Metcalf & Eddy
3740 Executive Way, Miramar, Florida 33025
T 954.450.7770 F 954.450.5100 www.m-e.com

April 17, 2006

Mr. David Phillips

State of Florida
Department of Environmental Protection
Site Investigation Section, MS 4515
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Site Investigation Report
Key Largo Hammock Botanical State Park
P.O. Box 487
Key Largo, Monroe County, Florida
Site Number 40SL

Dear Mr. Phillips:

This letter presents the results of the Site Investigation (SI) conducted at Key Largo Hammock Botanical State Park in Key Largo, Monroe County, Florida (**Figure 1**). The SI field tasks were based on the findings and recommendations of the Expanded Preliminary Site Investigation Report (PSIR) submitted to the Florida Department of Environmental Protection (FDEP) in November 2005 by Metcalf & Eddy, Inc. (M&E). The expanded PSI was conducted over three site visits on May 3, July 20, and September 27, 2005, and the SI was conducted on March 14, 2006.

Project background

The state park is located on a portion of the former Key Largo Air Force Station (FDEP Facility ID# 449200815). In 2003, M&E submitted a Site Reconnaissance Report (SRR) to the FDEP which listed two areas of concern (AOC):

- **AOC 1: Former Underground Storage Tanks (USTs)**
- **AOC 2: Former Skeet Range**

AOC 1 included two former USTs (one 8,000 gallon and one 500 gallon) and the SRR recommended additional research to confirm the locations. M&E obtained tank removal records from the Monroe County Department of Health. These records showed only one tank, initially thought to be 8000 gallons but, after removal, determined to be 500 gallons. During the first on-site meeting on May 3, 2005 to confirm sampling locations, Mr. Jim Duquesnel, the park biologist, reported that the UST area is on a portion of the former air force station not part of the current state park. The UST area was at the former missile launch site of Key Largo Air Force Station, located approximately one mile south of the current park location (**Figure 1**). According to Monroe County property records, this parcel is still owned by the United States Government.

The soil and groundwater samples targeting AOC 1, the former UST, were dropped from the scope of work at that time.

AOC 2, the former skeet range, is located in a northeast to southwest oriented clearing bordered by mangroves to the north and west. A golf course (Ocean Reef Club) is located approximately 500 feet to the east. During the first PSI visit, Mr. Duquesnel identified the former skeet range area and access road. The firing area was also located in the central portion of the clearing. The original scope of work for AOC 2 called for three paired samples consisting of a vadose zone soil sample and groundwater sample collected via direct push. Due to current efforts to allow natural vegetation to reclaim these areas, Mr. Duquesnel declined to allow the truck-mounted, direct-push drill rig to access these areas. Sampling equipment was limited to gear that could be carried to the sampling locations. Depth to bedrock was less than 1 foot throughout the former skeet range and temporary monitoring wells could not be advanced using the available equipment. Consequently, only soil samples were collected at that time.

Based on the proximity of the mangroves within 100 feet of the firing area and the apparent direction of firing, there was a possibility of lead shot across the skeet firing range to the northwest and in the mangroves. Therefore, after the May 3 site visit, the scope of work was expanded to include additional characterization in the former skeet range and adjacent mangrove area.

During the second site visit on July 20, 2005, M&E sampled soil and sediment at additional locations within AOC 2. After leaving the former skeet range, park personnel identified an area of stressed or absent vegetation near the former helipad. This area has been designated AOC 3, the former helipad area, and is located within the former missile tracking station (**Figure 1**)**.** M&E conducted soil sampling at this location during the third and final PSI site visit on September 27, 2005.

On March 14, 2006, M&E again sampled AOC 2 and AOC 3 for completion of this Site Investigation Report. The SI scope of work is detailed in the following section.

Sampling program

The section summarizes the field sampling program conducted at the Key Largo Hammock Botanical State Park. Soil and sediment samples were collected from land surface to approximately 0.5 feet below land surface (bls) with a stainless steel hand auger in accordance with DEP-SOP-001/01 FS 3000 (soil).

M&E conducted a quality control review of the laboratory data and confirmed those analyses were performed in accordance with NELAC standards. Blank/blank spike recoveries were within control limits. Matrix spike/matrix spike duplicates were within control limits. Samples were analyzed within required holding times. Method detection levels were less than regulated groundwater cleanup target levels with the exception of the polynuclear aromatic hydrocarbon (PAH) analysis of the sample from SB005. Due to overall high concentrations of PAHs in this sample it was diluted, resulting in a detection limit for benzo(b)fluoranthene of 2,510 micrograms per kilogram (µg/kg), greater than the residential direct exposure limit of 1,000 µg/kg.

AOC 1 Former USTs

No sampling was conducted at this AOC since it was determined that the former UST site is located outside of current park boundaries.

AOC 2 Former Skeet Range

The AOC 2 former skeet range sample locations are described in the table below. **Figure 2** is an aerial photograph of the former skeet range showing the sampling locations.

AOC 2 FORMER SKEET RANGE SAMPLING LOCATIONS

Sample ID	*Rationale*	*Analytical Parameters*
5/3/2005 (PSI – Visit #1)		
SB001	Firing point to assess potential for black powder residues	Lead, arsenic, antimony
SB002	West range to assess potential metals contamination	
SB003	North range to assess potential metals contamination	
7/20/2005 (PSI – Visit #2)		
SB004 & SB005	Samples of skeet range soils to test for lead mobility and the potential for PAHs from clay targets	SPLP lead and PAHs
SB006 & SB007	Background soil samples to assess background arsenic levels	Arsenic
SED-1, 2 & 3	Sediment samples to assess potential for lead shot in mangrove area	Lead, arsenic, antimony
3/14/06 (SI)		
SB012	Samples to assess southwestern extent of AOC	PAHs, arsenic, lead
SB013	Samples to assess southern extent of AOC	arsenic, lead
SB014, 015 & 016	Samples to assess eastern and northeastern extent of AOC	PAHs, arsenic, lead
SED-4	Samples to characterize sediments in the area between SED-1 and SED-3	PAHs, arsenic, lead, antimony, SPLP lead & SPLP arsenic
SED-5, 6, 7 & 8	Samples to assess northwest and western extent of AOC within mangrove area	PAHs, arsenic, lead

During the first PSI visit in May 2005, soil samples SB001, SB002 and SB003 were screened in the field for hydrocarbon vapors with an organic vapor analyzer (OVA). At each location, two 16-ounce glass jars were half-filled with soil and allowed to equilibrate for approximately five minutes. The headspace in the first jar was analyzed with an OVA equipped with a flame ionization detector (FID). If organic vapors are detected in the first jar, sampling procedures call for the headspace in the second jar to be screened for naturally-occurring methane gas with the OVA/FID equipped with an activated carbon filter. However, no detectable concentrations of organic vapors were found in any of the soil samples and the second screening with the activated carbon filter was not necessary. The OVA/FID was calibrated prior to screening using methane gas at 100 parts per million (ppm). The calibration was verified upon completion of

field screening. After screening, the samples were placed in the appropriate containers and submitted to a state-certified, fixed-base laboratory (Severn Trent Laboratories, Inc.) for analysis. SB001 was collected from the firing point area as indicated by Mr. Duquesnel, and SB002 and SB003 were collected from the western and northern areas of the shooting range, respectively. The soil samples were analyzed for lead, arsenic and antimony.

