New York State Department of Environmental Conservation

ENVIRONMENTAL ASSESSMENT

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

Booth Oil Site
City of North Tonawanda, Niagara County, New York
(Site Registry No. 9-32-100)

Dvirka and Bartilucci

Consulting Engineers

IN ASSOCIATION WITH

SADAT ASSOCIATES

MARCH 1991

PHASE I ENVIRONMENTAL ASSESSMENT

BOOTH OIL SITE

NORTH TONAWANDA, NEW YORK

SUBMITTED TO:
NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK

PREPARED FOR:
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EXECUTIVE SUMMARY

The environmental assessment, performed for the Booth Oil Site, is intended to provide a qualitative evaluation of the potential impacts to flora and fauna inhabiting the area posed by the current levels of soil contamination on site and surface water and sediment contamination in the Little River. The Booth Oil Site is located on 2.5 acres of land in the City of Tonawanda, Niagara County, New York, approximately 1,500 feet east of the Little River.

At current levels of contamination terrestrial plant species are expected to bioaccumulate various volatile, semivolatile, inorganic compounds and PCBs from the surficial and subsurface soils. Data indicate that volatile, semivolatiles, inorganics and pesticides/PCBs may bioaccululate in plant species at a rate of up to 27, 17, 0.4 and 1.4 times the concentration in the onsite soils, respectively.

Contaminant levels of various inorganics and gamma-chlordane detected in the catch basin surface water exceeded the EPA Ambient Water Quality Criteria and the NYSDEC Water Quality Standards and Guidelines. However, further analysis indicate that adequate dilution would likely occur as surface water runoff and sediment from the Booth Oil Site enter the Little River.

Section 1

1.0 INTRODUCTION

As part of the State of New York's program to remediate inactive hazardous waste sites, the New York State Department of Environmental Conservation (NYSDEC) contracted with Dvirka and Bartilucci Consulting Engineers to undertake a Remedial Investigation and Feasibility Study (RI/FS) for the Booth Oil Site in the City of North Tonawanda, Niagara County, New York. Sadat Associates, Inc. was retained by Dvirka and Bartilucci, as part of the Project Team to perform an environmental risk assessment for the Booth Oil Site.

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires the U.S. Environmental Protection Agency (EPA) to ensure the protection of human health and the environment through the development of cleanup goals and through the selection of remedial alternatives for Superfund sites. To meet these requirements the EPA has developed an environmental risk assessment process described in a two volume guidance series, entitled, Risk Assessment Guidance for Superfund. Specifically, Volume II - the Environmental Evaluation Manual (EPA, 1989b), provides guidance for the performance of environmental assessments at Superfund sites.

Although the Booth Oil Site is under the jurisdiction of New York State and is not a federal Superfund site, the RI/FS for the site was performed in accordance with the requirements of CERCLA. Accordingly, the environmental risk assessment for the Booth Oil Site provided herein was prepared under the guidance of the Environmental Evaluation Manual (EPA, 1989b).

The presence of contaminants in an ecosystem can result in a variety of effects, ranging from a reduction in population size or changes in community structure to changes in the structure and function in the entire ecosystem. Methods for the measurement of these impacts are presented in Ecological Assessments of Hazardous Waste Sites (EPA, 1989c), and require the collection of extensive field data and laboratory analyses. As the collection of quantitative data regarding plant and animal abundance, and the analysis of plant and animal tissues from the Booth Oil Site were beyond the scope of the Phase I Remedial Investigation (RI), quantification of ecological impacts is, therefore beyond the scope of this environmental assessment. However, sufficient data is available from the Phase I RI and published literature to provide a qualitative assessment.

In the environmental assessment, the current levels of contamination at the Booth Oil Site are compared with water quality criteria for the protection of freshwater aquatic life and toxicity data from the available literature to identify potential threats to

individual organisms and populations at the site. There are no viable surface water habitats on at the Booth Oil Site. There are several small areas of ponded water, which lack any aquatic life and appear to be transient in nature. However, the Little River and Niagara River are a potential environmental concern, as surface water runoff from the site empties into the Little River. The potential for accumulation of contaminants in aquatic life in the Little River and terrestrial organisms at the Booth Oil Site was evaluated in a qualitative manner. Published biological concentration predictions factors were used to calculate the potential concentrations of contaminants in the tissues of biota at the Booth Oil Site. The chemical/physical properties of the contaminants were used to indicate the potential for biomagnification of the contamination with increasing trophic levels. In must be noted that the tissue contamination levels presented herein are intended to illustrate the potential for bioconcentration, bioaccumulation, and biomagnification of contaminants and are not meant to represent actual levels of contaminants present on the plants and animals at the site.

This environmental assessment is intended to provide a qualitative evaluation of the potential impacts to flora and fauna inhabiting the Booth Oil Site posed by the current levels of soil contamination onsite and surface water and surface water sediment contamination in the Little River. This assessment should be used in conjunction with the Baseline Health Risk Assessment in

evaluating alternatives for remediation at the Booth Oil Site.

Section 2

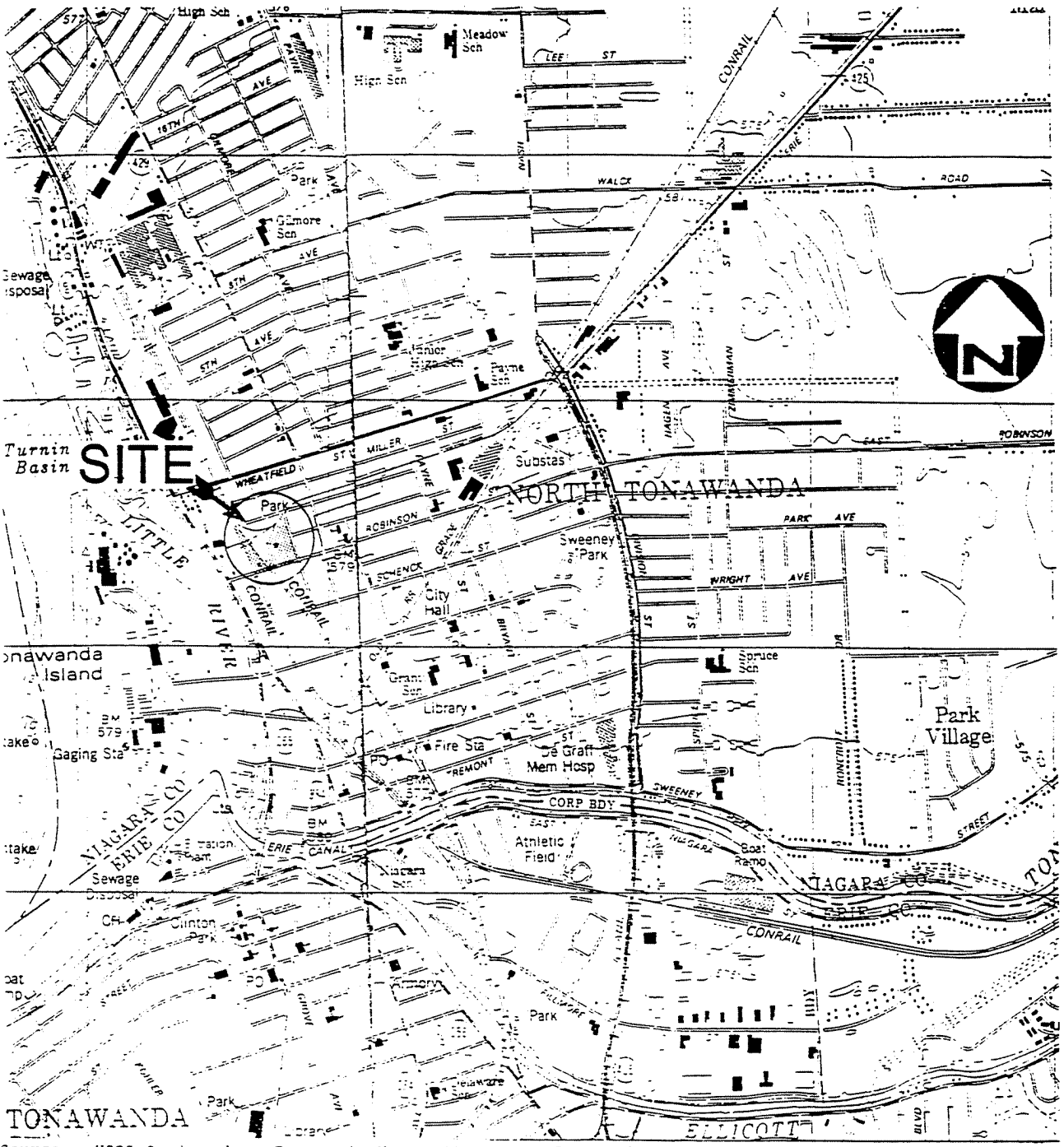
2.0 MAJOR HABITAT TYPES

The Booth Oil Site is located on 2.5 acres of land in the City of Tonawanda, Niagara County, New York (See Figure 2-1). The site is located approximately 1,500 feet east of the Little/Niagara River. Urban land usage in the surrounding area consists of commercial and industrial intermixed with residential housing.

Section 3.2.1.1 of the Phase I RI Report identified the major habitat types and associated biota at the Booth Oil Site. Habitat types identified at the Booth Oil Site include the following:

- Disturbed Lands
- Grassland Habitats
  - Mowed Areas
  - Overgrown Areas
- Scrub/Shrub Habitats
- Ponded Water Habitat
- Developed Areas

Figure 2-2, obtained from the Phase I RI Report, details the location of the various habitat types at the site. The following sections of this report provide a summary discussion of each habitat type and its characteristics, as detailed in the RI Report. Plant and animal species associated with each habitat type will be discussed. It should be noted, however, that due to the size of the Booth Oil Site and the mobility of most terrestrial animals, habitat restriction is not the rule. Animals and birds may cross



Source: USGS Quadrangles; Tonawanda West, NY 1980 & Tonawanda East, NY 1980.

FIGURE 2-1

Site Location Map

Scale 1:2500

SADAT ASSOCIATES, INC.
PRINCETON, NEW JERSEY

BOOTH OIL SITE
NORTH TONAWANDA, NIAGARA COUNTY, NEW YORK

VEGETATIVE COVERTYPES

Dvirka and Bartlucci CONSULTING ENGINEERS

Figure 2-2

habitat lines to forage or mate.

The RI Report also ranks the habitat types identified at the Booth Oil Site. This qualitative habitat value analysis provides for the determination of ecological, environmental and cultural value for each habitat type. Table 2-1 indicates the results of this analysis. The results will be discussed in the following sections.

2.1 Disturbed Lands

As noted in the Phase I RI Report, forty percent of the Booth Oil Site is comprised of disturbed lands. For the purpose of habitat classification, disturbed lands are defined as those which exhibit visible signs of past usage. In this context, disturbed lands at the Booth Oil Site include paved areas, railroad corridors including associated maintenance/storage areas, and other areas of disruption due to past site activities. The disturbed areas of the site are ranked lowest among the habitat types identified at the Booth Oil Site in terms of qualitative habitat values.

Disturbed lands, such as those at the Booth Oil Site, are subject to secondary succession, which is characterized by rapid colonization of hardy grasses, weeds and other plant species having high tolerance of severe conditions (Smith, 1980). Vegetation observed in the disturbed areas of the site include chicory

Table No. 2-1

QUALITATIVE HABITAT VALUES*
BOOTH OIL SITE

Evaluation Factors	Disturbed Lands	Grasslands (Mowed Areas)	Grasslands (Unmowed Areas)	Scrub/ Shrub
Food Chain Production				
Primary Productivity	0	1	2	1
Nutrient Transport	0	1	1	1
Food Chain Support (i.e., Nesting, etc.)	0	1	1	1
Hydroperiod	0	0	0	0
Elevational Location	0	0	0	0
Vegetative Characteristics	0	1	1	1
Cultural Evaluation	0	1	1	1
Recreation	0	1	1	0
Socio - Economic	0	1	1	0
Asthetics	0	1	1	0
Water Purification Factor	0	0	0	0
TOTALS	0	8	9	5

*Scoring is as follows:

3 - high value
2 - moderate value
1 - low value
0 - none

B0278G

(Cichorium intybus), clover (Trifolium spp.), goldenrod (Soldago spp.) and Queen Anne's lace (Daucus carola). Table 2-2 presents a full listing of all plant species present at the Booth Oil Site.

Early terrestrial successional stages, such as those observed in the disturbed areas of the site typically support animals associated with open field habitats. Animal species observed in the disturbed areas of the site during the RI include small mammals such as grey squirrels (Sciuius carolinensis), cottontail rabbits (Sylnagius spp.) and moles. Mice and toads may also be associated with this habitat type, however, none were observed during the Phase 1 RI site reconnaissance. As stated in the Phase I RI, no reptiles or amphibians were observed on site. However, the disturbed areas contain rock, rubble and cement structures which may provide suitable habitat niches for snakes. Table 2-3 provides a listing of all mammals, reptiles and amphibians which probably occur on site and those that were observed by sight or sign.

