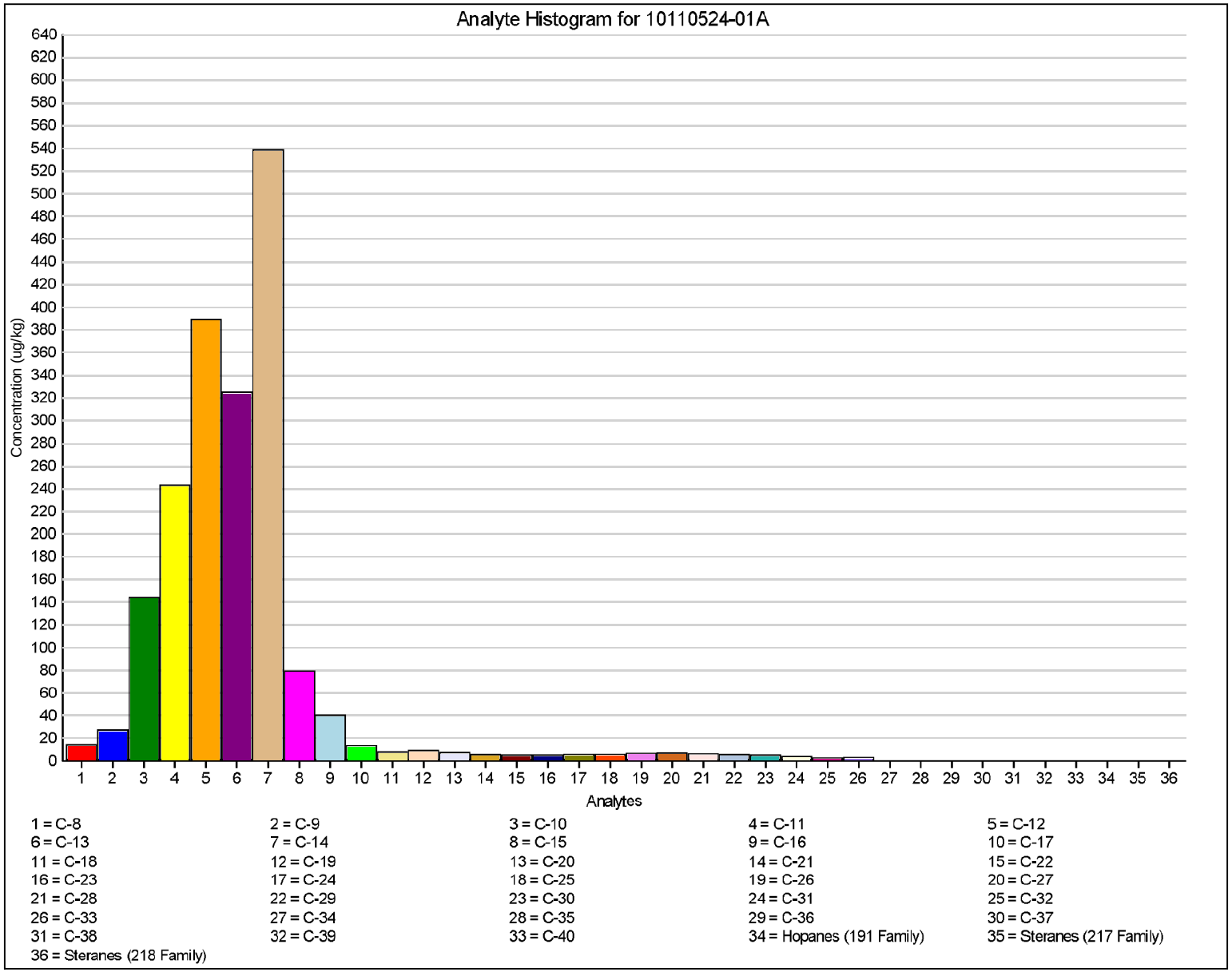
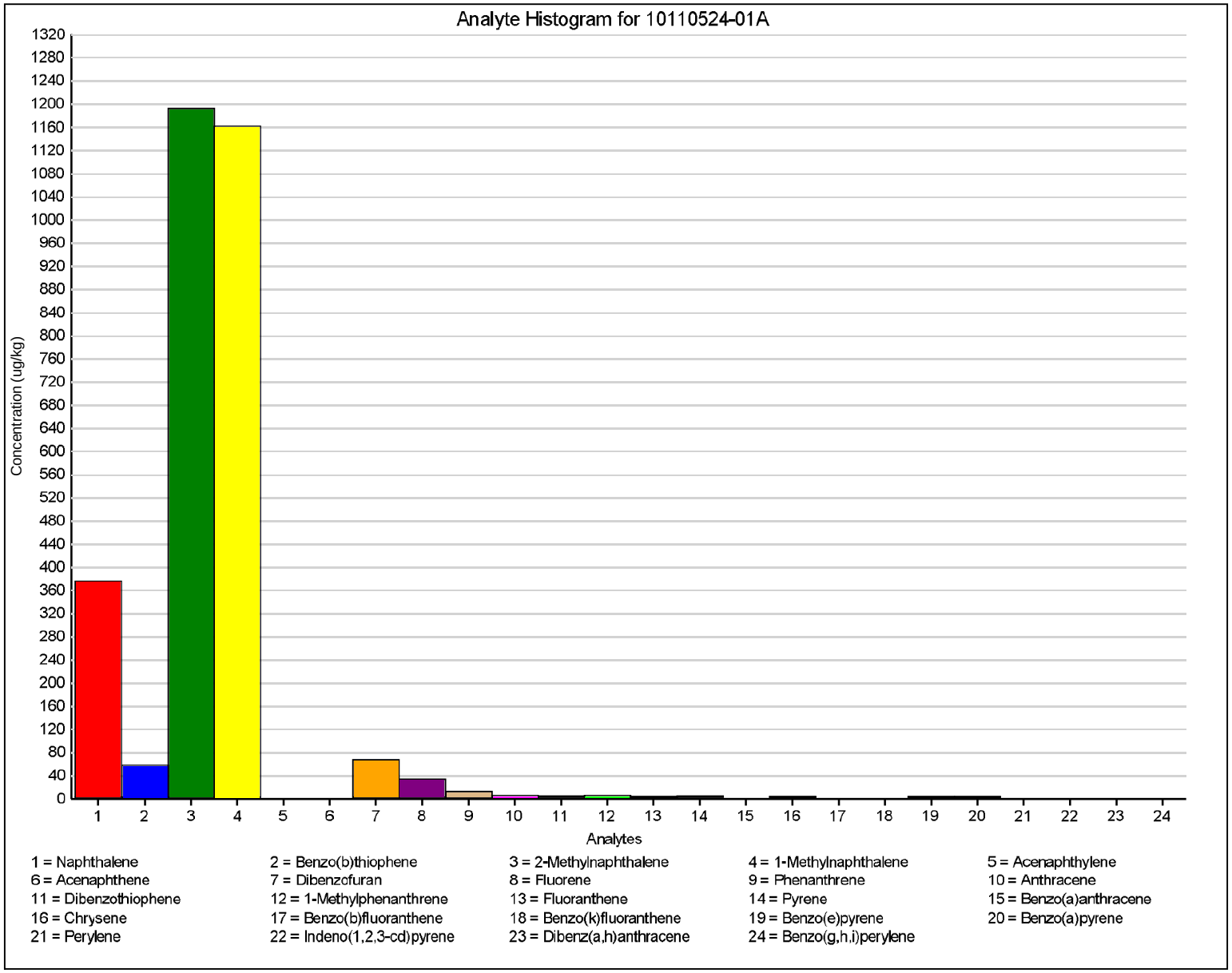