For the second PSI visit in July 2005, shooting range sampling locations (SB004 and SB005) were chosen in areas with visible debris from shattered clay targets to determine the presence and level of PAH contamination. SB004 and SB005 were also analyzed for lead via synthetic precipitate leaching procedure (SPLP) to assess the potential for metals leaching to groundwater. No discrete shot pellets were visible in these areas and the depth to water was approximately 0.5 feet bls. Soil samples (SB006 and SB007) were then collected from an area east of the former skeet range for analysis of arsenic. These samples were collected to verify that arsenic concentrations within the shooting range were associated with lead shot and not background levels. Lastly, M&E collected three sediment samples (SED-1, SED-2 and SED-3) for analyses of lead, arsenic and antimony to determine the presence and level of lead shot contamination in the mangrove area. The samples were considered to be sediment, as opposed to soil, because the mangrove area was entirely saturated during sampling and assumed to be underwater after heavy rains or high tide.

The recent SI sampling was conducted on March 14, 2006 to better delineate the aerial extent of both PAH and lead shot contamination at AOC 2. Soil samples SB012 through SB016 were collected to delineate contamination along the southern and eastern portions of the shooting range. All soil samples were analyzed for arsenic and lead and all but SB013 were analyzed for PAHs. Sediment samples SED-4 through SED-8 were then collected for delineation of the northern and western portions of AOC 2 within the mangroves. SED-4 was also analyzed for lead and arsenic via SPLP to assess the potential for lead and arsenic leaching from sediments to surface water. In addition, SED-4 was analyzed for antimony to compare mangrove area concentrations with skeet range concentrations.

AOC 3 Former Helipad Area

The AOC 3 former helipad area sample locations are shown on **Figure 3**. Soil samples SB008 through SB011 were collected approximately 10 feet apart along a northeast-southwest transect of the area of stressed vegetation during the final PSI visit in September 2005. The depth to water was approximately 0.5 feet bls. The samples were placed in the appropriate containers and submitted to a state-certified, fixed-base laboratory (Xenco Laboratories, Inc.) for analysis of semi-volatile organic compounds, chlorinated herbicides, organochlorine pesticides and RCRA metals.

For the March 2006 SI, M&E collected two soil samples (SB017 and SB018) from areas of normal vegetation adjacent to AOC 3, and compared them with two samples (SB019 and SB020) collected within AOC 3 itself. All samples were analyzed by A&L Southern Agricultural Laboratories (A&L) for analyses of soil nutrients including available phosphorus, soil pH and soluble salts. One sample from the normal area (SB018) and one sample from AOC 3 (SB020) were also analyzed by a toxicity bio-assay (TBA). For the TBA, radish and ryegrass seeds were planted in the soil samples and allowed to germinate. Toxicity of the soil was then determined by the percentage of seeds that exhibited some degree of growth.

Findings

The soil analytical results for AOC 2 are presented in **Table 1.** Soil analytical and nutrient testing results for AOC 3 are presented on **Tables 2 and 3**, respectively. The analytical results were compared with Florida soil cleanup target levels (SCTLs) (Chapter 62-777, Florida Administrative Code [F.A.C.]) based on residential and industrial direct exposure and leachability to groundwater to determine the relative environmental impact. The results from the sediment samples from the mangrove area were also compared to the standard for fresh and marine surface water leachability.

AOC 2 Former Skeet Range

During the first site visit, target metals were detected in each of the three soil samples collected at AOC 2 for metals analysis. Antimony was detected in two samples, SB002 and SB003, at 5.3 milligrams per kilogram (mg/kg) and 5.4 mg/kg respectively. These concentrations do not exceed any of the referenced SCTLs for antimony. Arsenic was detected in all three soil samples at concentrations ranging from 3.0 mg/kg in SB002 to 3.4 mg/kg in SB001. Concentrations in all three samples exceeded the residential direct exposure SCTL for arsenic of 2.1 mg/kg. Lead was also detected in all three soil samples at concentrations ranging from 2.5 mg/kg in SB001 to 405 mg/kg in SB003. Only SB003 contained lead in excess of the residential direct exposure SCTL for lead of 400 mg/kg.

During the second site visit, M&E completed four shallow soil borings: two in the former skeet range for analyses of SPLP lead and PAHs and two outside the former skeet range to provide data on background levels of total arsenic. M&E also completed three shallow borings in the mangrove area sediments for analyses of total lead, arsenic, and antimony. A summary of the second site visit results follows:

- The soil samples from the skeet range borings, SB004 and SB005, contained 4 micrograms per liter (µg/L) and 8 µg/L lead by SPLP, respectively. These concentrations are less than the groundwater cleanup target level (GCTL) for lead of 15 µg/L.

- SB004 and SB005 contained significant concentrations of PAHs, including acenaphthalene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene and pyrene. Benzo(a)pyrene was detected in both samples at concentrations exceeding the limits for residential direct exposure (100 µg/kg), industrial direct exposure (700 µg/kg) and leachability based on groundwater criteria (8,000 µg/kg). Sample SB005 also contained benzo(a)anthracene at 46,900 µg/kg (exceeding the industrial direct exposure limit of 7,000 µg/kg), and benzo(k)fluoranthene at 10,600 µg/kg (exceeding the residential direct exposure limit of 10,000 µg/kg. Sample SB004 also contained benzo(a)anthracene at 3,830 µg/kg (exceeding the residential direct exposure limit of 1,000 µg/kg and benzo(b)fluoranthene at 1,990 µg/kg (exceeding the residential direct exposure limit of 1,000 µg/kg.

- The soil samples from the background borings, SB006 and SB007, were both non-detect for arsenic.

- The three sediment samples (SED-1, SED-2 and SED-3) from the mangrove area were analyzed for total antimony, arsenic and lead. All three samples contained arsenic at concentrations greater than the residential direct exposure SCTL of 2.1 mg/kg. The sample SED-2 also contained 29.8 mg/kg antimony (exceeding the residential direct exposure limit of 27 mg/kg) and 2,610 mg/kg lead (exceeding the industrial direct exposure limit of 1,400 mg/kg).