Table 2-4 indicates all bird species and their breeding status as recorded in the North Tonawanda area. The table also contains probable and confirmed bird sightings in the Booth Oil Site. Confirmed bird species associated with the Booth Oil Site include: mourning dove (Zenaida macrours), chimney swift (Chaetura pelagica), american crow (Corvous brachyrhynchos), house wren (Troglodytes aedon), european starling (Sturnus vulgaris), house sparrow (Passer domesticus). red-winged blackbird (A g e l a i u s

Table 2-2

PLANT SPECIES PRESENT AT THE BOOTH OIL SITE

Common Name	Scientific Name
Queen Anne's Lace	Daucus carola
Chicory	Cichorium intybus
Field Bindweed	Convolvulus arvenisis
Rough Dandelion	Taraxacum officinale
Smooth Dandelion	Taraxacum spp.
Virginia Creeper	Parthenocissus quinquefolia
Blue Lettuce	Lactuca spp.
Field Sow Thistle	Sonchus aruensis
Burs	Xanthium spp.
Populars	Populus spp.
Red Maple	Acer rubrum (sapling)
Goldenrod	Soldago spp.
Clover	Trifolium spp.
American Elm	Ulmus americana (sapling)
Broad Leaf Plantain	Plantago spp.
Peppermint	Pycnanthemum spp.
Fools Parsley	Aethusa cynapium
Narrow Leaf Plantain	Plantago spp.
Tree of Heaven	Alanthus spp.
Black Locust	Roninia pseudocacia
Clotbur	Xanthium spp.
Sumac	Rhus spp.
Yellow Vetching	Lathurus spp.

Table 2-3

MAMMALS, REPTILES AND AMPHIBIANS INHABITING THE BOOTH OIL SITE

Common Name	Scientific Name	Occurrence	
		Probable	Confirmed
Grey Squirrel	Sciurus carolinensis		X
Rabbits	Sylvilagus floridanus		X
Field Mouse	Peromyscus spp.	X	
House Mouse	Mus musculus	X	
Vole	Microtus pennsylanicus	X	
Garter Snake	Thamnophis sirtalis	X	
Moles			X
Shrew	Sorex spp.	X	
American Toad	Bufo americanus	X	

Table 2-4

BIRD SPECIES RECORDED* IN NORTH TONAWANDA
AND THE BOOTH OIL SITE

Common Name	Scientific Name	Possible Breeding	Probable Breeding	Confirmed Breeding	Confirmed On-site
Green-backed Heron	Butorides striatus			X	
Mallard	Anas platyrhynchos			X	
Wood Duck	Aix sponsa		X		
Red-tailed Hawk	Buteo jamaicensis		X		
Northern Harrier	Circus cyaneus		X		
American Kestrel	Falco sparverius			X	
Ring-necked Pheasant	Phasianus colchicus			X	P
Killdeer	Charadrius vociferus			X	P
Spotted Sandpiper	Actitis macularia			X	
Rock Dove	Columba livia			X	
Mourning Dove	Zenaida macroura			X	N
Yellow-billed Cuckoo	Coccyzus americanus		X		
Eastern Screech-Owl	Otus asio			X	
Great Horned Owl	Bubo Virginianus			X	
Chimney Swift	Chaetura pelagica	X			N
Belted Kingfisher	Ceryle alcyon		X		
Northern Flicker	Colaptes auratus			X	
Hairy Woodpecker	Picoides villosus	X			
Downy Woodpecker	Picoides pubescens			X	
Eastern Kingbird	Tyrannus tyrannus			X	
Eastern Phoebe	Sayornis Phoebe		X		
Willow Flycatcher	Empidonax traillii		X		
Eastern Wood-Pewee	Contopus virens		X		
Tree Swallow	Tachycineta bicolor			X	
Bank Swallow	Riparia riparia			X	
Northern Rough-winged Swallow	Stelgidopteryx serripennis			X	
Barn Swallow	Hirundo rustica			X	

Table 2-4 (continued)

BIRD SPECIES RECORDED* IN NORTH TONAWANDA
AND THE BOOTH OIL SITE

Common Name	Scientific Name	Possible Breeding	Probable Breeding	Confirmed Breeding	Confirmed On-site
Purple Martin	Progne subis			X	
Blue Jay	Cyanocitta cristata			X	P
American Crow	Corvus brachyrhynchos			X	N
Black-capped Chickadee	Parus atricapillus			X	
Brown Creeper	Certhia americana	X			
House Wren	Troglodytes aedon		X		N
Gray Catbird	Dumetella carolinensis			X	
Brown Thrasher	Toxostoma rufum			X	
American Robin	Turdus migratorius			X	P
Wood Thrush	Hylocichla mustelina		X		
Cedar Waxwing	Bombycilla cedrorum	X			P
European Starling	Sturnus vulgaris			X	N
Red-eyed Vireo	Vireo olivaceus		X		
Warbling Vireo	Vireo gilvus		X		
Blue-winged Warbler	Vermivora pinus		X		
Yellow Warbler	Dendroica petechia			X	
Common Yellowthroat	Geothlypis trichas			X	
House Sparrow	Passer domesticus			X	N
Eastern Meadowlark	Sturnella magna		X		
Red-winged Blackbird	Agelaius phoeniceus			X	N
Northern Oriole	Icterus galbula			X	P
Common Grackle	Quiscalus quiscula			X	
Brown-headed Cowbird	Molothrus ater			X	
Scarlet Tanager	Piranga olivacea			X	
Northern Cardinal	Cardinalis cardinalis			X	
Rose-breasted Grosbeak	Pheucticus ludovicianus		X		
House Finch	Carpodacus mexicanus	X			

Table 2-4 (continued)

BIRD SPECIES RECORDED* IN NORTH TONAWANDA
AND THE BOOTH OIL SITE

Common Name	Scientific Name	Possible Breeding	Probable Breeding	Confirmed Breeding	Confirmed On-site
American Goldfinch	Carduelis tristis			X	
Rufous-sided Towhee	Pipilo erythrophthalmus		X		
Savannah Sparrow	Passerculus sandwichensis		X		
Chipping Sparrow	Spizella passerina			X	
Field Sparrow	Spizella pusilla		X		N
Swamp Sparrow	Melospiza georgiana			X	
Song Sparrow	Melospiza melodia			X	
Herring Gull	Larus argentatus				N

*Source NYS Breeding Bird Atlas

P - Probable on-site
N - Noted on-site during August 17, 1990 Habitat Survey

phoeniceus), fields sparrow (Spizella pusilla) and herring gull (Larus argentatus).

2.2 Grassland Habitats

2.2.1 Mowed Areas

Grassland habitats in the north and northeast portions of the site are mowed to prevent further successional colonization of these previously disturbed and abandoned areas. Presently, these areas contain the following plantlife: clover (Trifolium spp.), field sow thistle (Sonchus aruensis), and fescue (Festuca).

Animal life associated with this habitat is scant, due mainly to the lack of sufficient vegetative cover, frequent habitat disruption and inadequate food supply. Animal species associated with this habitat type include voles (Microtus pennsylanicus) and toads (Bufo americanus). Bird species associated with these areas include the american crow (Corvous brachyrhynchos) and the mourning dove (Zenaida macrours).

The RI report ranks the mowed grassland the second highest, in terms of qualitative habitat values, among the habitat types found

at the Booth Oil Site.

2.2.2 Unmowed Areas

As stated in the Phase I RI Report, the unmowed central portion of the site is not maintained, whereby previously disturbed areas were colonized by secondary successional plant and animal life. Unlike the mowed grassland habitat, the unmowed grassland habitat is capable of supporting a greater diversity of plant and animal life, by supplying sufficient vegetative cover and food.

The RI Report indicates that vegetation observed in this area of the site include goldenrod (Soldago spp.), Queen Anne's lace (Daucus carola) and purple loosestrife (Lythrum salcanria). Although not observed, animal species associated with the unmowed grasslands of the Booth Oil Site include cottontail rabbits (Sylnagius spp.), field mice (Peromyscus spp.), house mice (Mus musculus), garter snakes (Thamnophis sirtalis) and toads (Bufo americanus). Birds affiliated with this habitat type consist of the american crow (Corvus brachyrhynchos), mourning dove (Zenaida macroura), american robin (Turdus migratorius), european starling (Sturnus vulgaris) and sparrows (Passer spp. and Spizella spp.).

The unmowed grasslands are ranked highest among the habitat types identified at the Booth Oil Site during the qualitative habitat value assessment. This ranking is a direct result of the

primary productivity, which is a measure of the stored food potential of the vegetation in excess of that used by the plant. This habitat is the most diverse and fertile of the habitat types identified at the Booth Oil Site.

2.3 Scrub/Shrub Habitat

The scrub/shrub habitat consists of grasslands that have been allowed to continue in natural succession. The definition of a scrub/shrub is a plant with woody persistent stems, no central trunk and a height of up to 15 to 20 feet. Seral shrub habitats are generally characterized by woody structures, increased stratification over grassland dense branching on a fine scale and low height (Smith, 1980).

Plant life observed in this habitat type consist of american elm saplings (Ulmas americana), red maple saplings (Acer rubrum) and other wildflower and grass species. Other plant species associated with this habitat type include purple loosestrife (Lythrum salcanria), goldenrod (Soldago spp.), tree of heaven (Alanthus spp.) and sumac (Rhus spp.).

Animal species associated with this habitat type, probably existing onsite but not confirmed, include cottontail rabbits (Sylnagius spp.), american crow (Corvus brachyrhynchos), american robin (Turdus migratorius), european starling (Sturnus vulgaris),

sparrows (Passer spp. and Spizella spp.) and toads (Bufo americanus).

The scrub/shrub habitat is ranked third among the habitat types identified at the Booth Oil Site in terms of the qualitative habitat value assessment.

2.4 Ponded Water Habitat

As stated in the RI Report, there are several small areas of ponded water. These pools of standing water lack any form of hydrophilic vegetation or aquatic life, which indicates that they may be transient in nature. The lack of vegetation and wildlife demonstrates that these areas cannot be considered to be permanent habitats and therefore will not be considered as such in this assessment.

Section 3

3.0 AREAS OF ENVIRONMENTAL CONCERN

Based upon the location of the railroad tracks and property lines, the Booth Oil Site is divided into four areas of environmental concern, refer to as Area A, B, C and D (See Figure 3-1). Areas A and B include the parcels of land between the Penn Central Main Track and the Erie Railroad Main Track, toward the southern portion of the site. Areas C and D consist of the parcels of land between the developed areas on North Marion Street to the east, and the southern fork of the railroad track that meets the Erie Railroad Main Track at Robinson Street. Areas C and D are covered by a cap which extends from the northern portion of the area to the dashed line. Surficial and subsurface soil samples were collected in all of the above mentioned areas.

The major open flowing water systems in close proximity to the Booth Oil Site include the Little River, Niagara River, Ellicott Creek and Tonawanda Creek. (See Figure 3-2). Stormwater runoff from the Booth Oil Site discharges into a catch basin located along the southern border of the site and empties into the Little River approximately 1,500 feet away, through the Robinson Street outfall pipe. The deposition of contaminants in the surface water and sediments of the Little River is a potential route of contaminant transport. Therefore, surface water and sediment samples were collected in the catch basins which drain the site during the Phase I RI.