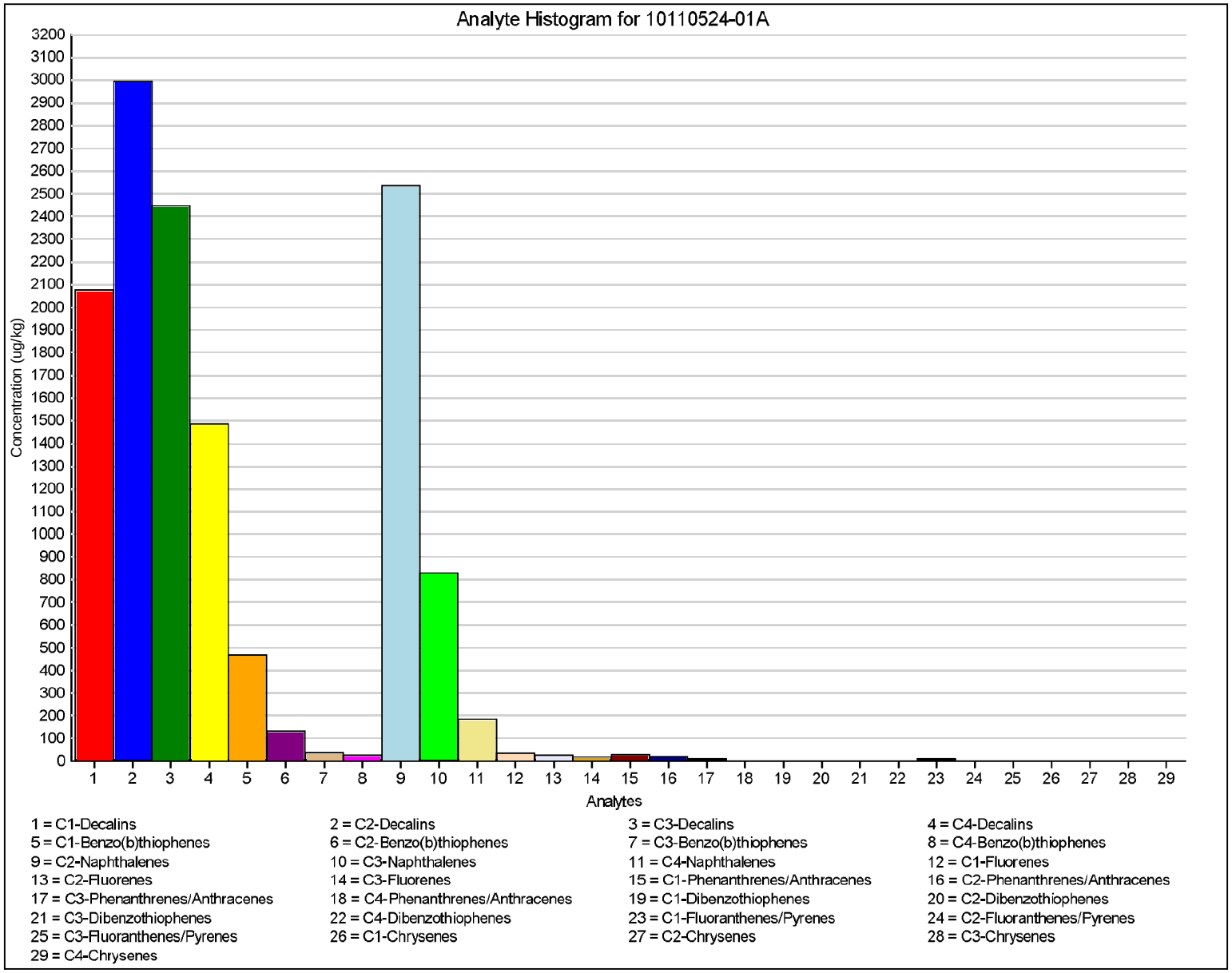
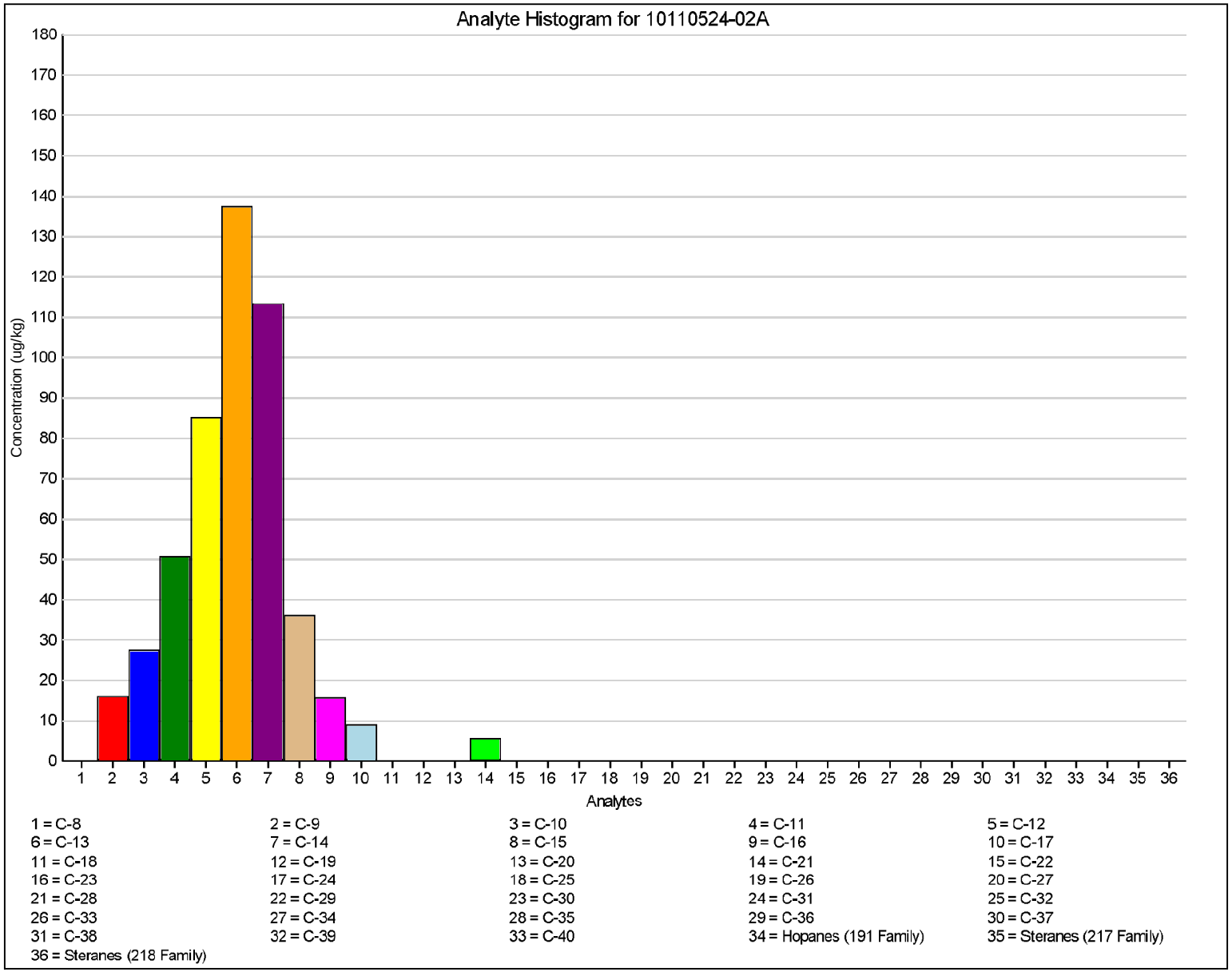
10110524-01