For the SI, M&E collected five shallow soil samples (SB012 through SB016) in the former skeet range and collected five shallow sediment samples (SED-4 through SED-8) in the mangrove area. A summary of the SI results follows:

- Of the five soil samples collected, only SB016 contained lead and arsenic greater than respective residential or industrial direct exposure SCTLs. Specifically, arsenic was detected in SB016 at a concentration of 17.7 mg/kg, greater than the industrial SCTL of 12 mg/kg, and lead was detected at 6,960 mg/kg, greater than the industrial SCTL of 1,400 mg/kg.

- Of the four soil samples analyzed for PAHs, only SB012 contained significant concentrations. Specifically, benzo(a)pyrene was detected above the industrial SCTL at concentration of 821 µg/kg, and dibenz(a,h)anthracene was detected above the residential SCTL at a concentration of 155 µg/kg.

- Lead was detected in all five sediment samples at concentrations ranging from 899 mg/kg at SED-8, to 6,380 mg/kg at SED-6. All but the SED-8 sample contained lead in excess of the industrial direct exposure SCTL.

- Arsenic was detected in excess of the residential SCTL in four sediment samples (SED-4, SED-5, SED-7 and SED-8). Concentrations were similar in all four and ranged from 3.03 mg/kg to 4.94 mg/kg. Conversely, the arsenic concentration in SED-6 was 28.3 mg/kg, which exceeds the industrial SCTL of 12 mg/kg.

- Antimony was detected in SED-4 at a concentration of 88.3 mg/kg, exceeding the residential SCTL of 27 mg/kg.

- Lead and arsenic were not detected in the SPLP samples collected at SED-4.

- No PAHs were detected above respective SCTLs at SED-5, SED-6 or SED-7. Only one PAH compound was detected above SCTLs at SED-4 and SED-8. Specifically, benzo(a)pyrene was detected in SED-4 at a concentration of 747 µg/kg, above the industrial SCTL of 700 µg/kg. At SED-8, benzo(a)pyrene was detected at a concentration of 126 µg/kg, above the residential SCTL of 100 µg/kg.

AOC 3 Former Helipad Area

The soil samples (SB008 through SB011) from AOC 3, collected during the third PSI visit, were negative for all semi-volatile organic compounds (SVOCs), chlorinated herbicides, and organochlorine pesticides. Five RCRA metals were detected in the samples: arsenic, barium, chromium, and lead were detected in all four samples and selenium was detected in three of four samples. All metals concentrations were less than the SCTLs.

For the SI in March 2006, soil samples for AOC 3 were collected for nutrient and toxicity bio-assay testing. Two samples (SB017 and SB018) were collected in normal vegetated areas and two samples (SB019 and SB020) were collected within the area of stressed vegetation. A summary of the results follows:

- In general, organic matter, available phosphorus, magnesium, sodium, and sulfur are more abundant in the samples from unstressed areas, but not significantly.
- Soil pH and calcium are elevated in all samples.
- Estimated nitrogen release is elevated in all samples
- Seeds planted in samples from both stressed and unstressed areas exhibited equal growth percentages. The growth percentages for both samples were high (96% or greater) even without added charcoal.

Conclusions

AOC 2 Former Skeet Range

Based on results of the expanded PSI, M&E previously concluded that lead, arsenic and antimony contamination is due to the presence of lead shot within soils and sediments, and is not indicative of background levels. M&E also concluded that soil conditions within AOC 2 are not conducive to mobility of the metals into groundwater, and the PSI confirmed that clay target fragments are the source of PAH contamination in soils. Based on the new results of the SI, M&E adds the following conclusions:

- When compared with the previous results, the SI sampling indicates that the aerial extent of PAH contamination is well delineated and is primarily contained within the skeet range clearing. The highest PAH concentrations are in the central portion of the clearing (SB005) and generally decrease with distance from the firing area. The lateral extent of PAHs greater than SCTLs is depicted on **Figure 4**, along with a summary of sampling results.
- The extent of metals contamination below SCTLs is also well delineated for soil samples. Low concentrations were detected at the firing point (SB001) and at points surrounding the southern and eastern edges of the clearing (SB012 through SB015). The high concentrations of lead and arsenic to the north (SB016) verify that lead shot was fired in a predominantly northern and western direction from the firing point.

- The extent of metals contamination below SCTLs is not well defined for sediment samples. All sediment samples contain one or more metals in excess of SCTLs. However, the distribution indicates that shot was fired out over the mangroves to the northwest. The highest concentrations are seen in the area from SED-4 to SED-6, with a general decrease in metals concentrations to the south. The projected lateral extent of lead, arsenic and antimony concentrations greater than SCTLs is depicted on **Figure 5** along with a summary of sampling results.

- Similar to soils samples, lead and arsenic SPLP analyses indicate that conditions within the sediments are not conducive to metals leaching into fresh or marine surface water. The sediments within the mangrove area are organic and comprised predominantly of peat. Based on the SPLP data, it is possible that metals from the lead shot are being concentrated within the organic material and by the root systems of the mangroves.

AOC 3 Former Helipad Area

The PSI analytical results for soil samples from the area of stressed vegetation near the former helipad did not indicate concentrations of any analytes that might explain the absence of vegetation (metals, SVOCs, herbicides and pesticides were all below the laboratory detection levels or below SCTLs). Based on the PSI and the soil nutrient and toxicity testing conducted for the SI, M&E concludes that soil contamination is not the cause of stressed vegetation at AOC 3.

Recommendations

AOC 2 Former Skeet Range

Remediation of contaminated soils and sediments in AOC 2 would require vehicle access. However, park management is currently prohibiting vehicle access to allow natural revegetation of this area. Therefore, M&E recommends that the area be subject to an environmental use restriction as deemed appropriate by the FDEP.

AOC 3 Former Helipad Area

Laboratory analyses have verified that soil contamination and potential lingering toxic effects are not present at AOC 3. Therefore, M&E recommends no further action for the former helipad area.

If you have any questions or require additional information, please contact me at (954) 450-5125 or Guy Frearson at (954) 450-5144.

Sincerely,

Metcalf & Eddy, Inc.