PENN CENTRAL
MAIN TRACK

ERIE R.R.
MAIN TRACK

CARRUTHERS STREET

SOMMER STREET

KIEL STREET

NORTH MARION STREET

RIVER ROAD

AREA A

AREA B

AREA C

AREA D

DECONTAMINATION
AREA

FIELD
OFFICE
TRAILER

STORM SEWER

ROBINSON STREET

SANITARY SEWER

LITTLE RIVER

N

LEGEND

LEASEHOLD PROPERTY LINE (PROPERTY LEASED TO BOOTH OIL FROM CONRAIL)

BOOTH OIL PROPERTY LINE

APPROXIMATE LIMITS OF CAPPED AREA

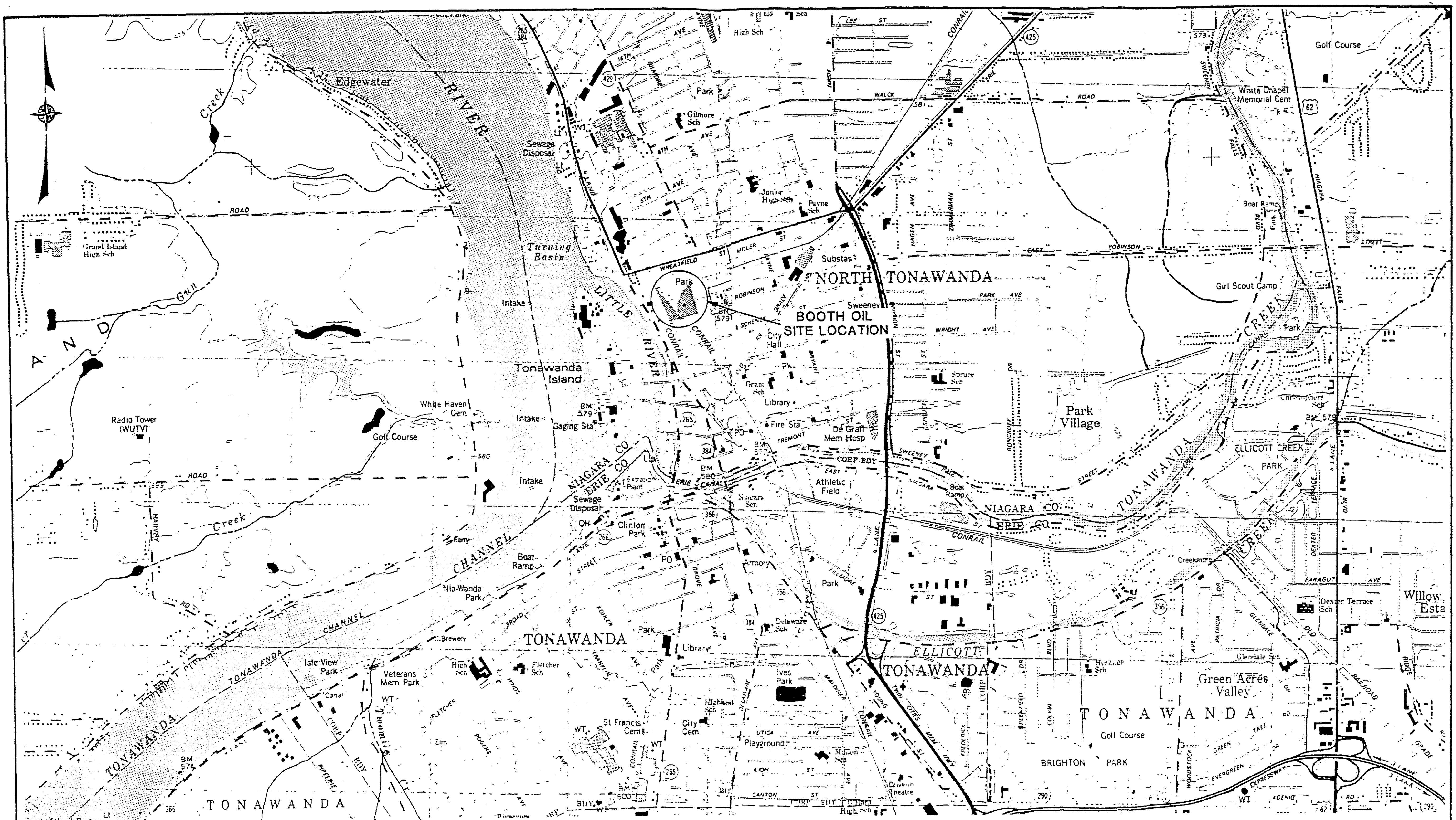
SANITARY SEWER MANHOLE

CATCHBASIN

NOTE: THIS DRAWING BASED ON DRAWING BY DVIRKA and BARTILUCCI, CONSULTING ENGINEERS.

Figure 3-1	DATE 11/29/90
SITE PLAN	SCALE: 1"=100'
	DR/CH SNH/
	AUTOCAD NO. BOS2/SITE (292)

SADAT ASSOCIATES, INC.
PRINCETON, NEW JERSEY



SCALE: 1" = 2000'

BOOTH OIL SITE
NORTH TONAWANDA, NIAGARA COUNTY, NEW YORK

OPEN WATER SYSTEMS

Dvirka and Bartilucci CONSULTING ENGINEERS

Figure 3-2

Surface water runoff from the Booth Oil Site does not discharge to the Ellicott Creek or the Tonawanda Creek. Both creeks merge into the Erie Canal which discharges into the Little River approximately 4000 feet south the Booth Oil Site.

It is also important to note that the NYSDEC has issued a health advisory concerning the consumption of carp (Cyprinus carpio) for the entire Niagara River south of the Niagara Falls. No more than one meal (1/2 pound) of carp per month should be ingested from the specified regions of the Niagara River. Table 3-1 shows a listing of fish known to inhabit the Tonawanda Creek. It can be assumed that these species may be found in larger bodies of water associated with the Tonawanda Creek system (See Phase I RI report).

Table 3-1

FISH SPECIES PRESENT IN TONAWANDA CREEK IN THE VICINITY OF THE BOOTH OIL SITE

Common Name	Scientific Name	Relative Abundance
Largemouth Bass	Micropterus salimoides	Common
Smallmouth Bass	Micropterus dolomieui	Common
Northern Pike	Esox lucius	Common
Muskellunge	Esox masquinongy	Present
Wallege	Stizostedion vitreum	Rare
White Crappie	Pomoxis annularis	Variable
Black Crappie	Pomoxis nigromaculatus	Variable
Yellow Perch	Perca flavescens	Variable
Brown Bullhead	Ictalusos nebulosus	Variable
Rock Bass	Ambloplites rupestris	Variable
White Bass	Morone chrysops	Present
Carp	Cyprinus carpio	Common
Rednose Sucker	Moxostoma carinatum	Common
Common Sucker	Catostomus commersoni	Common
Emerald Shiner	Notropis atherinoides	Common
Golden Shiner	Notemigonus crysoleucas	Common
Darters	Etheostoma spp.	Common
Bluntnose Minnows	Pimephales notratus	Common
Logperch	Percina caproides	Rare
Pumpkinseed Sunfish	Lepomis gibbosus	Common
Bluegill Sunfish	Lepomis macrochirus	Common
Daces	Clinostomus spp.	Common
Daces	Rhinichthys spp.	Common
American Eel	Anguilla rostrata	Common
Rainbow Trout	Salmo gairdneri	Present
Brown Trout	Salmo trutta	Seasonal
Coho Salmon	Oncorhynchus kitsutch	Seasonal
Goldfish	Carassius auratus	Present
Grizzard Shad	Dorosoma cepedianium	Present
American Shad	Alosa sapidissium	Present
Lake Whitefish	Loregonus clupeaformis	Present
Smelts	Osmerus spp.	Common

Source: Personal communication with NYSDEC Region 9 biologists.

Section 4

4.0 ENVIRONMENTAL CONCENTRATIONS AND POTENTIAL IMPACTS

The presence of contaminants in an ecosystem can result in a variety of effects, ranging from direct mortality in a few susceptible individuals or reduction in breeding success or large scale mortality, which function to reduce population size, to changes in the structure and function of the entire ecosystem. Quantification of these effects is beyond the scope of this assessment. Instead, the current levels of contamination at the Booth Oil Site, as defined during the Phase I RI, are compared to toxicity data from the available literature and potential impacts to individual organisms in each habitat are identified. In addition, the potential for accumulation of contaminants within the aquatic and terrestrial food webs is evaluated in a qualitative fashion. The uncertainties associated with these analyses will be discussed in Section 5.0 of this report.

4.1 Terrestrial Habitats

During the Phase I RI, eight surficial soil samples and eleven subsurface soil samples were collected in the areas of environmental concern. Samples were analyzed for volatile and semi-volatile organic compounds, inorganic compounds and pesticides and PCBs. The results of these analyses are summarized in Tables 4-1 through 4-8 and compared to the New York State Department of Environmental Conservation New Preliminary Soil Cleanup Criteria.

Table 4-1

Surficial Soil Results
Volatile Organic Compounds

VOLATILES	Area A BOSS7S 6/26/90 (mg/kg)		Area A BOSS8S* 6/26/90 (mg/kg)		Area A BOSS9S 6/26/90 (mg/kg)	Area B BOSS3S 6/26/90 (mg/kg)	Area B BOSS6S* 6/26/90 (mg/kg)		Area B BOSS10S 6/26/90 (mg/kg)		Area C BOSS1S 6/26/90 (mg/kg)	Area C BOSS2S 6/26/90 (mg/kg)
DILUTION FACTOR	1.180		1.120		-	-	1.050		1.270		-	-
Benzene	0.003	U	0.347	U	NA	NA	0.370	J	0.003	U	NA	NA
Carbon Disulfide	0.003	U	0.090	J	NA	NA	0.326	U	0.003	U	NA	NA
1,1-Dichloroethane	0.003	U	0.780		NA	NA	0.326	U	0.003	U	NA	NA
1,2-Dichloroethene (tot	0.003	U	0.160		NA	NA	0.500	J	0.007		NA	NA
Ethylbenzene	0.003	U	0.490	JB	NA	NA	0.326	U	0.003	U	NA	NA
Tetrachloroethene	0.003	U	0.140	J	NA	NA	1.300		0.003	J	NA	NA
Toluene	0.003	U	0.347	UB	NA	NA	0.326	U	0.003	U	NA	NA
Trichloroethene	0.003	U	0.347	U	NA	NA	2.300		0.003	U	NA	NA
Xylene (total)	0.003	U	10.000	B	NA	NA	0.326	U	0.003	U	NA	NA

QUALIFIERS

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES

---: not established
*: samples analyzed at medium level
[ ] -value exceeds standard/guideline
-sample detection limit exceeds standard/guideline

Table 4-1 (cont'd.)

Surficial Soil Results
Volatile Organic Compounds

VOLATILES	Area C BOSS4S 6/26/90 (mg/kg)		Area C BOSS5S 6/26/90 (mg/kg)		Area D BOSS13S 6/26/90 (mg/kg)		Area D BOSS14S 6/26/90 (mg/kg)		Playground BOSS11S 6/26/90 (mg/kg)		Playground BOSS12S 6/26/90 (mg/kg)		Preliminary Soil Cleanup Criteria (mg/kg)
DILUTION FACTOR	-		1.100		1.220				1.220		1.750		
Benzene		NA	0.004	J	0.003	U		NA	0.003	U	0.004	U	---
Carbon Disulfide		NA	0.005	J	0.003	U		NA	0.003	U	0.004	U	0.168
1,1-Dichloroethane		NA	0.003	U	0.003	U		NA	0.003	U	0.004	U	0.100
1,2-Dichloroethene (tot		NA	0.065		0.003	U		NA	0.003	U	0.004	U	---
Ethylbenzene		NA	0.006		0.003	U		NA	0.003	U	0.004	U	0.668
Tetrachloroethene		NA	0.007		0.003	U		NA	0.003	U	0.004	U	0.008
Toluene		NA	0.014		0.003	U		NA	0.003	U	0.004	U	0.358
Trichloroethene		NA	0.019		0.003	U		NA	0.003	U	0.004	U	0.049
Xylene (total)		NA	0.036		0.003	U		NA	0.003	U	0.004	U	0.670

QUALIFIERS

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES

---: not established
*: samples analyzed at medium level
[ ] -value exceeds standard/guideline
[▒] -sample detection limit exceeds standard/guideline

mss/bos-3

Table 4-2

Surficial Soil Results
Semivolatile Organic Compounds

SEMIVOLATILES	Area A BOSS7S 6/26/90 (mg/kg)		Area A BOSS8S 6/26/90 (mg/kg)		Area A BOSS9S 6/26/90 (mg/kg)	Area B BOSS3S 6/26/90 (mg/kg)	Area B BOSS6S 6/26/90 (mg/kg)		Area B BOSS10S 6/26/90 (mg/kg)		Area C BOSS1S 6/26/90 (mg/kg)	Area C BOSS2S 6/26/90 (mg/kg)
DILUTION FACTOR	1.160		4.550		-	-	43.480		5.950		-	-
Acenaphthene	0.170	J	1.600	J		NA	NA	14.348	U	1.964	U	NA	NA
Acenaphthylene	0.460	J	1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
Anthracene	0.400	J	1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
Benzo(a)anthracene	1.100		1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
Benzo(b)fluoranthene	1.600		1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
Benzo(k)fluoranthene	0.383	U	1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
Benzoic acid	1.858	U	7.280	U		NA	NA	69.568	U	9.520	U	NA	NA
Benzo(g,h,i)perylene	0.430	J	1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
Benzo(a)pyrene	1.000		1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
Butylbenzylphthalate	0.383	U	0.750	J		NA	NA	14.348	U	1.964	U	NA	NA
Chrysene	0.910		1.300	J		NA	NA	14.348	U	1.964	U	NA	NA
Dibenzo(a,h)anthracen	0.383	U	1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
Dibenzofuran	0.440	J	1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
2,4-Dimethylphenol	0.240	J	1.502	U		NA	NA	66.000		6.100		NA	NA
bis(2-Ethylhexyl)phthal	0.383	U	2.600	JB		NA	NA	8.200	JB	39.000		NA	NA
Fluoranthene	1.300		2.500	J		NA	NA	14.348	U	1.964	U	NA	NA
Fluorene	0.220	J	1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
Indeno(1,2,3-cd)pyrene	0.420	J	1.502	U		NA	NA	14.348	U	1.964	U	NA	NA
2-Methylnaphthalene	2.000		6.000			NA	NA	3.800	J	2.000	J	NA	NA
2-Methylphenol	0.383	U	1.502	U		NA	NA	48.000		1.964	U	NA	NA
4-Methylphenol	0.410	J	1.502	U		NA	NA	360.000		13.000		NA	NA
Naphthalene	1.200		1.502	U		NA	NA	14.348	U	0.910	J	NA	NA
Di-n-octylphthalate	0.150	J	1.502	U		NA	NA	14.348	U	3.400	J	NA	NA
Phenanthrene	1.400		3.100			NA	NA	2.400	J	1.964	U	NA	NA
Phenol	0.383	U	1.502	U		NA	NA	210.000		1.964	U	NA	NA
Pyrene	1.100		2.000	J		NA	NA	14.348	U	3.500	J	NA	NA

QUALIFIERS

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES

---: not established
[ ] -value exceeds standard/guideline
[ ] -sample detection limit exceeds standard/guideline

Table 4-2 (cont'd.)