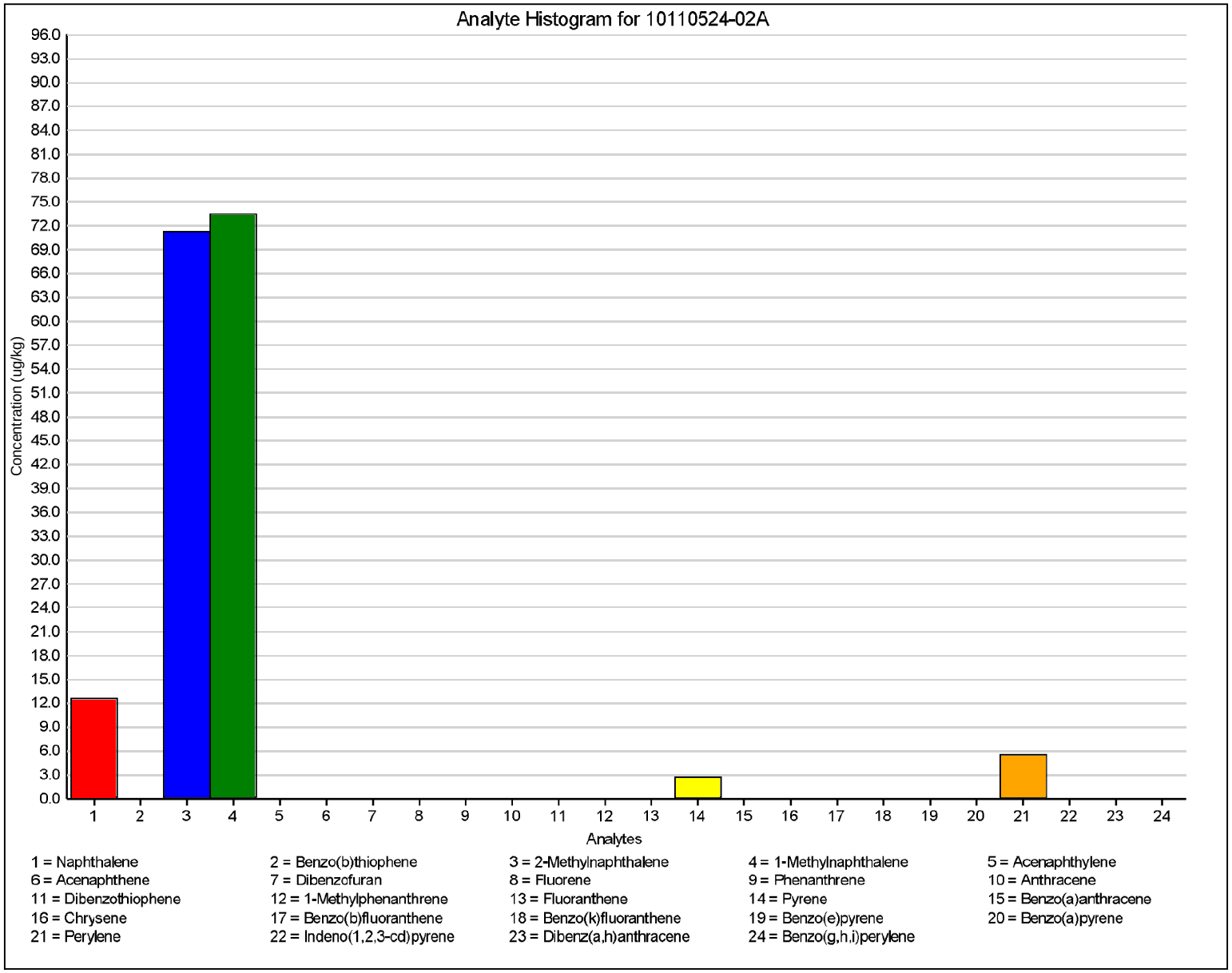

Analyte Histogram for 10110524-01A
Concentration (ug/kg)
640
620
600
580
560
540
520
500
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
Analytes
1 = C-8
2 = C-9
3 = C-10
4 = C-11
5 = C-12
6 = C-13
7 = C-14
8 = C-15
9 = C-16
10 = C-17
11 = C-18
12 = C-19
13 = C-20
14 = C-21
15 = C-22
16 = C-23
17 = C-24
18 = C-25
19 = C-26
20 = C-27
21 = C-28
22 = C-29
23 = C-30
24 = C-31
25 = C-32
26 = C-33
27 = C-34
28 = C-35
29 = C-36
30 = C-37
31 = C-38
32 = C-39
33 = C-40
34 = Hopanes (191 Family)
35 = Steranes (217 Family)
36 = Steranes (218 Family)