Jeremy W. Turner, P.G.
Project Manager
PG License #: 2363
Date: 4/17/06

Guy Frearson
Senior Project Manager

Enc: Tables 1, 2 and 3
Figures 1, 2, 3, 4 and 5

TABLES

TABLE 1
AOC 2 FORMER SKEET RANGE
ANALYTICAL RESULTS

Sample ID:		SB001	SB002	SB003	SB004	SB005	SB006	SB007	SB012	SB013	SB014	SB015	SB016	SOIL CLEANUP TARGET LEVELS[a]			GCTL[b]
Sample Depth:		0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	Direct Exposure		Leachability	Groundwater
Sample Date:		3-May-05	3-May-05	3-May-05	20-Jul-05	20-Jul-05	20-Jul-05	20-Jul-05	14-Mar-06	14-Mar-06	14-Mar-06	14-Mar-06	14-Mar-06	Residential	Industrial	GW Criteria	Criteria
Total Metals (by SW8463 6010)																	
Antimony	mg/kg	1U	**5.3**	**5.4**										27	370	5.4	--
Arsenic	mg/kg	**3.4**	**3.0**	**3.2**			1U	1U	0.5 U	**0.87**	0.5 U	0.5 U	**17.7**	2.1	12	***	--
Lead	mg/kg	**2.5**	**338**	**405**					**18.4**	**25.1**	**1.41**	**57.4**	**6960**	400	1,400	***	--
SPLP Metals (by SW 6020A)																	
SPLP Lead	µg/L				**4**	**8**								--	--	--	15
PAHs (by EPA Method 8310)																	
Acenaphthene	µg/kg				**38.4**	**1,930**			**44.2**		2.04 U	4.97 U	13.3 U	2,400,000	20,000,000	2,100	--
Anthracene	µg/kg				**301**	**5,770**			**26.2**		2.11 U	5.13 U	13.7 U	21,000,000	300,000,000	2,500,000	-
Benzo(a)anthracene	µg/kg				**3,830**	**46,900**			**194**		**6.55**	**7.77**	14.1 U	1,000[c]	7,000[c]	800	--
Benzo(a)pyrene	µg/kg				**10,700**	**55,300**			**821**		**48.2**	**39.3**	15.4 U	100[c]	700[c]	8,000	--
Benzo(b)fluoranthene	µg/kg				**1,990**	**2,510 U**			**649**		**25.7**	4.52 U	12.1 U	1,000[c]	7,000[c]	2,400	--
Benzo(g,h,i)perylene	µg/kg				**16,300**	**34,200**			**771**		**58.2**	19.9 U	53.2 U	2,500,000	52,000,000	32,000,000	--
Benzo(k)fluoranthene	µg/kg				13.9 U	**10,600**			**311**		**10.9**	**6.04**	12.3 U	10,000[c]	70,000[c]	24,000	--
Chrysene	µg/kg				**2,090**	**49,300**			**1240**		**34.7**	**8.20**	**12.3**	100,000[c]	700,000[c]	77,000	--
Dibenz(a,h)anthracene	µg/kg				12.1 U	2220 U			**155**		1.64 U	3.98 U	10.6 U	100[c]	700[c]	700	--
1-Methylnaphthalene	µg/kg				**18.3**	1,700 U			6.22 U		1.26 U	3.06 U	8.19 U	200,000	1,800,000	3,100	--
2-Methylnaphthalene	µg/kg				**43.7**	1,700 U			**13.8**		1.26 U	3.06 U	8.19 U	210,000	2,100,000	8,500	--
Ideno(1,2,3-c,d)pyrene	µg/kg				13.2 U	2420 U			**768**		**18.5**	4.35 U	11.6 U	1,000[c]	7,000[c]	6,600	--
Fluoranthene	µg/kg				**620**	**15,400**			**537**		**13.6**	**12.1**	10.0 U	3,200,000	59,000,000	1,200,000	--
Fluorene	µg/kg				13.2 U	2420 U			**29.4**		1.79 U	4.35 U	11.6 U	2,600,000	33,000,000	160,000	--
Naphthalene	µg/kg				8.6 U	1580 U			**25.0**		1.16 U	2.83 U	7.58 U	55,000	300,000	1,200	--
Phenanthrene	µg/kg				**2,870**	**64,300**			**367**		**10.2**	**15.8**	10.4 U	2,200,000	36,000,000	250,000	--
Pyrene	µg/kg				**3,830**	**69,800**			**707**		**6.01**	**27.1**	**13.6**	2,400,000	4,500,000	880,000	--

Sample ID:		SED-1	SED-2	SED-3	SED-4	SED-5	SED-6	SED-7	SED-8	SOIL CLEANUP TARGET LEVELS[a]			
Sample Depth:		0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	Direct Exposure		Leachability	
Sample Date:		20-Jul-05	20-Jul-05	20-Jul-05	14-Mar-06	14-Mar-06	14-Mar-06	14-Mar-06	14-Mar-06	Residential	Industrial	Fresh SW	Marine SW
Total Metals (by SW8463 6010)													
Antimony	mg/kg	**3.3**	**29.8**	**10.5**	**88.3**					27	370	3,900	3,900
Arsenic	mg/kg	**7.5**	**7.5**	**4.9**	**3.34**	**3.74**	**28.3**	**3.03**	**4.94**	2.1	12	***	***
Lead	mg/kg	**94.7**	**2,610**	**174**	**3080**	**1510**	**6380**	**1460**	**899**	400	1,400	NA	***
SPLP Metals (by SW 6020A)													
SPLP Lead	µg/L				0.05 U					--	--	0.54[d]	8.5[d]
SPLP Arsenic	µg/L				0.05 U					--	--	50[d]	50[d]
PAHs (by EPA Method 8310)													
Acenaphthene	µg/kg				90.4 U	9.46 U	18.2 U	20.0 U	19.7 U	2,400,000	20,000,000	2,100	--
Anthracene	µg/kg				93.2 U	9.75 U	18.7 U	20.7 U	20.3 U	21,000,000	300,000,000	2,500,000	-
Benzo(a)anthracene	µg/kg				**466**	**25.9**	19.3 U	21.3 U	**24.9**	1,000[c]	7,000[c]	800	--
Benzo(a)pyrene	µg/kg				**747**	**48.8**	20.9 U	**40.9**	**126**	100[c]	700[c]	8,000	--
Benzo(b)fluoranthene	µg/kg				82.0 U	**13.5**	**37.1**	**20.6**	**95.3**	1,000[c]	7,000[c]	2,400	--
Benzo(g,h,i)perylene	µg/kg				**838**	**67.2**	72.6 U	80.2 U	**103**	2,500,000	52,000,000	32,000,000	--
Benzo(k)fluoranthene	µg/kg				83.4 U	**17.1**	16.8 U	18.5 U	**41.5**	10,000[c]	70,000[c]	24,000	--
Chrysene	µg/kg				**505**	**9.67**	**57.3**	15.7 U	**32.2**	100,000[c]	700,000[c]	77,000	--
1-Methylnaphthalene	µg/kg				55.6 U	5.82 U	11.2 U	12.3 U	12.1 U	200,000	1,800,000	3,100	--
2-Methylnaphthalene	µg/kg				55.6 U	5.82 U	11.2 U	12.3 U	12.1 U	210,000	2,100,000	8,500	--
Ideno(1,2,3-c,d)pyrene	µg/kg				79.0 U	**15.9**	15.9 U	**24.8**	**89.7**	1,000[c]	7,000[c]	6,600	
Fluoranthene	µg/kg				68.0 U	**17.4**	**32.4**	**19.6**	**57.5**	3,200,000	59,000,000	1,200,000	--
Phenanthrene	µg/kg				**700**	**42.6**	**18.1**	15.7 U	**42.8**	2,200,000	36,000,000	250,000	--
Pyrene	µg/kg				**707**	**56.0**	**30.1**	**29.6**	**89.6**	2,400,000	4,500,000	880,000	--

NOTES:

[a] Soil Cleanup Target Level (per Chapter 62-777, F.A.C.)