Surficial Soil Results
Semivolatile Organic Compounds

SEMIVOLATILES	Area C BOSS4S 6/26/90 (mg/kg)		Area C BOSS5S 6/26/90 (mg/kg)		Area D BOSS13S 6/26/90 (mg/kg)		Area D BOSS14S 6/26/90 (mg/kg)		Playground BOSS11S 6/26/90 (mg/kg)		Playground BOSS12S 6/26/90 (mg/kg)		Preliminary Soil Cleanup Criteria (mg/kg)
DILUTION FACTOR	-		4.260		1.230		-		1.140		1.230		
Acenaphthene		NA	1.406	U	0.406	U		NA	0.043	J	0.406	U	2.220
Acenaphthylene		NA	1.406	U	0.140	J		NA	0.092	J	0.406	U	5.140
Anthracene		NA	1.406	U	0.087	J		NA	0.082	J	0.406	U	65.000
Benzo(a)anthracene		NA	1.406	U	0.406	U		NA	0.660	J	0.406	U	0.005
Benzo(b)fluoranthene		NA	1.800	J	1.500			NA	0.740	J	0.300	J	0.055
Benzo(k)fluoranthene		NA	0.810	J	0.406	U		NA	0.720	J	0.190	J	0.055
Benzoic acid		NA	6.818	U	0.200	J		NA	0.120	J	0.063	J	0.167
Benzo(g,h,i)perylene		NA	1.406	U	0.360	J		NA	0.560	J	0.230	J	593.110
Benzo(a)pyrene		NA	1.406	U	0.990			NA	0.650	J	0.210	J	---
Butylbenzylphthalate		NA	1.406	U	0.406	U		NA	0.376	U	0.406	U	---
Chrysene		NA	1.100	J	1.200			NA	0.960		0.330	J	0.020
Dibenzo(a,h)anthracen		NA	1.406	U	0.120	J		NA	0.120	J	0.406	U	713.680
Dibenzofuran		NA	1.406	U	0.042	J		NA	0.120	J	0.406	U	---
2,4-Dimethylphenol		NA	0.750	J	0.406	U		NA	0.376	U	0.406	U	0.050
bis(2-Ethylhexyl)phthal		NA	8.200	B	3.300	B		NA	0.376	U	0.406	U	1517.325
Fluoranthene		NA	1.500	J	2.200			NA	2.000		0.550	J	22.892
Fluorene		NA	1.406	U	0.406	U		NA	0.170	J	0.406	U	8.180
Indeno(1,2,3-cd)pyrene		NA	1.406	U	0.900			NA	0.620	J	0.230	J	0.028
2-Methylnaphthalene		NA	1.100	J	0.120	J		NA	0.190	J	0.089	J	21.250
2-Methylphenol		NA	1.406	U	0.406	U		NA	0.376	U	0.406	U	---
4-Methylphenol		NA	1.406	U	0.406	U		NA	0.376	U	0.406	U	---
Naphthalene		NA	1.406	U	0.068	J		NA	0.100	J	0.052	J	0.650
Di-n-octylphthalate		NA	1.406	U	0.406	U		NA	0.376	U	0.406	U	5.965
Phenanthrene		NA	1.700	J	0.620	J		NA	2.000		0.370	J	57.300
Phenol		NA	1.406	U	0.406	U		NA	0.376	U	0.406	U	0.000
Pyrene		NA	1.900	J	1.300			NA	1.400		0.340	J	210.000

QUALIFIERS

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES

---: not established
[ ] -value exceeds standard/guideline
[ ] -sample detection limit exceeds standard/guideline .

Table 4-3

Surficial Soil Results
Inorganic Compounds

INORGANICS	Area A BOSS7S 6/26/90 (mg/kg)		Area A BOSS8S 6/26/90 (mg/kg)		Area A BOSS9S 6/26/90 (mg/kg)		Area B BOSS3S 6/26/90 (mg/kg)		Area B BOSS6S 6/26/90 (mg/kg)		Area B BOSS10S 6/26/90 (mg/kg)		Area C BOSS1S 6/26/90 (mg/kg)		Area C BOSS2S 6/26/90 (mg/kg)	
Aluminum	11100.000		10800.000			NA		NA	31600.000		19300.000			NA		NA
Antimony	6.600	B	5.600	BN		NA		NA	3.700	U	156.000	N		NA		NA
Arsenic	**26.200**		**22.400**			NA		NA	4.100		12.300			NA		NA
Barium	118.000	*	188.000	*		NA		NA	345.000	*	2600.000	*		NA		NA
Beryllium	1.100	B	1.400			NA		NA	5.600		2.000			NA		NA
Cadmium	1.300		1.600			NA		NA	1.100		**8.000**			NA		NA
Calcium	107000.000	*	85200.000	*		NA		NA	187000.000	*	73600.000	*		NA		NA
Chromium	20.600	*	23.000	*		NA		NA	39.800	*	**152.000**	*		NA		NA
Cobalt	6.900	B	6.600	B		NA		NA	2.800	B	11.600			NA		NA
Copper	75.600	E	83.000	E*		NA		NA	54.700	E	**541.000**	E		NA		NA
Iron	27000.000	*	28300.000	*		NA		NA	13700.000	*	45300.000	*		NA		NA
Lead	**300.000**		**801.000**			NA		NA	**1390.000**		**2280.000**			NA		NA
Magnesium	51900.000		24900.000			NA		NA	57100.000		13700.000			NA		NA
Manganese	946.000		876.000			NA		NA	2550.000		1040.000			NA		NA
Mercury	0.180		0.270			NA		NA	0.160		0.170			NA		NA
Nickel	16.800		19.200			NA		NA	10.000		40.100			NA		NA
Potassium	1730.000		1270.000			NA		NA	2390.000		1540.000			NA		NA
Selenium	1.000	B	1.500			NA		NA	0.460	B	1.900			NA		NA
Silver	0.910	U	0.820	U		NA		NA	0.830	U	0.920	U		NA		NA
Sodium	443.000	B	473.000	B		NA		NA	1440.000		733.000	B		NA		NA
Thallium	0.440	U	0.510	B		NA		NA	0.510	B	0.670	B		NA		NA
Vanadium	22.500	E	19.500	E		NA		NA	13.700	E	26.400	E		NA		NA
Zinc	235.000	N*	336.000	N*		NA		NA	**358.000**	N*	**1200.000**	N*		NA		NA
Cyanide	0.600	U	7.600			NA		NA	1.900		5.500			NA		NA

QUALIFIERS

U : value is less than the instrument detection limit (IDL)
B : value is between IDL and contract required detection limit (CRDL)
E : value is estimated due to interference
M : duplicate injection precision not met
N : spiked sample recovery not within control limits
*:duplicate analysis not within control limits

NOTES

---: not established
[ ] -value exceeds standard/guideline
▒▒▒ -sample detection limit exceeds standard/guideline

Table 4-3 (cont'd.)

Surficial Soil Results
Inorganic Compounds

INORGANICS	Area C BOSS4S 6/26/90 (mg/kg)		Area C BOSS5S 6/26/90 (mg/kg)		Area D BOSS13S 6/26/90 (mg/kg)		Area D BOSS14S 6/26/90 (mg/kg)		Playground BOSS11S 6/26/90 (mg/kg)		Playground BOSS12S 6/26/90 (mg/kg)		NJDEP Soil Action Levels (mg/kg)
Aluminum		NA	13300.000		15400.000			NA	14600.000		16700.000		----
Antimony		NA	4.800	B	4.200	UN		NA	4.100	U	4.300	U	----
Arsenic		NA	**21.200**		**80.700**			NA	16.600		8.800		20.000
Barium		NA	237.000	*	281.000	*		NA	134.000	*	120.000	*	----
Beryllium		NA	0.970	B	0.990	B		NA	0.860	B	1.100	B	----
Cadmium		NA	2.400		2.900			NA	0.970	B	0.920	B	3.000
Calcium		NA	73300.000	*	25800.000	*		NA	12300.000	*	14200.000	*	----
Chromium		NA	29.700	*	31.200	*		NA	22.900	*	26.100	*	100.000
Cobalt		NA	8.100	B	15.400			NA	10.100	B	9.800	B	----
Copper		NA	73.900	E*	89.900	E*		NA	68.800	E	39.000	E	170.000
Iron		NA	23800.000	*	56500.000	*		NA	34600.000	*	29700.000		----
Lead		NA	**744.000**		**469.000**			NA	**133.000**		**103.000**		100.000
Magnesium		NA	25300.000		12400.000			NA	6990.000		8260.000		----
Manganese		NA	745.000		751.000			NA	660.000		751.000		----
Mercury		NA	0.230		0.310			NA	0.120		0.120	U	1.000
Nickel		NA	22.400		29.000			NA	26.600		28.200		100.000
Potassium		NA	1990.000		2420.000			NA	2270.000		2500.000		----
Selenium		NA	0.670	B	1.500	B		NA	1.500	B	1.100	B	4.000
Silver		NA	0.830	U	0.930	U		NA	0.910	U	0.960	U	5.000
Sodium		NA	301.000	B	286.000	B		NA	214.000	B	270.000	B	----
Thallium		NA	0.420	U	0.620	B		NA	0.540	B	0.490	B	----
Vanadium		NA	21.700	E	45.600	E		NA	35.000	E	38.400	E	----
Zinc		NA	343.000	N*	**940.000**	N*		NA	279.000	N*	215.000	N*	350.000
Cyanide		NA	0.540	U	0.750			NA	0.590	U	0.640	U	----

QUALIFIERS

U : value is less than the instrument detection limit (IDL)
B : value is between IDL and contract required detection limit (CRDL)
E : value is estimated due to interference
M : duplicate injection precision not met
N : spiked sample recovery not within control limits
*:duplicate analysis not within control limits

NOTES

---: not established
-value exceeds standard/guideline
-sample detection limit exceeds standard/guideline

Table 4-4

Surficial Soil Results
Pesticides/PCBs

PESTICIDES/PCBS	Area A BOSS7S 6/26/90 (mg/kg)	Area A BOSS8S 6/26/90 (mg/kg)	Area A BOSS9S 6/26/90 (mg/kg)	Area B BOSS3S 6/26/90 (mg/kg)	Area B BOSS6S 6/26/90 (mg/kg)	Area B BOSS10S 6/26/90 (mg/kg)	Area C BOSS1S 6/26/90 (mg/kg)	Area C BOSS2S 6/26/90 (mg/kg)
DILUTION FACTOR	1.160	5.680	5.490	5.210	10.870	11.900	21.740	10.640
PCB-1242	0.093 U	0.454 U	0.439 U	0.417 U	19.000	0.952 U	1.739 U	0.851 U
PCB-1254	9.100	15.000	11.000	0.834 U	1.740 U	44.000	82.000	1.702 U
PCB-1260	5.700	12.000	6.100	5.900	32.000	31.000	3.478 U	1.702 U
PCB-1248	4.100	16.000	13.000	15.000	0.870 U	37.000	1.739 U	32.000

QUALIFIERS

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES

---: not established
[ ] -value exceeds standard/guideline
[ ] -sample detection limit exceeds standard/guideline

Table 4-4 (cont'd.)

Surficial Soil Results
Pesticides/PCBs

PESTICIDES/PCBS	Area C BOSS4S 6/26/90 (mg/kg)	Area C BOSS5S 6/26/90 (mg/kg)	Area D BOSS13S 6/26/90 (mg/kg)	Area D BOSS14S 6/26/90 (mg/kg)	Playground BOSS11S 6/26/90 (mg/kg)	Playground BOSS12S 6/26/90 (mg/kg)	Preliminary Soil Cleanup Criteria (mg/kg)
DILUTION FACTOR	1.230	10.640	1.230	1.200	1.140	1.230	
PCB-1242	0.098 U	0.851 U	0.098 U	0.098 U	0.091 U	0.098 U	0.085
PCB-1254	0.197 U	1.702 U	0.197 U	0.192 U	0.182 U	0.197 U	0.275
PCB-1260	1.300	8.000	0.197 U	0.192 U	0.182 U	0.197 U	----
PCB-1248	0.098 U	35.000	0.098 U	0.096 U	0.091 U	0.098 U	0.205

QUALIFIERS

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES

---: not established
-value exceeds standard/guideline
-sample detection limit exceeds standard/guideline

msub/bos-3

Table 4-5

Subsurface Soil Results
Volatile Organic Compounds

VOLATILES	Area A BOMW1S(0-2)* 7/12/90 (mg/kg)		Area A BOMW4S(0-2) 7/16/90 (mg/kg)		Area A BOSB1S(7-9)* 7/13/90 (mg/kg)		Area A BOSB12S(2-4) 7/18/90 (mg/kg)		Area B BOMW5S(4-6)* 7/16/90 (mg/kg)		Area B BOMW8S(2-4) 7/17/90 (mg/kg)	
DILUTION FACTOR	1.180		-		1.320		1.150		1.090		-	
Benzene	0.366	U	NA		0.409	U	0.001	J	0.338	U	NA	
Carbon Disulfide	0.366	U	NA		0.409	U	0.001	J	0.338	U	NA	
1,1-Dichloroethane	0.366	U	NA		0.409	U	0.003	U	0.338	U	NA	
1,1-Dichloroethene	0.366	U	NA		0.409	U	0.001	J	0.338	U	NA	
1,2-Dichloroethene (total)	0.366	U	NA		0.640	J	0.002	J	8.300		NA	
Ethylbenzene	3.800		NA		2.300		0.003	U	6.800		NA	
Tetrachloroethene	0.366	U	NA		0.409	U	0.003	U	1.800		NA	
Toluene	0.366	U	NA		0.409	U	0.002	J	7.800	B	NA	
Trichloroethene	0.366	U	NA		0.220	J	0.003	U	0.338	U	NA	
1,1,1-Trichloroethane	0.366	U	NA		0.409	U	0.003	U	1.200		NA	
Xylene (total)	27.000		NA		8.100		0.003	U	38.000		NA	

QUALIFIERS:

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES:

* - a medium level soil analysis was performed
[ ] - value exceeds standard/guideline
▒ - sample detection limit exceeds standard/guideline

Table 4-5 (cont'd.)