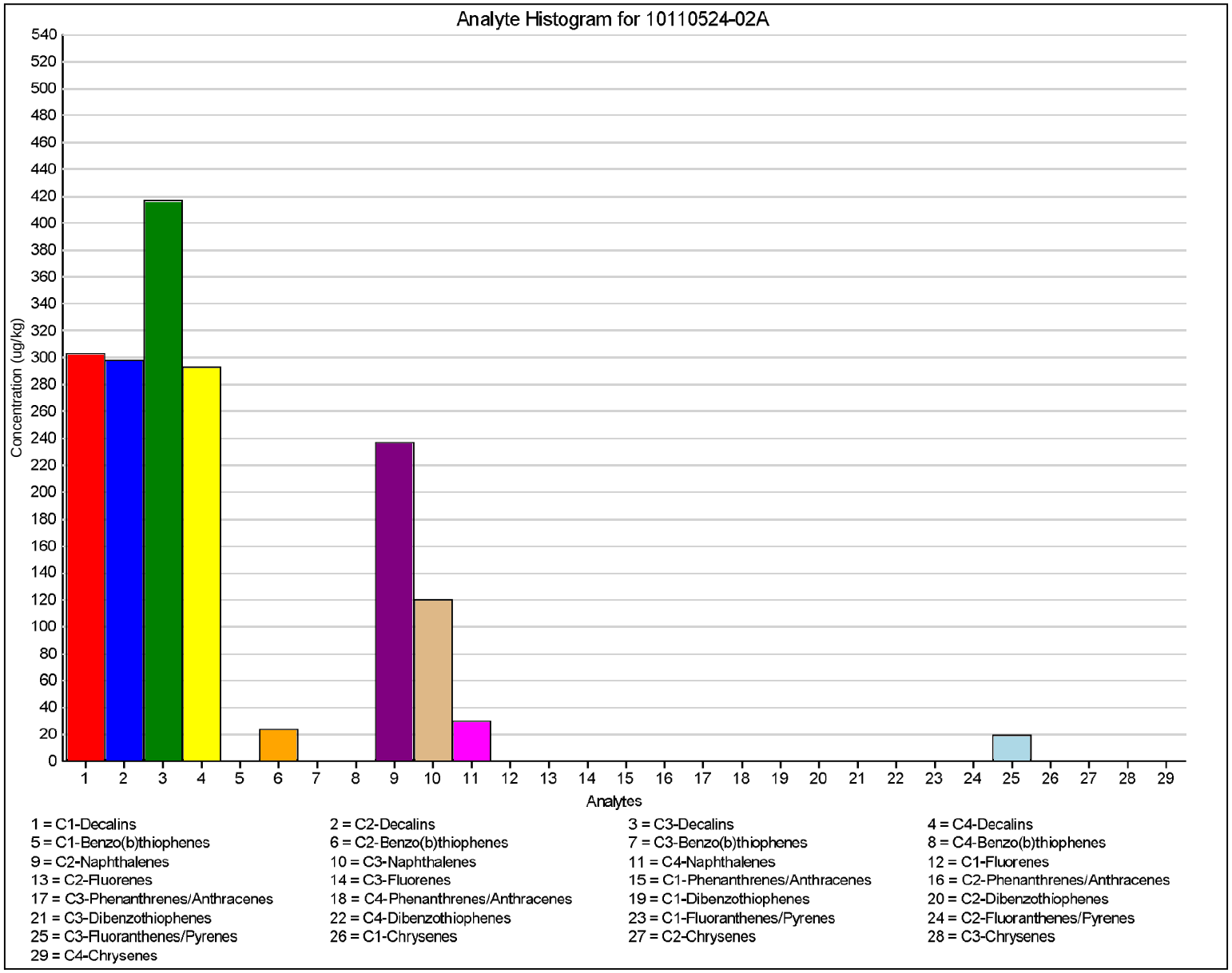

Analyte Histogram for 10110524-01A
Concentration (ug/kg)
1320
1280
1240
1200
1160
1120
1080
1040
1000
960
920
880
840
800
760
720
680
640
600
560
520
480
440
400
360
320
280
240
200
160
120
80
40
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Analytes
1 = Naphthalene
2 = Benzo(b)thiophene
3 = 2-Methylnaphthalene
4 = 1-Methylnaphthalene
5 = Acenaphthylene
6 = Acenaphthene
7 = Dibenzofuran
8 = Fluorene
9 = Phenanthrene
10 = Anthracene
11 = Dibenzothiophene
12 = 1-Methylphenanthrene
13 = Fluoranthene
14 = Pyrene
15 = Benzo(a)anthracene
16 = Chrysene
17 = Benzo(b)fluoranthene
18 = Benzo(k)fluoranthene
19 = Benzo(e)pyrene
20 = Benzo(a)pyrene
21 = Perylene
22 = Indeno(1,2,3-cd)pyrene
23 = Dibenz(a,h)anthracene
24 = Benzo(g,h,i)perylene


Analyte Histogram for 10110524-01A
Concentration (ug/kg)
3200
3100
3000
2900
2800
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Analytes
1 = C1-Decalins
2 = C2-Decalins
3 = C3-Decalins
4 = C4-Decalins
5 = C1-Benzo(b)thiophenes
6 = C2-Benzo(b)thiophenes
7 = C3-Benzo(b)thiophenes
8 = C4-Benzo(b)thiophenes
9 = C2-Naphthalenes
10 = C3-Naphthalenes
11 = C4-Naphthalenes
12 = C1-Fluorenes
13 = C2-Fluorenes
14 = C3-Fluorenes
15 = C1-Phenanthrenes/Anthracenes
16 = C2-Phenanthrenes/Anthracenes
17 = C3-Phenanthrenes/Anthracenes
18 = C4-Phenanthrenes/Anthracenes
19 = C1-Dibenzothiophenes
20 = C2-Dibenzothiophenes
21 = C3-Dibenzothiophenes
22 = C4-Dibenzothiophenes
23 = C1-Fluoranthenes/Pyrenes
24 = C2-Fluoranthenes/Pyrenes
25 = C3-Fluoranthenes/Pyrenes
26 = C1-Chrysenes
27 = C2-Chrysenes
28 = C3-Chrysenes
29 = C4-Chrysenes