[b] GCTL - Groundwater Cleanup Target Level (per Chapter 62-777, F.A.C.)

[c] Soil Cleanup Target Level calucated from "Toxic Equivalency Factors for Carcinogenic PAHs" in comaprison to Benzo(a)pyrene (February 2005, *Final Technical Report: Development of Cleanup Target Levels for Chapter 62-777, FAC*)

[d] Criteria for Surface Water Quality Classifications (per Chapter 62-302, F.A.C.)

Bold text indicates analyte detected at concentration greater than detection limits

Bold blue text indicates analyte detected at concentration greater than the SCTL for residential direct contact

Bold red text indicates analyte detected at concentration greater than the SCTL for industrial direct contact

indicates analyte detected at concentrations greater than the SCTL for leachability

bls - below land surface

mg/kg - milligrams per kilogram

µg/kg - micrograms per kilogram

mg/L - milligrams per liter

PAHs - Polynuclear Aromatic Hydrocarbons

U - indicates analyte not detected at specified detection limit

SPLP - synthetic precipitate leaching procedure

(***) indicates leachability values may be derived from SPLP test to calculate a site-specific SCTL

NA - not available at time of rule adoption

(--) indicates standard not applicable

TABLE 2
AOC 3 FORMER HELIPAD AREA
ANALYTICAL RESULTS

Sample ID:		SB008	SB009	SB010	SB011	SOIL CLEANUP TARGET LEVELS[a]		
Sample Depth:		0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls	Direct Exposure		Leachability
Sample Date:		27-Sep-05	27-Sep-05	27-Sep-05	27-Sep-05	Residential	Industrial	GW Criteria
Total RCRA Metals (by SW8463 6010)								
Arsenic	mg/kg	**0.753**	**0.662**	**0.700**	**1.34**	2.1	12	*
Barium	mg/kg	**8.40**	**11.2**	**9.49**	**13.8**	120	130,000	1,600
Cadmium	mg/kg	0.579 U	0.649 U	0.614 U	0.587 U	82	1,700	7.5
Chromium	mg/kg	**3.56**	**3.45**	**4.04**	**4.65**	210	470	38
Lead	mg/kg	**11.6**	**4.41**	**6.85**	**12.2**	400	1,400	*
Mercury	mg/kg	0.5794 U	0.6488 U	0.6139 U	0.5872 U	3	17	2.1
Selenium	mg/kg	**0.962**	0.649 U	**0.724**	**0.857**	440	11,000	5.2
Silver	mg/kg	0.579 U	0.649 U	0.614 U	0.587 U	410	8,200	17
SVOCs (by EPA Method 8270)								
No compounds detected at concentrations greater than the reporting limit								
Chlorinated Herbicides (by EPA Method 8151)								
No compounds detected at concentrations greater than the reporting limit								
Organochlorine Pesticides (by EPA Method 8081)								
No compounds detected at concentrations greater than the reporting limit								

TABLE 3
AOC 3 FORMER HELIPAD AREA
SOIL NUTRIENT & TOXICITY TESTING RESULTS

Sample ID:		SB017	SB018	SB019	SB020
Sample Depth:		0.5 ft bls	0.5 ft bls	0.5 ft bls	0.5 ft bls
Sample Date:		14-Mar-06	14-Mar-06	14-Mar-06	14-Mar-06
SOIL NUTRIENTS		**Unstressed Area**		**Stressed Area**	
Organic Matter	%	**9.9**	**9.9**	**7.4**	**9.2**
ENR	lbs/acre	**242 VH**	**242 VH**	**192 VH**	**228 VH**
Available Phosphorus	ppm	**7 VL**	**13 VL**	**3 VL**	**11 VL**
Potassium	ppm	**105 VL**	**70 VL**	**42 VL**	**75 VL**
Magnesium	ppm	**390 H**	**330 M**	**121 VL**	**210 L**
Calcium	ppm	**6350 VH**	**6220 VH**	**5000 VH**	**6000 VH**
Sodium	ppm	**130 H**	**132 H**	**55 M**	**107 H**
Soil pH	pH units	**7.5 H**	**7.8 VH**	**7.9 VH**	**8.0 VH**
Sulfur	ppm	**212 H**	**178 M**	**140 M**	**131 M**
Zinc	ppm	**1.9 L**	**1.7 L**	**1.5 L**	**1.7 L**
Manganese	ppm	**9 L**	**7 L**	**4 L**	**8 L**
Iron	ppm	**1 L**	**1 L**	**1 L**	**2 L**
Copper	ppm	**0.6 M**	**0.5 M**	**0.5 M**	**0.7 M**
Boron	ppm	**1 M**	**0.9 M**	**0.5 L**	**0.5 L**
Soluble Salts	mmhos/cm	**0.59 M**	**0.68 M**	**0.28 M**	**0.32 M**
TOXICITY BIO ASSAY (GROWTH TEST)		**Unstressed Area**		**Stressed Area**	
Radish Seed					
w/ charcoal	% growth[a]	NA	**98**	NA	**98**
w/o charcoal	% growth[a]	NA	**96**	NA	**96**
Ryegrass					
w/ charcoal	% growth[a]	NA	**100**	NA	**100**
w/o charcoal	% growth[a]	NA	**98**	NA	**96**