Subsurface Soil Results

Volatile Organic Compounds

VOLATILES	Area B BOSB7S(2-4)* 7/18/90 (mg/kg)		Area B BOSB9S(11-13) 7/12/90 (mg/kg)		Area C BOMW6S(1-4)* 7/11/90 (mg/kg)		Area C BOSB4S(6-8) 7/12/90 (mg/kg)	Area C BOSB4S(11-13) 7/12/90 (mg/kg)		Area C BOSB10S(0-2) 7/10/90 (mg/kg)	
DILUTION FACTOR	1.140		6.300		1.210		-	2.560		1.000	
Benzene	0.353	U	0.005	J	0.375	U	NA	0.006	U	0.001	J
Carbon Disulfide	0.353	U	0.016	U	0.375	U	NA	0.002	J	0.003	J
1,1-Dichloroethane	0.353	U	0.007	J	0.375	U	NA	0.005	J	0.003	U
1,1-Dichloroethene	0.353	U	0.016	U	0.375	U	NA	0.006	U	0.003	U
1,2-Dichloroethene (total)	3.000		0.073		0.630	J	NA	0.008	J	0.047	
Ethylbenzene	2.800		0.041		0.200	J	NA	0.020		0.002	J
Tetrachloroethene	0.200	J	0.016	U	0.375	U	NA	0.019		0.120	
Toluene	2.200	B	0.081		0.300	J	NA	0.007	JB	0.006	
Trichloroethene	0.353	U	0.016	U	0.375	U	NA	0.032		0.044	
1,1,1-Trichloroethane	0.353	U	0.016	U	0.375	U	NA	0.006	J	0.003	U
Xylene (total)	14.000		0.230		1.200		NA	0.050		0.020	

QUALIFIERS:

J: compound present below the detection limit

B: compound is found in the blank as well as the sample

U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)

UB: reported concentration is 1/2 the sample detection limit

NOTES:

* - a medium level soil analysis was performed

- value exceeds standard/guideline

- sample detection limit exceeds standard/guideline

Table 4-5 (cont'd.)

Subsurface Soil Results
Volatile Organic Compounds

VOLATILES	Area D BOMW7S(5-7) 7/11/90 (mg/kg)		Area D BOMW9S(0-2) 7/12/90 (mg/kg)		Area D BOSB2S(6-8) 7/10/90 (mg/kg)		Area D BOSB5S(3-7.5)* 7/10/90 (mg/kg)		Area D BOSB8S(2-4) 7/10/90 (mg/kg)		Preliminary Soil Cleanup Criteria (mg/kg)
DILUTION FACTOR	1.100		-		-		12.820		-		
Benzene	0.003	U	NA		NA		3.000	J	NA		---
Carbon Disulfide	0.003	U	NA		NA		3.970	U	NA		0.168
1,1-Dichloroethane	0.005	J	NA		NA		15.000		NA		0.100
1,1-Dichloroethene	0.003	U	NA		NA		3.970	U	NA		0.00057
1,2-Dichloroethene (total)	0.003	U	NA		NA		160.000		NA		---
Ethylbenzene	0.009	J	NA		NA		75.000		NA		0.668
Tetrachloroethene	0.003	U	NA		NA		220.000		NA		0.008
Toluene	0.003	U	NA		NA		300.000		NA		0.358
Trichloroethene	0.003	U	NA		NA		170.000		NA		0.049
1,1,1-Trichloroethane	0.003	U	NA		NA		22.000		NA		0.150
Xylene (total)	0.008		NA		NA		390.000	B	NA		0.670

QUALIFIERS:

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES:

* - a medium level soil analysis was performed
- value exceeds standard/guideline
- sample detection limit exceeds standard/guideline

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Table 4-6

Subsurface Soil Results
Semi-Volatile Organic Compounds

SEMIVOLATILES	Area A BOMW1S(0-2) 7/12/90 (mg/kg)	Area A BOMW4S(0-2) 7/16/90 (mg/kg)	Area A BOSB1S(7-9) 7/13/90 (mg/kg)	Area A BOSB12S(2-4) 7/18/90 (mg/kg)	Area B BOMW5S(4-6) 7/16/90 (mg/kg)	Area B BOMW8S(2-4) 7/17/90 (mg/kg)
DILUTION FACTOR	4.560	-	1.300	1.250	1.420	-
Acenaphthene	0.752 U	NA	0.215 U	0.412 U	0.469 U	NA
Anthracene	0.752 U	NA	0.215 U	0.041 J	0.469 U	NA
Benzo(a)anthracene	1.500 J	NA	0.480 J	0.160 J	0.469 U	NA
Benzo(b)fluoranthene	2.900 J	NA	0.215 U	0.220 J	0.469 U	NA
Benzo(k)fluoranthene	1.800 J	NA	0.215 U	0.170 J	0.469 U	NA
Butylbenzylphthalate	0.752 U	NA	0.215 U	0.412 U	0.469 U	NA
Chrysene	2.400 J	NA	0.700 J	0.330 J	0.469 U	NA
1,2-Dichlorobenzene	0.752 U	NA	0.215 U	0.412 U	0.469 U	NA
1,4-Dichlorobenzene	0.752 U	NA	0.215 U	0.412 U	0.469 U	NA
Fluoranthene	3.700	NA	0.960	0.260 J	0.469 U	NA
Fluorene	4.200	NA	0.215 U	0.052 J	0.960	NA
2-Methylnaphthalene	36.000	NA	13.000	0.420 J	17.000 E	NA
4-Methylphenol	0.752 U	NA	1.800	0.412 U	0.469 U	NA
Naphthalene	8.500	NA	0.215 U	0.310 J	11.000	NA
N-Nitrosodiphenylamine (1)	0.752 U	NA	0.215 U	0.412 U	1.100	NA
Di-n-octylphthalate	0.752 U	NA	0.200 JB	0.021 J	0.469 U	NA
Phenanthrene	13.000	NA	3.400	0.310 J	1.800	NA
Pyrene	5.100	NA	2.600	0.230 J	0.280 J	NA
1,2,4-Trichlorobenzene	0.752 U	NA	0.215 U	0.412 U	1.000	NA

QUALIFIERS:

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit
E: exceeds calibration curve range
D: Identified at a secondary dilution factor

NOTES:

* - a medium level soil analysis was performed
[ ] - value exceeds standard/guideline
▒▒ - sample detection limit exceeds standard/guideline

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Table 4-6 (cont'd.)

Subsurface Soil Results
Semi-Volatile Organic Compounds

SEMIVOLATILES	Area B BOSB7S(2-4) 7/18/90 (mg/kg)		Area B BOSB9S(11-13) 7/13/90 (mg/kg)		Area C BOMW6S(1-4) 7/11/90 (mg/kg)		Area C BOSB4S(6-8) 7/12/90 (mg/kg)		Area C BOSB4S(11-13) 7/12/90 (mg/kg)		Area C BOSB10S(0-2) 7/10/90 (mg/kg)	
DILUTION FACTOR	2.110		1.280		5.260		-		1.320		1.000	
Acenaphthene	0.696	U	0.211	U	1.740	U		NA	0.217	U	0.330	U
Anthracene	0.696	U	0.211	U	1.740	U		NA	0.217	U	0.330	U
Benzo(a)anthracene	0.696	U	0.211	U	1.740	U		NA	0.217	U	0.330	U
Benzo(b)fluoranthene	0.696	U	0.211	U	1.740	U		NA	0.007	J	0.330	U
Benzo(k)fluoranthene	0.696	U	0.211	U	1.740	U		NA	0.217	U	0.330	U
Butylbenzylphthalate	0.696	U	0.211	U	1.740	U		NA	0.217	U	0.330	U
Chrysene	0.696	U	0.211	U	1.500	J		NA	0.217	U	0.330	U
1,2-Dichlorobenzene	0.696	U	0.211	U	0.420	J		NA	0.217	U	0.330	U
1,4-Dichlorobenzene	0.696	U	0.211	U	0.140	J		NA	0.217	U	0.330	U
Fluoranthene	0.696	U	0.210	J	0.590	J		NA	0.013	J	0.059	J
Fluorene	0.990	J	0.211	U	1.740	U		NA	0.007	J	0.330	U
2-Methylnaphthalene	11.000		0.630	J	4.100	J		NA	0.046	J	0.042	J
4-Methylphenol	0.696	U	0.211	U	0.610	J		NA	0.018	J	0.330	U
Naphthalene	4.800		0.211	U	2.000	J		NA	0.033	J	0.025	J
N-Nitrosodiphenylamine (1)	1.600		0.211	U	1.740	U		NA	0.217	U	0.330	U
Di-n-octylphthalate	0.340	J	0.211	U	1.740	U		NA	0.217	UB	0.260	JB
Phenanthrene	1.800		0.690	J	3.500	J		NA	0.217	U	0.054	J
Pyrene	0.696	U	0.220	J	1.740	U		NA	0.014	J	0.210	J
1,2,4-Trichlorobenzene	0.696	U	0.211	U	1.740	U		NA	0.217	U	0.330	U

QUALIFIERS:

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit
E: exceeds calibration curve range
D: Identified at a secondary dilution factor

NOTES:

* - a medium level soil analysis was performed
- value exceeds standard/guideline
- sample detection limit exceeds standard/guideline

Table 4-6 (cont'd.)

Subsurface Soil Results
Semi-Volatile Organic Compounds

SEMIVOLATILES	Area D BOMW7S(5-7) 7/11/90 (mg/kg)		Area D BOMW9S(0-2) 7/12/90 (mg/kg)		Area D BOSB2S(6-8) 7/10/90 (mg/kg)		Area D BOSB5S(3-7.5) 7/10/90 (mg/kg)		Area D BOSB8S(2-4) 7/10/90 (mg/kg)		Preliminary Soil Cleanup Criteria (mg/kg)
DILUTION FACTOR	1.000		-		-		10.530		-		
Acenaphthene	0.330	U	NA		NA		16.000		NA		2.220
Anthracene	0.190	J	NA		NA		3.480	U	NA		65.000
Benzo(a)anthracene	0.270	J	NA		NA		3.480	U	NA		0.005
Benzo(b)fluoranthene	0.330	U	NA		NA		3.480	U	NA		0.055
Benzo(k)fluoranthene	0.330	U	NA		NA		3.480	U	NA		0.055
Butylbenzylphthalate	0.330	U	NA		NA		9.900		NA		---
Chrysene	0.320	J	NA		NA		6.800	J	NA		0.020
1,2-Dichlorobenzene	0.330	U	NA		NA		6.500	J	NA		0.066
1,4-Dichlorobenzene	0.330	U	NA		NA		0.890	J	NA		0.092
Fluoranthene	0.510	J	NA		NA		6.000	J	NA		22.892
Fluorene	0.330	U	NA		NA		3.480	U	NA		8.180
2-Methylnaphthalene	0.760		NA		NA		140.000		NA		21.250
4-Methylphenol	0.330	U	NA		NA		600.000	E	NA		---
Naphthalene	0.330	U	NA		NA		76.000		NA		0.650
N-Nitrosodiphenylamine (1)	3.800		NA		NA		3.480	U	NA		---
Di-n-octylphthalate	0.330	U	NA		NA		3.480	U	NA		5.965
Phenanthrene	2.000		NA		NA		54.000		NA		57.300
Pyrene	1.400		NA		NA		55.000		NA		210.000
1,2,4-Trichlorobenzene	0.330	U	NA		NA		3.480	U	NA		0.336

QUALIFIERS:

J: compound present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit
E: exceeds calibration curve range
D: Identified at a secondary dilution factor

NOTES:

* - a medium level soil analysis was performed
- value exceeds standard/guideline
- sample detection limit exceeds standard/guideline