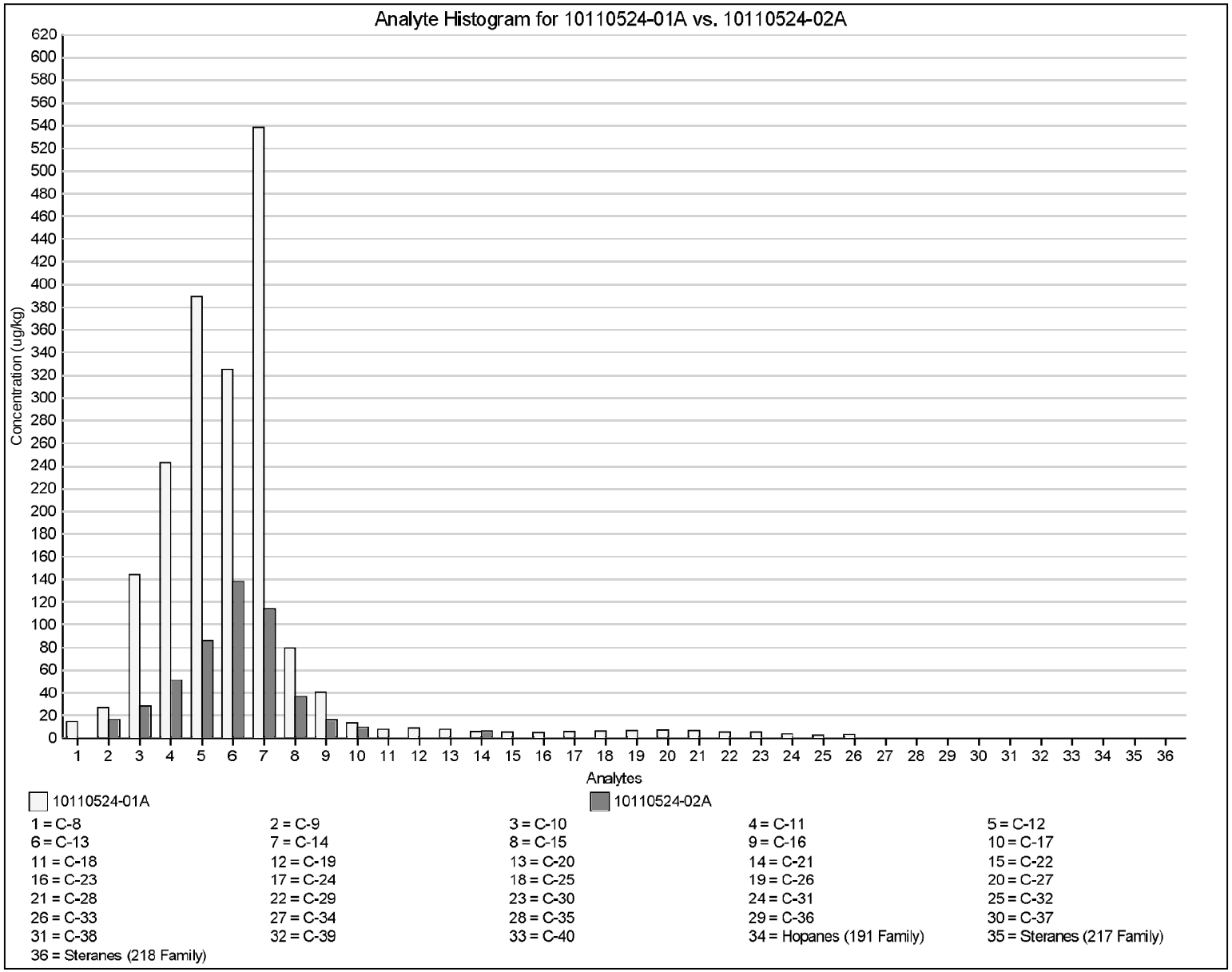
10110524-02

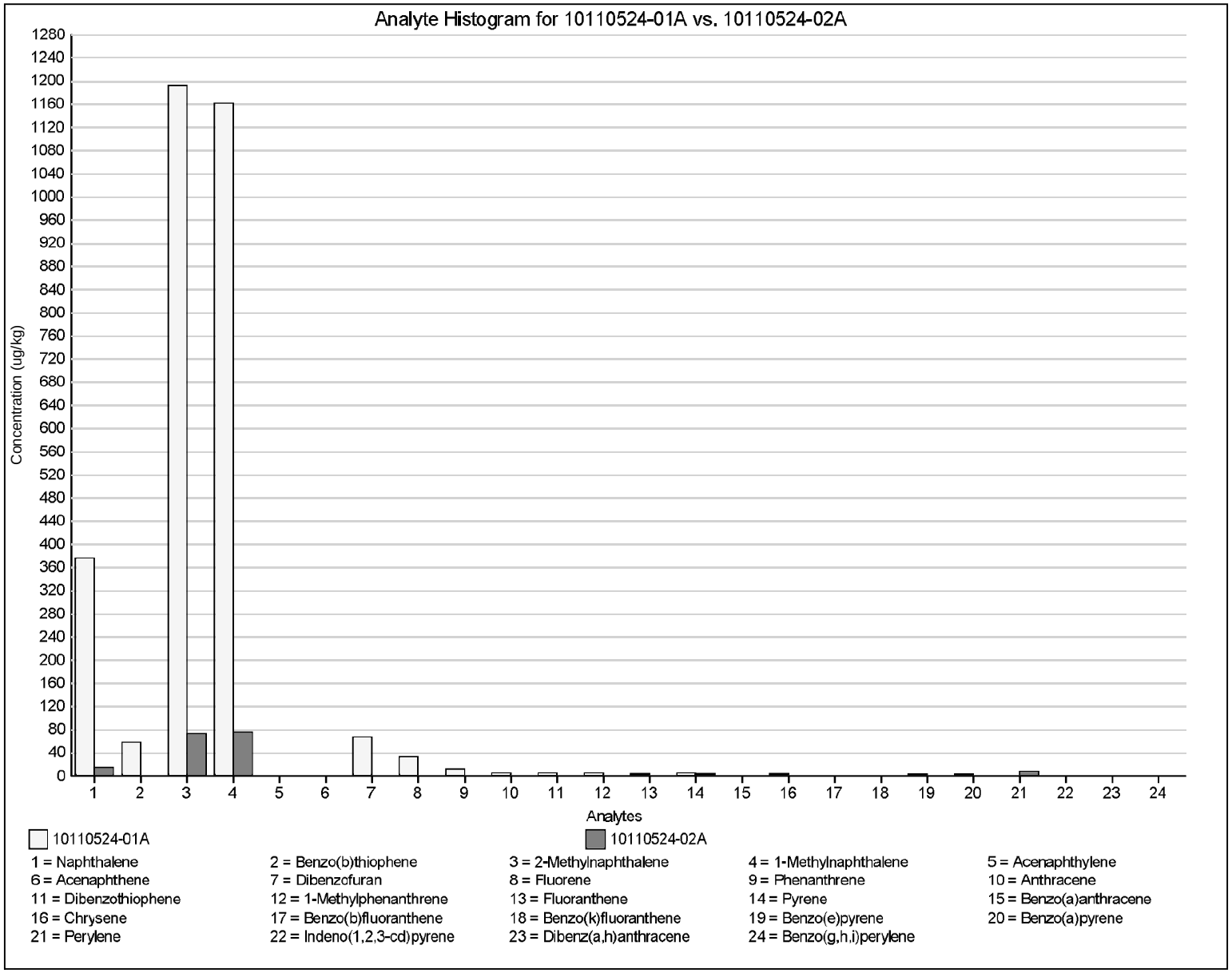

Analyte Histogram for 10110524-02A
Concentration (ug/kg)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
Analytes
1 = C-8
2 = C-9
3 = C-10
4 = C-11
5 = C-12
6 = C-13
7 = C-14
8 = C-15
9 = C-16
10 = C-17
11 = C-18
12 = C-19
13 = C-20
14 = C-21
15 = C-22
16 = C-23
17 = C-24
18 = C-25
19 = C-26
20 = C-27
21 = C-28
22 = C-29
23 = C-30
24 = C-31
25 = C-32
26 = C-33
27 = C-34
28 = C-35
29 = C-36
30 = C-37
31 = C-38
32 = C-39
33 = C-40
34 = Hopanes (191 Family)
35 = Steranes (217 Family)
36 = Steranes (218 Family)