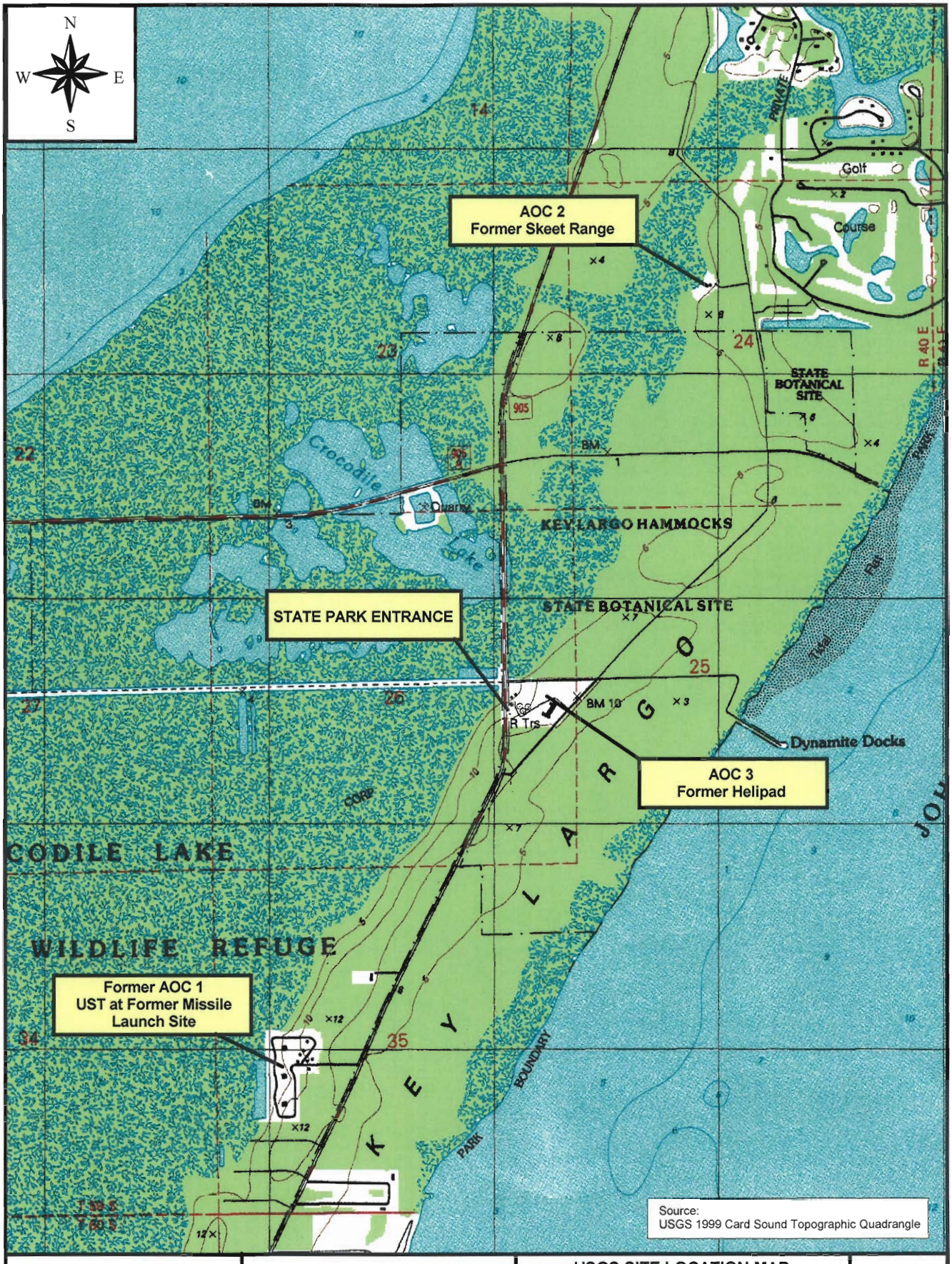
Notes:

ENR - estimated nitrogen release
lbs/acre - pounds per acre
ppm - parts per million
mmhos/cm - millimhos per centimeter
NA - not analyzed

VL - very low
L - low
M - medium
H - high
VH - very high

[a] Out of 50 seeds planted, the percentage of seeds that exhibited some degree of growth

FIGURES



METCALF & EDDY | AECOM

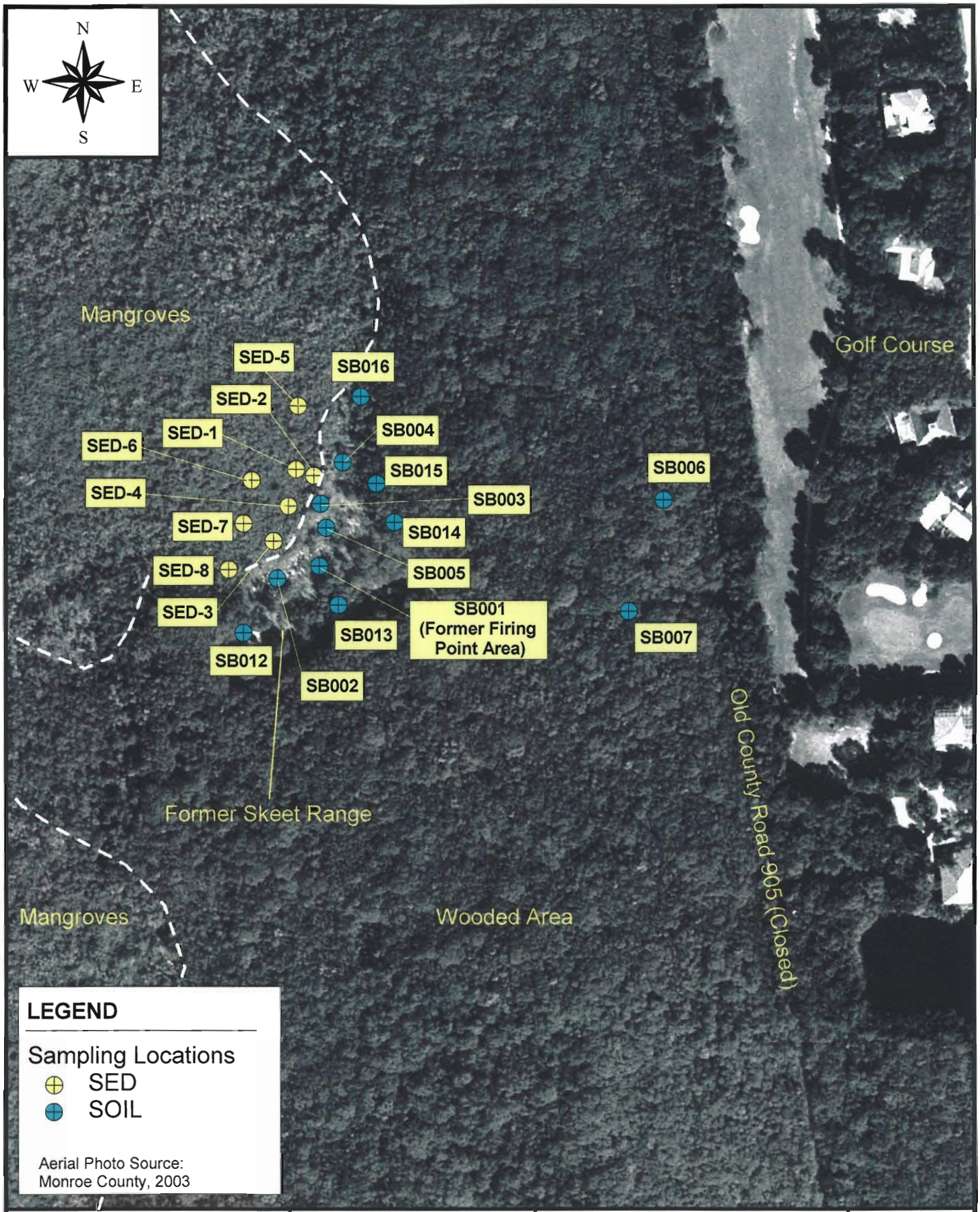
Scale (1:24000)