Table 4-7
Subsurface Soil Results
Inorganic Compounds

INORGANICS	Area A BOMW1S(0-2) 7/12/90 (mg/kg)		Area A BOMW4S(0-2) 7/16/90 (mg/kg)		Area A BOSB1S(7-9) 7/13/90 (mg/kg)		Area A BOSB12S(2-4) 7/18/90 (mg/kg)		Area B BOMW5S(4-6) 7/16/90 (mg/kg)		Area B BOMW8S(2-4) 7/17/90 (mg/kg)	
Aluminum	5690.000	*		NA	12500.000	*	12700.000	*	11600.000	*		NA
Antimony	3.800	U		NA	3.200	UN	3.500	UN	2.800	UN		NA
Arsenic	**42.200**	N*		NA	7.600	NS*	14.200	NS*	1.700	BN*		NA
Barium	107.000	N*		NA	117.000	N*	130.000	N*	95.700	N*		NA
Beryllium	0.730	B		NA	0.880	B	0.940	B	1.500			NA
Cadmium	1.400			NA	1.200		0.970		0.670	B		NA
Calcium	19300.000			NA	68700.000		26300.000		115000.000			NA
Chromium	16.600	N*		NA	16.900	N*	47.100	N*	6.600	N*		NA
Cobalt	11.100			NA	6.400	B	9.400	B	3.300	B		NA
Copper	106.000	EN		NA	37.900	EN	81.400	EN	29.800	EN		NA
Iron	53700.000			NA	20800.000		23900.000		14800.000			NA
Lead	**286.000**	*		NA	**157.000**	*	**119.000**		**107.000**	*		NA
Magnesium	6480.000			NA	29500.000		10200.000		44500.000			NA
Manganese	499.000			NA	685.000		542.000		1040.000			NA
Mercury	0.110	N		NA	0.090	UN	0.180	N	0.090	UN		NA
Nickel	26.300	N		NA	12.900	N	17.500	N	4.800	BN		NA
Potassium	733.000	B		NA	1710.000		1840.000		1300.000			NA
Selenium	1.800	N*		NA	0.700	BN*	0.910	BNS*	0.420	UN*		NA
Silver	0.840	U		NA	0.720	U	0.770	U	0.620	U		NA
Sodium	328.000	B		NA	424.000	B	472.000	B	593.000	B		NA
Thallium	0.480	B		NA	0.180	U	0.640	B	0.210	B		NA
Vanadium	17.500			NA	19.900		25.700	E	9.400	E		NA
Zinc	190.000	N*		NA	249.000	N*	220.000	N*	76.200	N*		NA
Cyanide	0.570	U		NA	3.800		0.670	U	0.640			NA

QUALIFIERS:

U: value is less than the instrument detection limit (IDL)
B: value is between the IDL and contract required limit
E: value is estimated due to interference
M: duplicate injection precision not met
N: spiked sample recovery not within control limits
*: Duplicate analysis not within control limit

NOTES:

[ ] - value exceeds standard/guideline
▒▒▒ - sample detection limit exceeds standard/guideline

Table 4-7 (cont'd.)

Subsurface Soil Results
Inorganic Compounds

INORGANICS	Area B BOSB7S(2-4) 7/18/90 (mg/kg)		Area B BOSB9S(11-13) 7/13/90 (mg/kg)		Area C BOMW6S(1-4) 7/11/90 (mg/kg)		Area C BOSB4S(6-8) 7/12/90 (mg/kg)	Area C BOSB4S(11-13) 7/12/90 (mg/kg)		Area C BOSB10S(0-2) 7/10/90 (mg/kg)	
Aluminum	14800.000	*	20500.000	*	13500.000	*	NA	25000.000	*	11200.000	*
Antimony	3.300	UN	4.700	BN	10.400	BN	NA	3.800	UN	4.800	BN
Arsenic	2.300	N*	3.000	BN*	17.200	NS*	NA	1.400	BN*	5.600	N*
Barium	130.000	N*	121.000	N*	599.000	N*	NA	252.000	N*	109.000	N*
Beryllium	1.700		0.820	B	1.500		NA	1.200		1.200	
Cadmium	0.630	B	0.340	B	2.400		NA	0.290	B	0.780	B
Calcium	118000.000		78500.000		62500.000		NA	72100.000		84400.000	
Chromium	10.100	N*	27.600	N*	84.900	N*	NA	33.200	N*	12.500	N*
Cobalt	3.700	B	14.200		7.400	B	NA	16.800		4.800	B
Copper	23.400	EN	25.600	EN	138.000	N	NA	31.100	EN	28.500	N*
Iron	18900.000		30200.000		25400.000		NA	34400.000		14500.000	
Lead	99.100	*	11.200		**1350.000**		NA	11.500		**171.000**	*
Magnesium	47300.000		16700.000		19200.000		NA	16400.000		39500.000	
Manganese	1110.000		560.000		705.000		NA	658.000		792.000	
Mercury	0.090	UN	0.130	UN	0.150	N	NA	0.110	UN	0.100	UN
Nickel	6.200	BN	28.600	N	21.100	N	NA	33.800	N	10.700	N
Potassium	1720.000		5350.000		1580.000		NA	5980.000		1800.000	
Selenium	0.360	UN*	0.380	UN*	1.500	N*	NA	0.450	UN*	0.670	BN*
Silver	0.730	U	0.950	U	0.860	U	NA	0.840	U	0.800	U
Sodium	701.000	B	609.000	B	651.000	B	NA	777.000	B	510.000	B
Thallium	0.180	B	0.190	U	0.470	U	NA	0.220	U	0.380	U
Vanadium	13.800	E	36.800		21.600		NA	47.400		17.400	
Zinc	74.200	N*	75.200	N*	**417.000**	N*	NA	74.800	N*	103.000	N*
Cyanide	2.300		0.670	U	0.720		NA	0.680	U	0.660	

QUALIFIERS:

U: value is less than the instrument detection limit (IDL)
B: value is between the IDL and contract required limit
E: value is estimated due to interference
M: duplicate injection precision not met
N: spiked sample recovery not within control limits
*: Duplicate analysis not within control limit

NOTES:

- value exceeds standard/guideline
- sample detection limit exceeds standard/guideline

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Table 4-7 (cont'd.)

Subsurface Soil Results
Inorganic Compounds

INORGANICS	Area D BOMW7S(5-7) 7/11/90 (mg/kg)		Area D BOMW9S(0-2) 7/12/90 (mg/kg)		Area D BOSB2S(6-8) 7/10/90 (mg/kg)		Area D BOSB5S(3-7.5) 7/10/90 (mg/kg)		Area D BOSB8S(2-4) 7/10/90 (mg/kg)		NJDEP Soil Action Levels (mg/kg)
Aluminum	11500.000	*	NA		NA		7350.000	*	NA		-
Antimony	3.600	UN	NA		NA		10.500	BN	NA		-
Arsenic	2.800	N*	NA		NA		**27.400**	N*	NA		20.000
Barium	115.000	B	NA		NA		3170.000	N*	NA		-
Beryllium	0.490	B	NA		NA		0.350	B	NA		-
Cadmium	0.530	B	NA		NA		**19.300**		NA		3.000
Calcium	84800.000		NA		NA		54000.000		NA		-
Chromium	13.000	N*	NA		NA		**200.000**	N*	NA		100.000
Cobalt	6.400	B	NA		NA		11.000	B	NA		-
Copper	30.300	N	NA		NA		**1160.000**	N	NA		170.000
Iron	16200.000		NA		NA		30500.000		NA		-
Lead	90.000	*	NA		NA		**27700.000**	*	NA		100.000
Magnesium	44500.000		NA		NA		14000.000		NA		-
Manganese	565.000		NA		NA		389.000		NA		-
Mercury	0.110	UN	NA		NA		**1.700**	N	NA		1.000
Nickel	14.200	N	NA		NA		**182.000**	N	NA		100.000
Potassium	3410.000		NA		NA		1280.000		NA		-
Selenium	0.450	BN*	NA		NA		0.460	BN*	NA		4.000
Silver	0.800	U	NA		NA		2.000	B	NA		5.000
Sodium	397.000	B	NA		NA		1540.000		NA		-
Thallium	0.410	U	NA		NA		0.380	U	NA		-
Vanadium	21.700		NA		NA		21.100		NA		-
Zinc	108.000	N*	NA		NA		**3040.000**	N*	NA		350.000
Cyanide	0.580	U	NA		NA		8.900		NA		-

QUALIFIERS:

U: value is less than the instrument detection limit (IDL)
B: value is between the IDL and contract required limit
E: value is estimated due to interference
M: duplicate injection precision not met
N: spiked sample recovery not within control limits
*: Duplicate analysis not within control limit

NOTES:

- value exceeds standard/guideline
- sample detection limit exceeds standard/guideline

Table 4- 8
Subsurface Soil Results
Pesticides/PCB's

PESTICIDES/PCBs	Area A BOMW1S(0-2) 7/12/90 (mg/kg)		Area A BOMW4S(0-2) 7/16/90 (mg/kg)		Area A BOSB1S(7-9) 7/13/90 (mg/kg)		Area A BOSB12S(2-4) 7/18/90 (mg/kg)		Area B BOMW5S(4-6) 7/16/90 (mg/kg)		Area B BOMW8S 7/17/90 (mg/kg)	
DILUTION FACTOR	5.750		1.200		6.500		1.250		1.430		5.750	
Aldrin	0.023	U		NA	0.026	U	0.010	U	0.011	U		NA
PCB - 1242	**13.000**		**25.000**		**0.260**	U	**0.100**	U	**1.400**		**6.600**	
PCB - 1254	**0.460**	U	0.192	U	**0.520**	U	0.200	U	0.229	U	**1.700**	
PCB - 1260	0.460	U	5.200		2.000		0.200	U	1.100		0.920	U
PCB - 1248	**0.230**	U	0.096	U	**7.000**		0.100	U	0.114	U	**0.460**	U
4,4'-DDD	0.046	U		NA	0.052	U	0.020	U	0.023	U		NA

QUALIFIERS:

J: compound present below the detection limit
U: analyzed for but not detected (reported concentration is 1/2 sample detection limit)
B: compound is found in the blanks as well as the sample
UB: reported concentration is 1/2 sample detection limit

NOTES:

- value exceeds standard/guideline
- sample detection limit exceeds standard/guideline

Table 4-8 (cont'd.)

Subsurface Soil Results

Pesticides/PCB's

PESTICIDES/PCBs	Area B BOSB7S(2-4) 7/18/90 (mg/kg)	Area B BOSB9S(11-13) 7/13/90 (mg/kg)	Area C BOMW6S(1-4) 7/11/90 (mg/kg)	Area C BOSB4S(6-8) 7/12/90 (mg/kg)	Area C BOSB4S(11-13) 7/12/90 (mg/kg)	Area C BOSB10S(0-2) 7/10/90 (mg/kg)
DILUTION FACTOR	1.050	1.280	12.220	6.250	1.300	1.070
Aldrin	0.008 U	0.005 U	0.098 U	NA	0.005 U	0.009 U
PCB - 1242	**3.500**	0.051 U	**0.978** U	**0.250** U	0.052 U	**0.086** U
PCB - 1254	0.168 U	0.102 U	**23.000**	**0.500** U	0.104 U	0.171 U
PCB - 1260	1.600	1.200	13.000	3.700	0.104 U	0.960
PCB - 1248	0.084 U	**3.000**	**31.000**	**0.250** U	0.052 U	**0.930**
4,4'-DDD	0.017 U	0.010 U	0.196 U	NA	0.010 U	0.050

QUALIFIERS:

J: compound present below the detection limit

U: analyzed for but not detected (reported concentration is 1/2 sample detection limit)

B: compound is found in the blanks as well as the sample

UB: reported concentration is 1/2 sample detection limit

NOTES:

- value exceeds standard/guideline

- sample detection limit exceeds standard/guideline

Table 4-8 (cont'd.)

Subsurface Soil Results
Pesticides/PCB's

PESTICIDES/PCBs	Area D BOMW7S(5-7) 7/11/90 (mg/kg)		Area D BOMW9S(0-2) 7/12/90 (mg/kg)		Area D BOSB2S(6-8) 7/10/90 (mg/kg)		Area D BOSB5S(3-7.5) 7/10/90 (mg/kg)		Area D BOSB8S(2-4) 7/10/90 (mg/kg)		Preliminary Soil Cleanup Criteria (mg/kg)
DILUTION FACTOR	1.140		5.260		1.220		66.000		1.370		
Aldrin	0.0067	J		NA	0.010	U	0.528	U	0.012	U	---
PCB - 1242	**0.091**	U	**18.000**		**0.098**	U	**5.280**	U	**0.120**	U	0.085
PCB - 1254	0.182	U	**0.421**	U	0.195	U	**39.000**		0.219	U	0.275
PCB - 1260	2.000		6.100		0.195	U	10.560	U	1.100		---
PCB - 1248	**0.340**		**0.210**	U	0.098	U	**83.000**		**0.330**		0.205
4,4'-DDD	0.018	U		NA	0.020	U	1.056	U	0.022	U	---

QUALIFIERS:

J: compound present below the detection limit
U: analyzed for but not detected (reported concentration is 1/2 sample detection limit)
B: compound is found in the blanks as well as the sample
UB: reported concentration is 1/2 sample detection limit

NOTES:

- value exceeds standard/guideline
- sample detection limit exceeds standard/guideline

However, in th absence of NYSDEC and federal soil action levels for inorganics the New Jersey Department of Environmental Protection (NJDEP) Soil Action Levels were selected for comparison with the analyzed results.