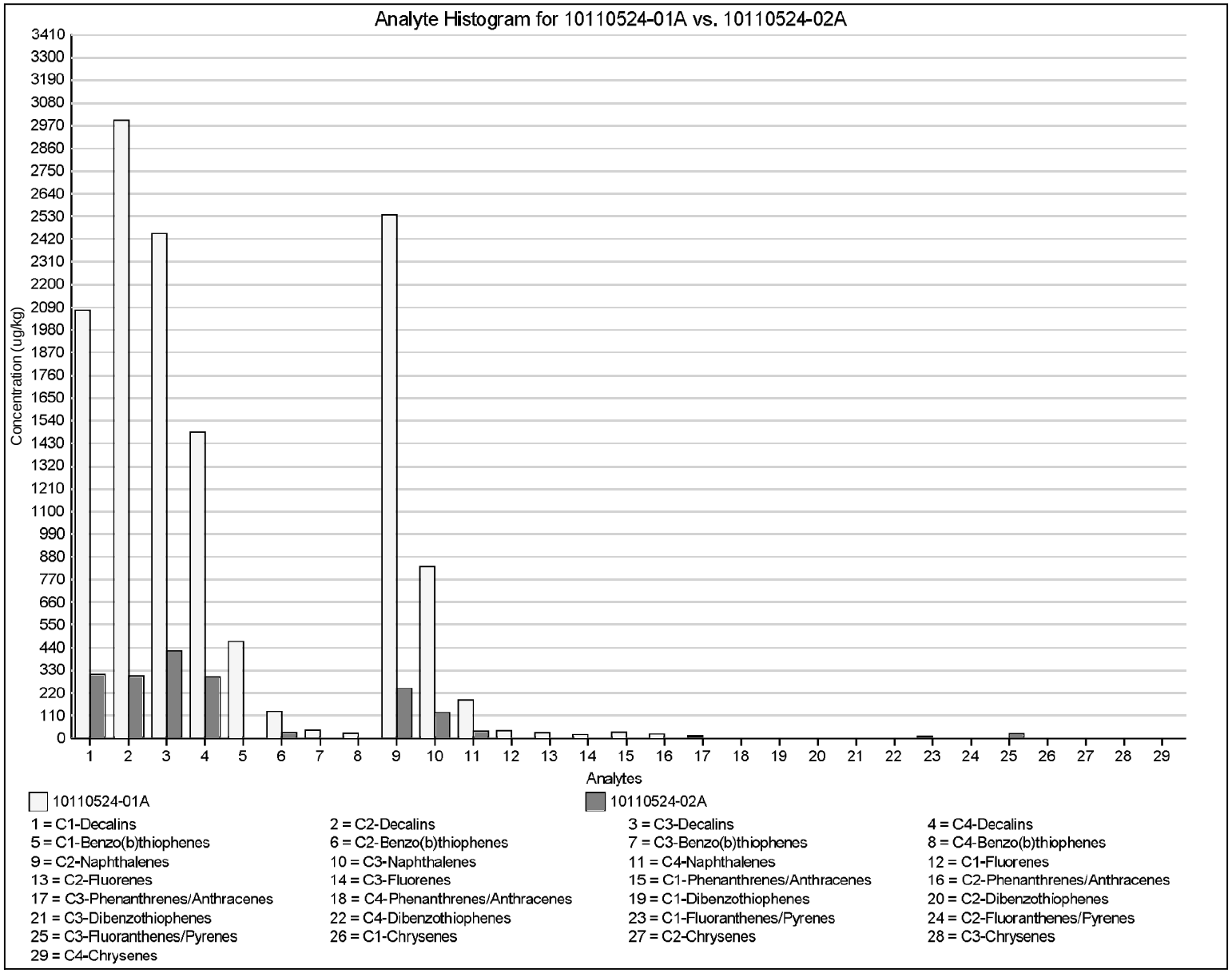

Analyte Histogram for 10110524-02A
Concentration (ug/kg)
96.0
93.0
90.0
87.0
84.0
81.0
78.0
75.0
72.0
69.0
66.0
63.0
60.0
57.0
54.0
51.0
48.0
45.0
42.0
39.0
36.0
33.0
30.0
27.0
24.0
21.0
18.0
15.0
12.0
9.0
6.0
3.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Analytes
1 = Naphthalene
2 = Benzo(b)thiophene
3 = 2-Methylnaphthalene
4 = 1-Methylnaphthalene
5 = Acenaphthylene
6 = Acenaphthene
7 = Dibenzofuran
8 = Fluorene
9 = Phenanthrene
10 = Anthracene
11 = Dibenzothiophene
12 = 1-Methylphenanthrene
13 = Fluoranthene
14 = Pyrene
15 = Benzo(a)anthracene
16 = Chrysene
17 = Benzo(b)fluoranthene
18 = Benzo(k)fluoranthene
19 = Benzo(e)pyrene
20 = Benzo(a)pyrene
21 = Perylene
22 = Indeno(1,2,3-cd)pyrene
23 = Dibenz(a,h)anthracene
24 = Benzo(g,h,i)perylene


Analyte Histogram for 10110524-02A
Concentration (ug/kg)
Analytes
1 = C1-Decalins
2 = C2-Decalins
3 = C3-Decalins
4 = C4-Decalins
5 = C1-Benzo(b)thiophenes
6 = C2-Benzo(b)thiophenes
7 = C3-Benzo(b)thiophenes
8 = C4-Benzo(b)thiophenes
9 = C2-Naphthalenes
10 = C3-Naphthalenes
11 = C4-Naphthalenes
12 = C1-Fluorenes
13 = C2-Fluorenes
14 = C3-Fluorenes
15 = C1-Phenanthrenes/Anthracenes
16 = C2-Phenanthrenes/Anthracenes
17 = C3-Phenanthrenes/Anthracenes
18 = C4-Phenanthrenes/Anthracenes
19 = C1-Dibenzothiophenes
20 = C2-Dibenzothiophenes
21 = C3-Dibenzothiophenes
22 = C4-Dibenzothiophenes
23 = C1-Fluoranthenes/Pyrenes
24 = C2-Fluoranthenes/Pyrenes
25 = C3-Fluoranthenes/Pyrenes
26 = C1-Chrysenes
27 = C2-Chrysenes
28 = C3-Chrysenes
29 = C4-Chrysenes

10110524-01 vs 10110524-02


Analyte Histogram for 10110524-01A vs. 10110524-02A
Concentration (ug/kg)
620
600
580
560
540
520
500
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
Analytes
10110524-01A
10110524-02A
1 = C-8
2 = C-9
3 = C-10
4 = C-11
5 = C-12
6 = C-13
7 = C-14
8 = C-15
9 = C-16
10 = C-17
11 = C-18
12 = C-19
13 = C-20
14 = C-21
15 = C-22
16 = C-23
17 = C-24
18 = C-25
19 = C-26
20 = C-27
21 = C-28
22 = C-29
23 = C-30
24 = C-31
25 = C-32
26 = C-33
27 = C-34
28 = C-35
29 = C-36
30 = C-37
31 = C-38
32 = C-39
33 = C-40
34 = Hopanes (191 Family)
35 = Steranes (217 Family)
36 = Steranes (218 Family)


Analyte Histogram for 10110524-01A vs. 10110524-02A
Concentration (ug/kg)
1280
1240
1200
1160
1120
1080
1040
1000
960
920
880
840
800
760
720
680
640
600
560
520
480
440
400
360
320
280
240
200
160
120
80
40
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Analytes
10110524-01A
10110524-02A
1 = Naphthalene
2 = Benzo(b)thiophene
3 = 2-Methylnaphthalene
4 = 1-Methylnaphthalene
5 = Acenaphthylene
6 = Acenaphthene
7 = Dibenzofuran
8 = Fluorene
9 = Phenanthrene
10 = Anthracene
11 = Dibenzothiophene
12 = 1-Methylphenanthrene
13 = Fluoranthene
14 = Pyrene
15 = Benzo(a)anthracene
16 = Chrysene
17 = Benzo(b)fluoranthene
18 = Benzo(k)fluoranthene
19 = Benzo(e)pyrene
20 = Benzo(a)pyrene
21 = Perylene
22 = Indeno(1,2,3-cd)pyrene
23 = Dibenz(a,h)anthracene
24 = Benzo(g,h,i)perylene