0 2000 Feet

USGS SITE LOCATION MAP

Key Largo Hammock Botanical State Park and Vicinity

Fig.1



METCALF & EDDY | AECOM

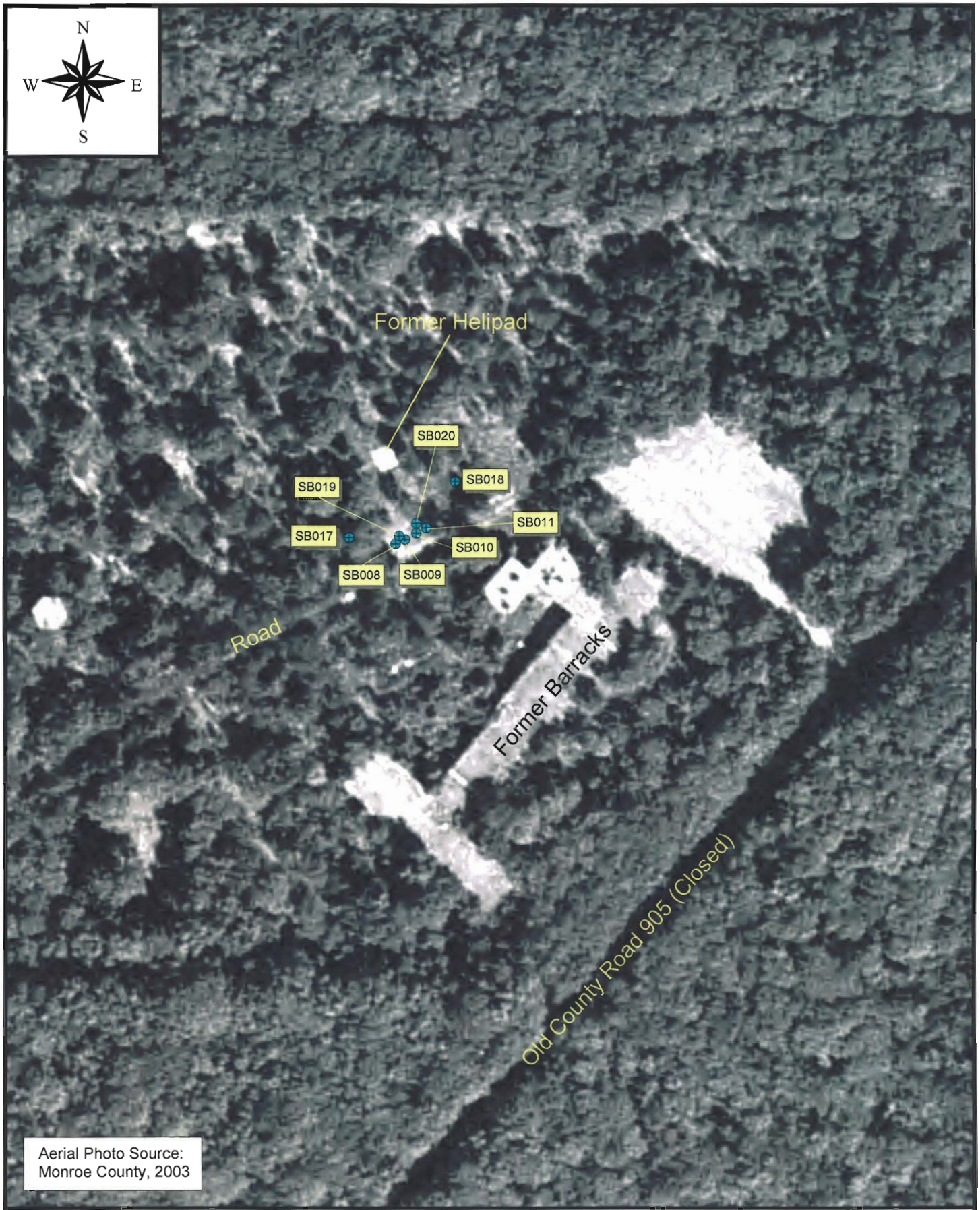
Scale

0 200 Feet

FORMER SKEET RANGE (AOC 2)
WITH SOIL AND SEDIMENT SAMPLING LOCATIONS

Key Largo Hammock
Botanical State Park

Fig.2



METCALF & EDDY | AECOM

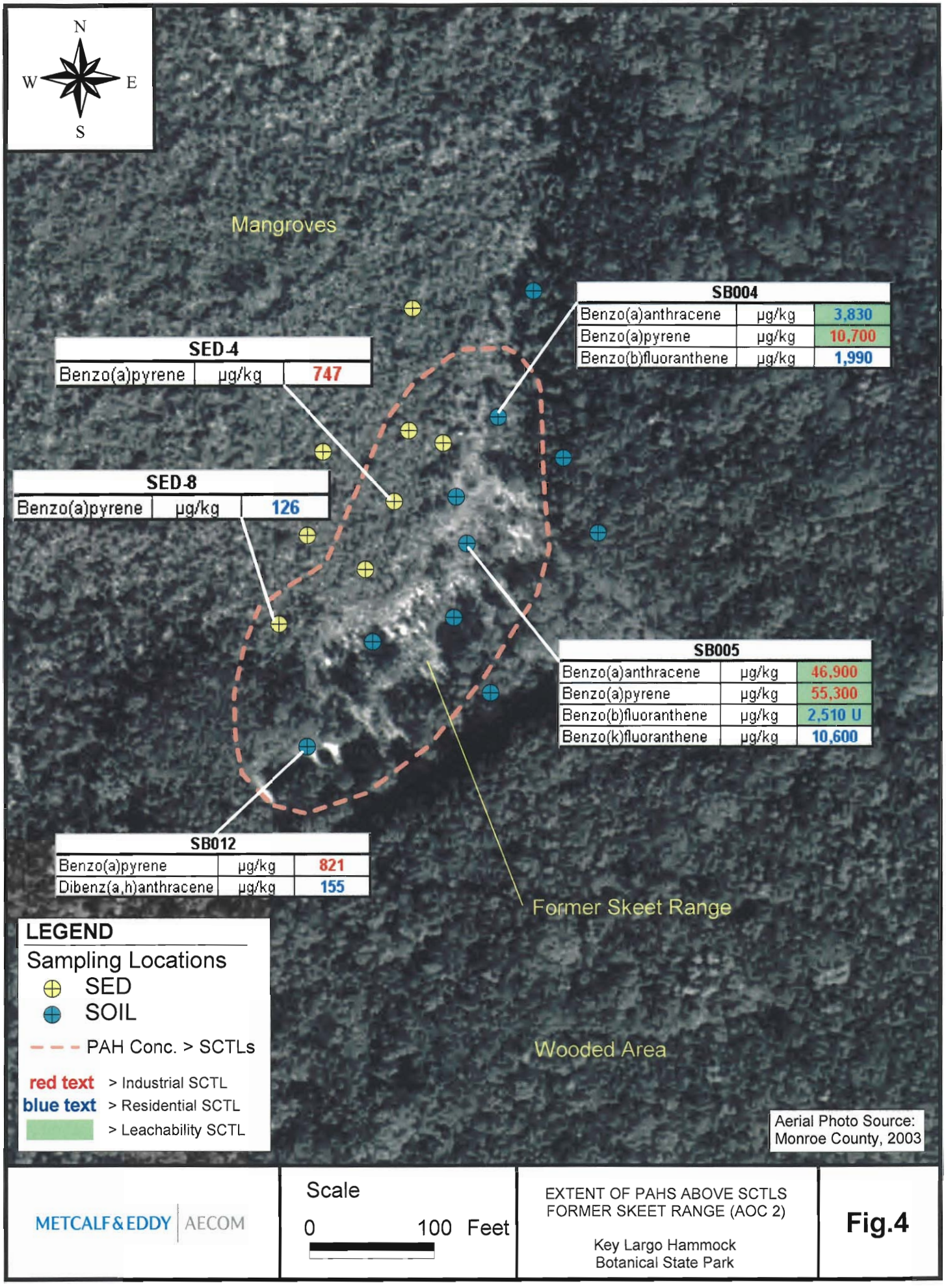
Scale

0 100 Feet

FORMER HELIPAD AREA (AOC 3)