Where applicable, the 95% confidence level arithmetic mean contaminant concentrations were calculated for these samples to obtain a representative value. The arithmetic mean is calculated as the sum of a detected concentrations, divided by the number of samples:

$$C_{ij} = \frac{\sum C_{ijx}}{N}$$

where:

C_{ij} = arithmetic mean concentration of contaminant i in medium j (mg/kg)

C_{ijx} = concentration of contaminant i in sample x in medium j (mg/kg)

N = number of samples in medium j in which contaminant i was detected

The upper 95% confidence level arithmetic mean is given by:

$$C_{95} = C_{ij} \pm 1.96 \frac{\sigma}{\sqrt{N}}$$

where:

C_{95} = upper 95 percent confidence level

Cij = arithmetic mean concentration of contaminant i in medium j (mg/kg)

σ = standard deviation of the arithmetic mean contaminant i on medium j

N = number of samples in medium j in which contaminant i was detected

The results of these calculations are summarized in Table 4-9 and 4-10.

Table 4-11 indicates that the following vegetation is associated with the disturbed and grassland habitat types found in the four areas of concern at the Booth Oil Site: chicory (Cichorium intybus), clover (Trifolium spp.), goldenrod (Soldago spp.), Queen Anne's lace (Daucus carola), field sow thistle (Sonchus aruensis), and fescue (Festuca) and purple loosestrife (Lythrum salcanria). Terrestrial plants may take in contaminants from the ambient air,

Table 4-9
Surficial Soils
Mean Contaminant Concentrations

VOLATILES	Area A Arith Mean (mg/kg)	Upper 95% Confidence Area A Arith Mean (mg/kg)	Area B Arith Mean (mg/kg)	Upper 95% Confidence Area B Arith Mean (mg/kg)	Area C Arith Mean (mg/kg)	Upper 95% Confidence Area C Arith Mean (mg/kg)	Area D Arith Mean (mg/kg)	Upper 95% Confidence Area D Arith Mean (mg/kg)	TOTAL Arith Mean (mg/kg)	Upper 95% Confidence TOTAL Arith Mean (mg/kg)	Playground Arith Mean (mg/kg)	Upper 95% Confidence Playground Arith Mean (mg/kg)
DILUTION FACTOR												
Benzene	0.175	0.413	0.187	0.441	0.004	N/A	0.003	N/A	0.122	0.354	0.004	0.005
Carbon Disulfide	0.047	0.107	0.165	0.388	0.005	N/A	0.003	N/A	0.072	0.235	0.004	0.005
1,1-Dichloroethane	0.392	0.930	0.165	0.388	0.003	N/A	0.003	N/A	0.186	0.589	0.004	0.005
1,2-Dichloroethene (tot	0.082	0.190	0.254	0.595	0.065	N/A	0.003	N/A	0.123	0.369	0.004	0.005
Ethylbenzene	0.247	0.584	0.165	0.388	0.006	N/A	0.003	N/A	0.139	0.411	0.004	0.005
Tetrachloroethene	0.072	0.166	0.652	1.550	0.007	N/A	0.003	N/A	0.243	0.902	0.004	0.005
Toluene	0.175	0.413	0.165	0.388	0.014	N/A	0.003	N/A	0.116	0.332	0.004	0.005
Trichloroethene	0.175	0.413	1.152	2.743	0.019	N/A	0.003	N/A	0.446	1.608	0.004	0.005
Xylene (total)	5.002	11.929	0.165	0.388	0.036	N/A	0.003	N/A	1.729	6.858	0.004	0.005

Table 4-9 (cont'd.)

Surficial Soils
Mean Contaminant Concentrations

SEMIVOLATILES	Area A Arith Mean (mg/kg)	Upper 95% Confidence Area A Arith Mean (mg/kg)	Area B Arith Mean (mg/kg)	Upper 95% Confidence Area B Arith Mean (mg/kg)	Area C Arith Mean (mg/kg)	Upper 95% Confidence Area C Arith Mean (mg/kg)	Area D Arith Mean (mg/kg)	Upper 95% Confidence Area D Arith Mean (mg/kg)	TOTAL Arith Mean (mg/kg)	Upper 95% Confidence TOTAL Arith Mean (mg/kg)	Playground Arith Mean (mg/kg)	Upper 95% Confidence Playground Arith Mean (mg/kg)
DILUTION FACTOR												
Acenaphthene	0.885	1.876	8.156	16.738	1.406	N/A	0.406	N/A	3.316	10.210	0.225	0.476
Acenaphthylene	0.981	1.703	8.156	16.738	1.406	N/A	0.140	N/A	3.303	10.203	0.249	0.467
Anthracene	0.951	1.715	8.156	16.738	1.406	N/A	0.087	N/A	3.285	10.200	0.244	0.469
Benzo(a)anthracene	1.301	1.580	8.156	16.738	1.406	N/A	0.406	N/A	3.454	10.238	0.533	0.709
Benzo(b)fluoranthene	1.551	1.619	8.156	16.738	1.800	N/A	1.500	N/A	3.786	10.336	0.520	0.825
Benzo(k)fluoranthene	0.943	1.718	8.156	16.738	0.810	N/A	0.406	N/A	3.236	10.168	0.455	0.822
Benzoic acid	4.568	8.327	39.544	81.155	6.816	N/A	0.200	N/A	15.873	49.449	0.092	0.131
Benzo(g,h,i)perylene	0.966	1.709	8.156	16.738	1.406	N/A	0.360	N/A	3.335	10.208	0.395	0.624
Benzo(a)pyrene	1.251	1.599	8.156	16.738	1.406	N/A	0.990	N/A	3.535	10.253	0.430	0.735
Butylbenzylphthalate	0.567	0.821	8.156	16.738	1.406	N/A	0.406	N/A	3.210	10.157	0.391	0.412
Chrysene	1.105	1.375	8.156	16.738	1.100	N/A	1.200	N/A	3.470	10.228	0.645	1.082
Dibenzo(a,h)anthracen	0.943	1.718	8.156	16.738	1.406	N/A	0.120	N/A	3.287	10.200	0.263	0.461
Dibenzofuran	0.971	1.707	8.156	16.738	1.406	N/A	0.042	N/A	3.284	10.201	0.263	0.461
2,4-Dimethylphenol	0.871	1.746	36.050	77.559	0.750	N/A	0.406	N/A	12.500	45.775	0.391	0.412
bis(2-Ethylhexyl)phthal	1.492	3.028	23.600	44.943	8.200	N/A	3.300	N/A	10.281	28.520	0.391	0.412
Fluoranthene	1.900	2.732	8.156	16.738	1.500	N/A	2.200	N/A	3.969	10.426	1.275	2.280
Fluorene	0.861	1.749	8.156	16.738	1.406	N/A	0.406	N/A	3.308	10.203	0.288	0.452
Indeno(1,2,3-cd)pyrene	0.961	1.711	8.156	16.738	1.406	N/A	0.900	N/A	3.423	10.228	0.425	0.695
2-Methylnaphthalene	4.000	6.772	2.900	4.147	1.100	N/A	0.120	N/A	2.503	5.161	0.140	0.209
2-Methylphenol	0.943	1.718	24.982	56.883	1.406	N/A	0.406	N/A	8.944	33.164	0.391	0.412
4-Methylphenol	0.956	1.713	186.500	426.959	1.406	N/A	0.406	N/A	62.787	247.104	0.391	0.412
Naphthalene	1.351	1.560	7.629	16.941	1.406	N/A	0.068	N/A	3.239	10.155	0.076	0.109
Di-n-octylphthalate	0.826	1.763	8.874	16.461	1.406	N/A	0.406	N/A	3.535	10.392	0.391	0.412
Phenanthrene	2.250	3.428	2.182	2.484	1.700	N/A	0.620	N/A	1.864	2.940	1.185	2.315
Phenol	0.943	1.718	105.982	250.144	1.406	N/A	0.406	N/A	35.944	143.828	0.391	0.412
Pyrene	1.550	2.174	8.924	16.441	1.900	N/A	1.300	N/A	4.025	10.511	0.870	1.605

Table 4-9 (cont'd.)

Surficial Soils
Mean Contaminant Concentrations

INORGANICS	Area A Arith Mean (mg/kg)	Upper 95% Confidence Area A Arith Mean (mg/kg)	Area B Arith Mean (mg/kg)	Upper 95% Confidence Area B Arith Mean (mg/kg)	Area C Arith Mean (mg/kg)	Upper 95% Confidence Area C Arith Mean (mg/kg)	Area D Arith Mean (mg/kg)	Upper 95% Confidence Area D Arith Mean (mg/kg)	TOTAL Arith Mean (mg/kg)	Upper 95% Confidence TOTAL Arith Mean (mg/kg)	Playground Arith Mean (mg/kg)	Upper 95% Confidence Playground Arith Mean (mg/kg)
Aluminum	10950.000	11157.889	25450.000	33973.465	13300.000	N/A	15400.000	N/A	16916.667	26844.996	15650.000	17105.226
Antimony	6.100	6.793	79.850	185.389	4.800	N/A	4.200	N/A	30.150	108.163	4.200	4.339
Arsenic	24.300	26.933	8.200	13.882	21.200	N/A	80.700	N/A	27.817	62.120	12.700	18.105
Barium	153.000	201.508	1472.500	3035.135	237.000	N/A	281.000	N/A	628.167	1854.259	127.000	136.702
Beryllium	1.250	1.458	3.800	6.295	0.970	N/A	0.990	N/A	2.010	4.288	0.980	1.146
Cadmium	1.450	1.658	4.550	9.331	2.400	N/A	2.900	N/A	2.883	6.170	0.945	0.980
Calcium	96100.000	111206.629	130300.000	208882.191	73300.000	N/A	25800.000	N/A	91983.333	159801.713	13250.000	14566.633
Chromium	21.800	23.463	95.900	173.651	29.700	N/A	31.200	N/A	49.383	113.558	24.500	26.717
Cobalt	6.750	6.958	7.200	13.298	8.100	N/A	15.400	N/A	8.567	14.111	9.950	10.158
Copper	79.300	84.428	297.850	634.839	73.900	N/A	89.900	N/A	153.017	393.956	53.900	75.550
Iron	27650.000	28550.854	29500.000	51397.683	23800.000	N/A	56500.000	N/A	32433.333	52170.327	32150.000	35545.527
Lead	550.500	897.675	1835.000	2451.739	744.000	N/A	469.000	N/A	997.333	1921.440	118.000	138.789
Magnesium	38400.000	57110.045	35400.000	65474.666	25300.000	N/A	12400.000	N/A	30883.333	55106.641	7625.000	8505.065
Manganese	911.000	959.508	1795.000	2841.377	745.000	N/A	751.000	N/A	1151.333	2030.062	705.500	768.560
Mercury	0.225	0.287	0.165	0.172	0.230	N/A	0.310	N/A	0.220	0.297	0.120	0.120
Nickel	18.000	19.663	25.050	45.908	22.400	N/A	29.000	N/A	22.917	36.193	27.400	28.509
Potassium	1500.000	1818.764	1965.000	2554.020	1990.000	N/A	2420.000	N/A	1890.000	2476.201	2385.000	2544.382
Selenium	1.250	1.596	1.180	2.178	0.670	N/A	1.500	N/A	1.172	1.872	1.300	1.577
Silver	0.865	0.927	0.875	0.937	0.830	N/A	0.930	N/A	0.873	0.939	0.935	0.970
Sodium	458.000	478.789	1086.500	1576.426	301.000	N/A	286.000	N/A	612.667	1164.463	242.000	280.806
Thallium	0.475	0.524	0.590	0.701	0.420	N/A	0.620	N/A	0.528	0.653	0.515	0.550
Vanadium	21.000	23.079	20.050	28.851	21.700	N/A	45.600	N/A	24.900	38.775	36.700	39.056
Zinc	285.500	355.489	779.000	1362.476	343.000	N/A	940.000	N/A	568.667	1073.864	247.000	291.350
Cyanide	4.100	8.951	3.700	6.195	0.540	N/A	0.750	N/A	2.815	6.623	0.615	0.650

mss/bos-3

Table 4-9 (cont'd.)