Analyte Histogram for 10110524-01A vs. 10110524-02A
Concentration (ug/kg)
3410
3300
3190
3080
2970
2860
2750
2640
2530
2420
2310
2200
2090
1980
1870
1760
1650
1540
1430
1320
1210
1100
990
880
770
660
550
440
330
220
110
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Analytes
10110524-01A
10110524-02A
1 = C1-Decalins
2 = C2-Decalins
3 = C3-Decalins
4 = C4-Decalins
5 = C1-Benzo(b)thiophenes
6 = C2-Benzo(b)thiophenes
7 = C3-Benzo(b)thiophenes
8 = C4-Benzo(b)thiophenes
9 = C2-Naphthalenes
10 = C3-Naphthalenes
11 = C4-Naphthalenes
12 = C1-Fluorenes
13 = C2-Fluorenes
14 = C3-Fluorenes
15 = C1-Phenanthrenes/Anthracenes
16 = C2-Phenanthrenes/Anthracenes
17 = C3-Phenanthrenes/Anthracenes
18 = C4-Phenanthrenes/Anthracenes
19 = C1-Dibenzothiophenes
20 = C2-Dibenzothiophenes
21 = C3-Dibenzothiophenes
22 = C4-Dibenzothiophenes
23 = C1-Fluoranthenes/Pyrenes
24 = C2-Fluoranthenes/Pyrenes
25 = C3-Fluoranthenes/Pyrenes
26 = C1-Chrysenes
27 = C2-Chrysenes
28 = C3-Chrysenes
29 = C4-Chrysenes

Reference Work Plan Attachment:

Fuel Tank Farm bioremediation work plan, Former Loring Air Force Base, Limestone

Gail Lipfert, Certified Geologist, GE506
Division of Technical Services
Bureau of Remediation and Waste Management
Department of Environmental Protection

September 13, 2010
Project Manager: Naji Akladiss
Consultants: Dan Burdette, 3 Tier Technologies; Jeff Stainfield, OES
Air Force: David Strainge
CC: Rob Peale, Bruce Hunter, Troy Smith

Introduction:
The goal of this project is to test the applicability of a bioremediation humic-acid product (SoilRx) in cleaning up petroleum-contaminated soils in a less energy-intensive, less expensive manner than excavation and landspreading. Soil at the Fuel Tank Farm (FTF) will be analyzed for PID headspace, GRO, DRO, VPH, and EPH and with an oleophilic dye shaker test. The soil will be sampled, treated with the SoilRx, allowed to act upon the petroleum contamination, and then soil sampling will be repeated. The soil sample data will be used to monitor the progress of the humic acid product and assess the success of the product to remediate the soil without resorting to excavation methods.

Background information:
The FTF was constructed in the early 1950s for bulk storage of the fuels used at Loring AFB. Originally, the FTF consisted of three large above ground storage tanks (ASTs), but by the late 1950s, two additional large ASTs were added to address the need for increased fuel requirements. The tanks were primarily used to store jet propulsion fuel No. 4 (JP-4) and No. 2 heating oil, but occasionally also contained motor gasoline and aviation gasoline.

Fuel at the site was transported from the tanks through aboveground piping to the pumphouse and was distributed from the pumphouse through underground piping to the end users. Each storage tank is surrounded by a separate earthen berm that is capped with asphalt and a crushed stone surface. Stormwater runoff from within the bermed areas flowed through drains to an oil/water separator. Petroleum product that accumulated in the separator was manually removed and the aqueous portion flowed via underground piping to a settling pond located on the site.

The FTF site also included several support buildings of masonry construction and a rail siding along the northern portion of the site. Numerous fuel spills and leaks from piping and fueling operations reportedly occurred at the FTF site over a period of approximately 50 years of operation. Fuel-related soil contamination occurred in the area of the ASTs and pumphouse.

Two bioventing/bioslurping remedial systems operated from 1996 to 2005 with limited success. During 2006-2007 more than 29,000 cubic yards of soil adjacent to the tanks were excavated, landspread, remediated, and replaced (URS, 2008). However, at the end of these activities, petroleum-contaminated soil was discovered outside the delineated areas. Test pits and soil borings revealed petroleum contamination in soil along a water line that supported fire-suppression structures (URS

2010). The test pits and soil borings have adequately delineated the areas of greatest soil contamination that require extraction or remediation.

The goal:
The ultimate goal is to remediate the soil and groundwater at the FTF site with a more environmentally-friendly (greener) and less expensive method than landspreading. The purpose of this project is to conduct a pilot test to explore new advances in anaerobic bioremediation of petroleum hydrocarbons. FTF is an ideal location for this type of experiment as there are no receptors and the contamination with the subsurface has already been delineated (URS 2009). We intend to test the ability of SoilRx, an activated humic acid microbial product developed by 3 Tier Technologies, to penetrate the tight till deposits and enhance the biodegradation of the petroleum contamination.

The ROD requires that PID headspace readings of soil at the FTF site be less than 500 ppm. An additional goal is to compare various analytical methods for measuring petroleum contamination in soils. Because we wish to evaluate this method for other sites that use different analytical data, we will analyze for VPH, EPH, and PID headspace and perform oleophilic dye shake test for collocated samples.

The Conceptual Site Model
Soil borings and test pits up to 12 feet in depth reveal reworked glacial till (sandy, gravely, clayey silt) overlying dense to very dense glacial till. Small lenses or layers of silty sand and gravel were observed occasionally at various depths. The water line which was buried approximately seven feet deep, follows the inside edge of an asphalt-paved road that bounds the two largest tanks, but outside the berm. The gravel and sand beds of the road and water line probably provided access routes for the transport of the petroleum during releases. The reworked till and lenses coarser materials within the till are other likely avenues for petroleum dispersal.

Perched water was observed during test-pit activities (URS 2009) at depths varying from 4 to 6.5 feet below ground surface. The water table for this perched water was probably seven ft bgs during the September 2008 test pitting.

Petroleum releases from the fuel tanks and associated pipelines followed preferential pathways of more permeable materials within the soils and till at this site. These pathways are associated with the fire-suppression water lines and roadbeds, construction-related disturbances within overburden, and naturally-occurring coarser deposits.

PID headspace analysis has revealed the areas of soil that exceeds the cleanup goal of 500 ppm, but because we are also assessing the usefulness of SoilRx at other sites, we will be analyzing the soil for VPH, EPH, and oleophilic dye shake tests.

Data Quality Objectives (DQOs):
The DQOs are to obtain data useful for:

- assessing the ability of this activated-humic acid microbial bioremediation product (SoilRx) to enhance bioremediation of petroleum-contaminated soil
- determining whether soil cleanup goals have been reached at the FTF site
- assessing the potential effectiveness of SoilRx and this method at remediating petroleum-contaminated soil at other sites.

Methodology:
The humic-acid product SoilRx will be injected into soil borings within a pilot test plot. A round of soil samples will be collected prior to product application and afterwards when weather conditions allow for soil boring activities. Nonparametric comparison tests will be conducted on the prior and subsequent sampling data to assess differences in median values.

A pilot study area and a control area, both approximately 50 x 50 foot, have been selected to test the humic-acid product (Figure 1). Nine soil borings will be completed within each area according to the plan in Figure 2. MEDEP staff will mark the sample locations with pin flags on which will be indicated the sample location ID. OES will be responsible for extracting soil samples from the subsurface with a contracted direct-push drill rig employing a sleeved soil sampling probe according to MEDEP SOP DR#006 (Appendix A). MEDEP geologists will record descriptions of the overburden material. Equipment decontamination will be conducted between samples and between borings according to MEDEP SOP RMW-DR-017 (Appendix A). Field documentation will be recorded and subsequent trip reports will be written according to MEDEP SOP RWM-DR-013 (Appendix A). MEDEP will measure UTM coordinates of all the borings using a GPS.