WITH SOIL SAMPLING LOCATIONS

Key Largo Hammock
Botanical State Park

Fig.3



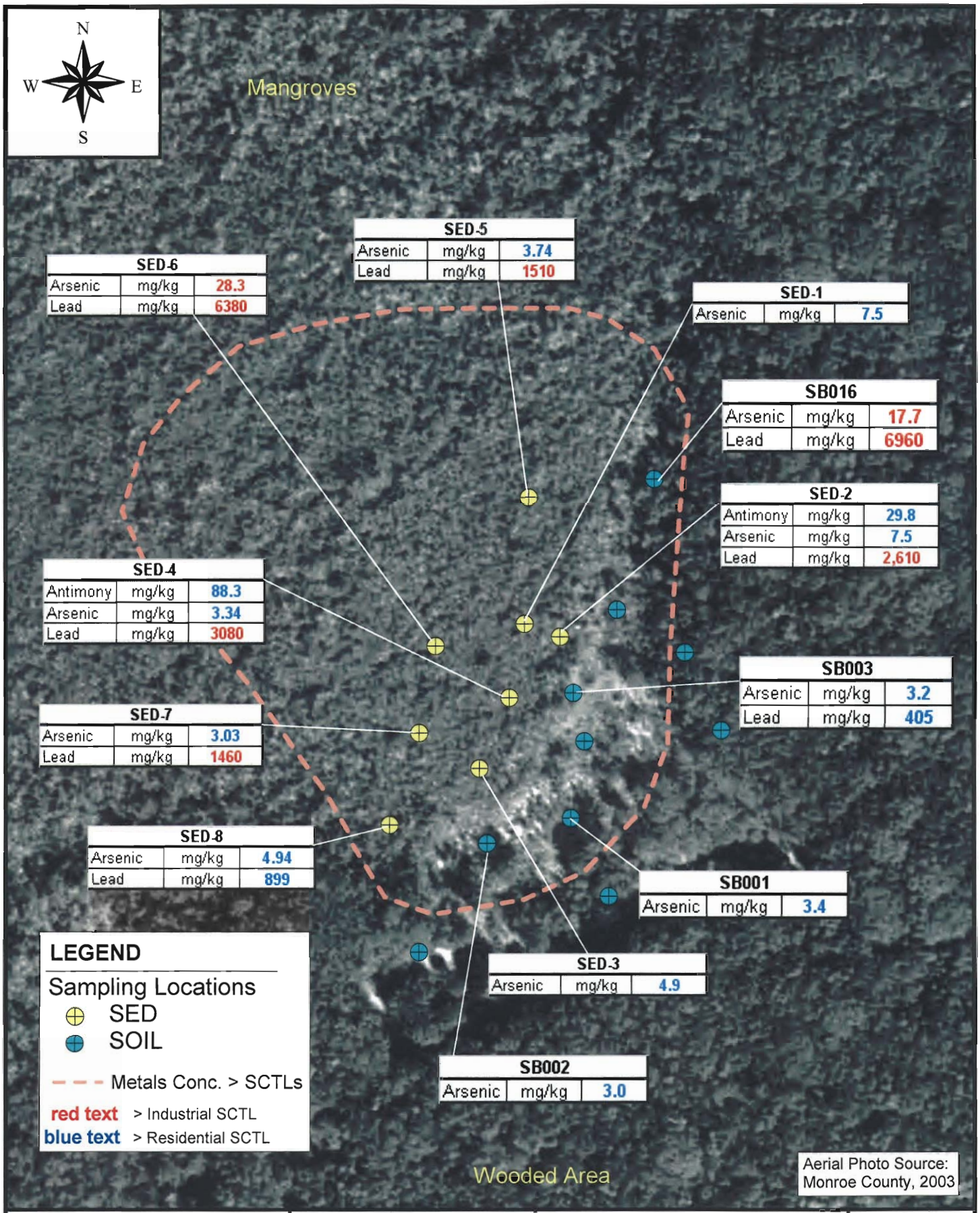
METCALF & EDDY | AECOM

Scale
0 100 Feet

EXTENT OF PAHS ABOVE SCTLS
FORMER SKEET RANGE (AOC 2)

Key Largo Hammock
Botanical State Park

Fig.4



METCALF & EDDY | AECOM

Scale
0 100 Feet

EXTENT OF METALS ABOVE SCTLS
FORMER SKEET RANGE (AOC 2)

Key Largo Hammock
Botanical State Park

Fig.5