Within each of the eighteen borings, four soil samples will be collected at one-foot depth intervals, from 2-3', 5-6', 8-9', and 11-12' below ground surface. A 20 mL PID headspace soil sample will be obtained by combining four 5mL subsamples across the one-foot interval and measured by following the updated MEDEP SOP TS004 (Appendix A). A collocated sample will be obtained from the 5-6' interval (or the interval with the greatest expected contamination) of each boring and analyzed for VPH/EPH and oleophilic dye test MEDEP SOP TS005 (Appendix A). The VPH/EPH samples will be stored on ice until delivery to the Maine HETL lab. Two duplicate VPH/EPH and oleophilic dye shaker test samples will be collected in the field and analyzed. One trip blank and one equipment blank will be obtained on site. Standard duplicate, blank, and spike samples will be analyzed for in the lab for the VPH and EPH analyses. Chains of custody will be maintained according to MEDEP SOP RWM-DR-012 (Appendix A).

After the 18 borings are completed, screened 1.5 inch PVC pipe will be inserted to 12 feet within each boring so that the holes will remain open for the injection of the humic-acid product. The PCV piping from nine borings within the pilot study will be connected to three 275-gallon totes (three holes per tote). The borings that are connected to each tote will be grouped according to expected hydraulic properties based on boring logs. The objective is to apply one gallon of product (diluted 1:10 with water) per cubic yard of contaminated soil. At the pilot test area, 90 gallons of SoilRx will be administered to approximately 925 cubic yards of material by diluting the product in the totes and injecting it into the network of interconnected borings by gravity feed. At the control area, an equal amount of product-free water will be injected by gravity feed during the same time period in the same manner, but all nine borings will be connected to a single 275-gallon tote that will need to be replenished.

A second round of samples will be collected after injection of the product in the same manner as the first round, but from a set of samples at randomly-selected locations within each area and at least two feet from the initial borings. The timing of the second round will be determined after assessing how quickly the liquid product drains into the holes and will likely be constrained by weather conditions.

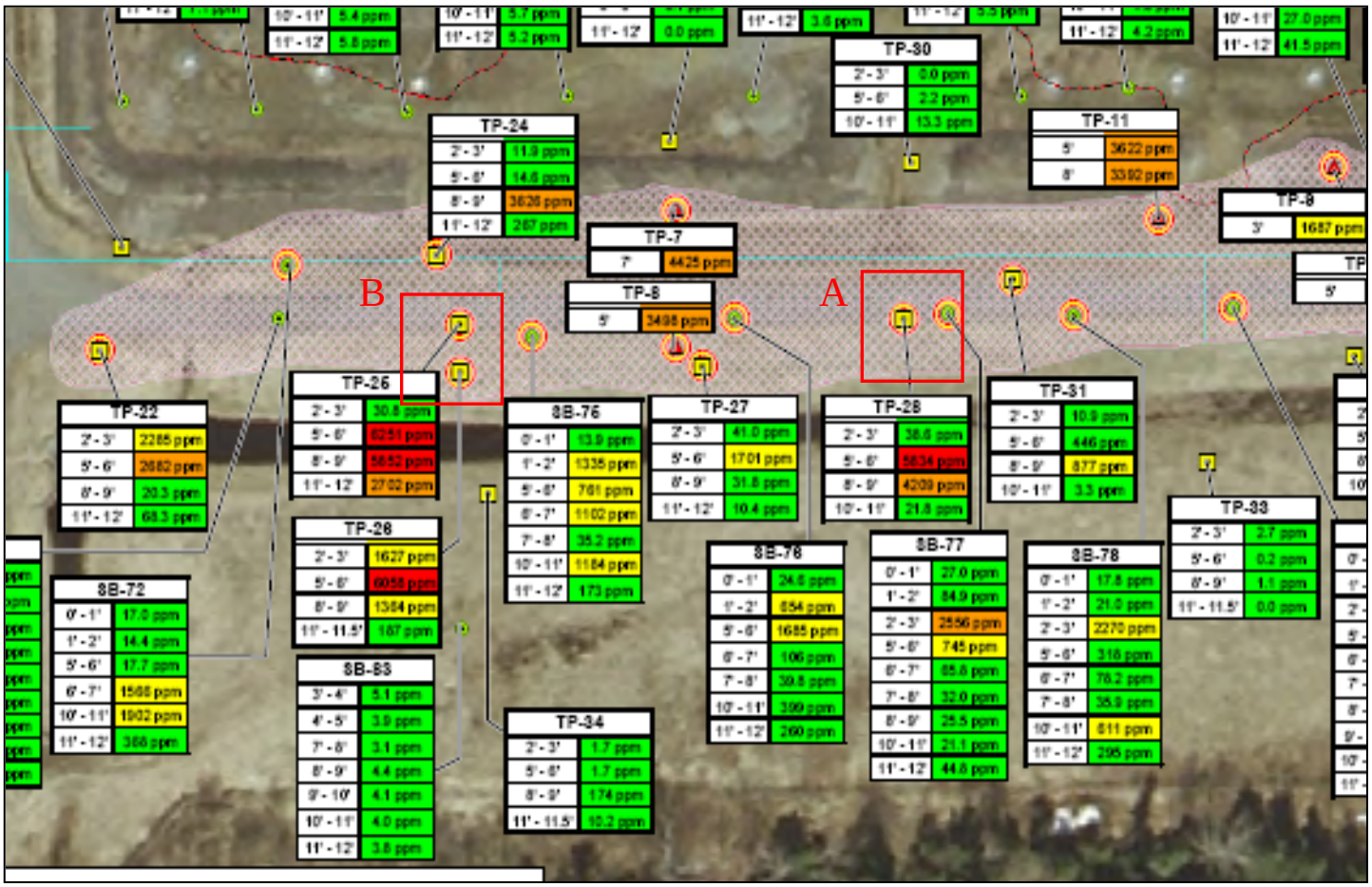
Responsibilities:
MEDEP: Location and GPS measurement of soil borings, soil description, two rounds of PID sampling and analysis, VPH/EPH sample collection, and oleophilic dye shaker tests.

3 Tier Technologies/OES: drilling soil borings, collection of subsurface soil for sampling, decontamination of equipment in between samples, construction of injection piping, injection of product.

Health and Safety:
Attachment B is the standard MEDEP Health and Safety Plan form which addresses site health and safety issues for this sampling event. The drilling contractor will supplement this information with details specific to the drill rig to be employed.

References:
URS, May 2008, Construction completion report fuel tank farm soil remediation, Former Loring Air Force Base, Limestone, Maine

URS, April 2010, Report of 2009 Additional test pit delineation activities at the fuel tank farm site and near former nose dock 8748, Former Loring Air Force Base, Limestone, Maine.



3 Tier Technologies LLC
250 National Place, Suite 142, Longwood, FL 32750
dburdette@3tiertech.com, Phone: 877-226-7498