Surficial Soils
Mean Contaminant Concentrations

PESTICIDES/PCBS	Group A Arith Mean (mg/kg)	Upper 95% Confidence Group A Arith Mean (mg/kg)	Group B Arith Mean (mg/kg)	Upper 95% Confidence Group B Arith Mean (mg/kg)	Group C Arith Mean (mg/kg)	Upper 95% Confidence Group C Arith Mean (mg/kg)	Group D Arith Mean (mg/kg)	Upper 95% Confidence Group D Arith Mean (mg/kg)	TOTAL Arith Mean (mg/kg)	Upper 95% Confidence TOTAL Arith Mean (mg/kg)	Group P Arith Mean (mg/kg)	Upper 95% Confidence Group P Arith Mean (mg/kg)
DILUTION FACTOR												
PCB-1242	0.329	0.517	6.790	16.563	0.885	1.454	0.097	0.098	1.792	4.773	0.095	0.154
PCB-1254	11.700	14.483	15.525	38.314	21.400	55.693	0.195	0.198	11.976	26.401	0.190	0.317
PCB-1260	7.933	11.193	22.967	36.631	3.620	6.225	0.195	0.198	7.684	14.520	0.190	0.317
PCB-1248	11.033	16.752	17.623	34.446	17.209	33.218	0.097	0.098	11.072	20.148	0.095	0.154

msub/bos-3

Table 4-10

Subsurface Soil
Mean Contaminant Concentrations

VOLATILES	Area A Arith. Mean (mg/kg)	95% Conf. Area A Arith. Mean (mg/kg)	Area B Arith. Mean (mg/kg)	95% Conf. Area B Arith. Mean (mg/kg)	Area C Arith. Mean (mg/kg)	95% Conf. Area C Arith. Mean (mg/kg)	Area D Arith. Mean (mg/kg)	95% Conf. Area D Arith. Mean (mg/kg)	TOTAL Arith. Mean (mg/kg)	95% Conf. TOTAL Arith. Mean (mg/kg)
DILUTION FACTOR										
Benzene	0.259	0.466	0.232	0.414	0.127	0.326	1.502	3.578	0.442	0.931
Carbon Disulfide	0.259	0.466	0.236	0.412	0.127	0.325	1.987	4.735	0.531	1.181
1,1-Dichloroethane	0.259	0.465	0.233	0.413	0.128	0.326	7.503	17.894	1.533	4.052
1,1-Dichloroethene	0.259	0.466	0.236	0.412	0.128	0.326	1.987	4.735	0.531	1.182
1,2-Dichloroethene (total)	0.336	0.632	3.791	7.644	0.228	0.550	80.002	190.874	15.734	42.730
Ethylbenzene	2.034	3.801	3.214	6.354	0.074	0.175	37.505	89.471	8.270	20.802
Tetrachloroethene	0.259	0.465	0.672	1.579	0.171	0.341	110.002	262.452	20.301	57.622
Toluene	0.259	0.466	3.360	7.045	0.104	0.261	150.002	357.889	28.289	79.082
Trichloroethene	0.196	0.365	0.236	0.412	0.150	0.330	85.002	202.803	15.614	44.465
1,1,1-Trichloroethane	0.259	0.465	0.523	1.087	0.128	0.326	11.002	26.245	2.249	5.945
Xylene (total)	11.701	24.501	17.410	35.071	0.423	1.045	195.004	465.255	43.510	108.665

msub/bos-3

Table 4-10 (cont'd.)

Subsurface Soil
Mean Contaminant Concentrations

SEMIVOLATILES	Area A Arith. Mean (mg/kg)	95% Conf. Area A Arith. Mean (mg/kg)	Area B Arith. Mean (mg/kg)	95% Conf. Area B Arith. Mean (mg/kg)	Area C Arith. Mean (mg/kg)	95% Conf. Area C Arith. Mean (mg/kg)	Area D Arith. Mean (mg/kg)	95% Conf. Area D Arith. Mean (mg/kg)	TOTAL Arith. Mean (mg/kg)	95% Conf. TOTAL Arith. Mean (mg/kg)
DILUTION FACTOR										
Acenaphthene	0.460	0.711	0.459	0.683	0.762	1.546	8.165	19.024	1.943	4.582
Anthracene	0.336	0.678	0.459	0.683	0.762	1.546	1.835	4.115	0.758	1.332
Benzo(a)anthracene	0.713	1.360	0.459	0.683	0.762	1.546	1.875	4.099	0.868	1.441
Benzo(b)fluoranthene	1.112	2.543	0.459	0.683	0.692	1.546	1.905	4.088	0.963	1.640
Benzo(k)fluoranthene	0.728	1.586	0.459	0.683	0.762	1.546	1.905	4.088	0.878	1.469
Butylbenzylphthalate	0.460	0.711	0.459	0.683	0.762	1.546	5.115	11.747	1.388	2.998
Chrysene	1.143	2.163	0.459	0.683	0.682	1.339	3.560	8.050	1.270	2.370
1,2-Dichlorobenzene	0.460	0.711	0.459	0.683	0.322	0.416	3.415	7.691	0.959	2.000
1,4-Dichlorobenzene	0.460	0.711	0.459	0.683	0.229	0.317	0.610	0.998	0.424	0.565
Fluoranthene	1.640	3.320	0.458	0.683	0.221	0.517	3.255	7.059	1.224	2.287
Fluorene	1.489	3.660	0.720	1.128	0.692	1.544	1.905	4.088	1.138	1.949
2-Methylnaphthalene	16.473	33.144	9.543	17.195	1.396	3.560	70.380	166.868	20.273	43.486
4-Methylphenol	0.988	1.656	0.459	0.683	0.319	0.593	300.165	715.715	55.057	156.896
Naphthalene	3.008	7.403	5.337	10.340	0.686	1.737	38.165	90.602	9.402	22.032
N-Nitrosodiphenylamine (1)	0.460	0.711	0.970	1.620	0.762	1.546	3.640	3.862	1.260	1.992
Di-n-octylphthalate	0.324	0.676	0.340	0.459	0.739	1.540	1.905	4.088	0.729	1.306
Phenanthrene	5.570	11.684	1.430	2.022	1.257	3.053	28.000	64.034	7.343	16.300
Pyrene	2.643	4.893	0.399	0.638	0.655	1.528	28.200	65.343	6.135	15.307
1,2,4-Trichlorobenzene	0.460	0.711	0.636	1.003	0.762	1.546	1.905	4.088	0.853	1.408

msub/bos-3

Table 4-10 (cont'd.)

Subsurface Soil
Mean Contaminant Concentrations

INORGANICS	Area A Arith. Mean (mg/kg)	95% Conf. Area A Arith. Mean (mg/kg)	Area B Arith. Mean (mg/kg)	95% Conf. Area B Arith. Mean (mg/kg)	Area C Arith. Mean (mg/kg)	95% Conf. Area C Arith. Mean (mg/kg)	Area D Arith. Mean (mg/kg)	95% Conf. Area D Arith. Mean (mg/kg)	TOTAL Arith. Mean (mg/kg)	95% Conf. TOTAL Arith. Mean (mg/kg)
Aluminum	10296.667	13983.925	15633.333	19798.643	16566.667	23397.880	9425.000	1230.803	13303.636	16368.542
Antimony	3.500	3.777	3.600	4.510	6.333	9.620	7.050	11.831	4.945	6.515
Arsenic	21.333	38.306	2.333	2.934	8.067	15.628	15.100	32.147	11.400	18.780
Barium	118.000	128.656	115.567	131.998	320.000	552.816	1642.500	3759.507	449.609	964.657
Beryllium	0.850	0.950	1.340	1.766	1.300	1.460	0.420	0.517	1.028	1.272
Cadmium	1.190	1.389	0.547	0.713	. 1.157	2.177	9.915	22.922	2.592	5.732
Calcium	38100.000	62797.728	103833.333	124151.545	73000.000	83142.882	69400.000	90743.311	71236.364	88703.059
Chromium	26.867	43.057	14.767	25.162	43.533	77.987	106.500	236.084	42.591	74.648
Cobalt	8.967	11.165	7.067	12.778	9.667	15.500	8.700	11.888	8.591	11.040
Copper	75.100	106.962	26.267	29.271	65.867	123.598	595.150	1377.992	153.818	343.100
Iron	32800.000	49584.692	21300.000	28669.067	24766.667	33973.955	23350.000	33259.394	25754.545	32206.172
Lead	187.333	268.211	72.433	121.566	510.833	1186.337	13895.000	33027.754	2736.527	7406.515
Magnesium	15393.333	26811.093	36166.667	51796.862	25033.333	36681.126	29250.000	50385.422	26207.273	34811.403
Manganese	575.333	665.305	903.333	1179.954	718.333	781.151	477.000	598.962	685.909	810.879
Mercury	0.127	0.170	0.103	0.125	0.120	0.144	0.905	2.007	0.260	0.530
Nickel	18.900	25.191	13.200	25.540	21.867	32.556	98.100	214.379	32.555	60.960
Potassium	1427.667	1986.751	2790.000	4847.596	3120.000	5410.732	2345.000	3821.015	2427.545	3404.438
Selenium	1.137	1.676	0.387	0.415	0.873	1.385	0.455	0.462	0.736	1.010
Silver	0.777	0.832	0.767	0.920	0.833	0.862	1.400	2.232	0.903	1.113
Sodium	408.000	475.745	634.333	688.187	646.000	769.413	968.500	1760.559	636.545	82.045
Thallium	0.433	0.649	0.193	0.207	0.357	0.474	0.395	0.416	0.340	0.427
Vanadium	21.033	24.929	20.000	33.596	28.800	43.809	21.400	21.816	22.936	28.955
Zinc	219.667	246.925	75.200	76.124	198.267	373.774	1574.000	3605.772	420.673	913.828
Cyanide	1.680	3.377	1.203	2.081	0.687	0.715	4.740	10.505	1.835	3.275

msub/bos-3

Table 4-10 (cont'd.)

Subsurface Soil
Mean Contaminant Concentrations

PESTICIDES/PCBs	Area A Arith. Mean (mg/kg)	95% Conf. Area A Arith. Mean (mg/kg)	Area B Arith. Mean (mg/kg)	95% Conf. Area B Arith. Mean (mg/kg)	Area C Arith. Mean (mg/kg)	95% Conf. Area C Arith. Mean (mg/kg)	Area D Arith. Mean (mg/kg)	95% Conf. Area D Arith. Mean (mg/kg)	TOTAL Arith. Mean (mg/kg)	95% Conf. TOTAL Arith. Mean (mg/kg)
DILUTION FACTOR										
Aldrin	0.015	0.026	0.006	0.010	0.028	0.079	0.111	0.336	0.044	0.123
PCB - 1242	9.590	19.706	2.888	5.309	0.342	0.709	4.718	10.799	4.404	7.815
PCB - 1254	0.343	0.489	0.550	1.202	5.944	15.595	8.003	21.588	3.963	8.837
PCB - 1260	1.965	3.916	1.205	1.449	4.441	9.456	3.991	7.371	2.965	4.696
PCB - 1248	1.857	4.767	0.915	2.103	8.058	21.043	16.796	45.811	7.488	17.104
4,4'-DDD	0.030	0.053	0.013	0.022	0.064	0.164	0.223	0.672	0.091	0.249

Table 4-11

Animal and Vegetative Covertypes*
Within the Booth Oil Site

Type	Disturbed Lands	Grasslands (Mowed Areas)	(Overgrown) Grasslands)	Shrub
Plants				
Queen Anne's Lace	X		X	
Purple Loosestrife			X	X
Clover	X	X		
Chicory	X		X	
Goldenrod	X		X	X
Thistle		X		
Fescues		X		
Trees				
Tree of Heaven				X
Sumacs				X
Red Maple (sapling)				X
American Elm (sapling)				X
Animals				
Rabbits			X	X
Mice	X		X	
Vole		X		
Crow			X	X
Mourning Dove		X	X	
Robin		X	X	X
Starling			X	X
Snakes	X		X	
Sparrows			X	X
Frogs	X	X	X	X

* Animal and plant lists refer to the most abundant types only.

** Although a major portion of the site can be considered "disturbed land," in this context these lands include portions of the site which still have extant structures or debris piles which are largely unvegetated.

MWi = molecular weight of contaminant i (g/mole)

The only organic chemicals encountered in the soil at the Booth Oil Site not expected to bioconcentrate in plants through root uptake, based on BCF_p values, are butylbenzylphthalate, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, PCB-1254 and PCB-1260. In addition, arsenic, cadmium, lead, mercury and zinc are not expected to bioconcentrate based on inorganic BCF_p values.

Table 4-12 through 4-19 lists calculated BCF_p values for organic contaminants detected in the surficial and subsurface soils of the four areas of concern at the Booth Oil Site during the Phase I RI and the estimated tissue concentrations for shallow and deep-rooted plants. The BCF_p values reported in the literature for organic contaminants in plants are generally greater than 1.0, indicating that the potential for bioconcentration. Conversely, the BCF_p values reported in the literature for inorganics in terrestrial habitats are generally less than 1.0, with some exceptions (Van Hook, 1978).

A review of Tables 4-12 and 4-13 indicates that in Area A concentrations of inorganic contaminants are highest in the surficial soil (1.28E+03 mg/kg) and concentrations of organic contaminants are highest in the subsurface soil (1.41E+02 mg/kg). The only contaminants not expected to bioconcentrate to levels greater than 1.0 mg/kg in plant rooted in the surficial soil layer

TABLE 4-12
Area A - Contaminant Concentration in Surficial Soil
and Predicted Concentration in Vegetation

	Upper 95% Confidence Group I Arith Mean (mg/kg)	Molecular Weight (g/mole)	Plant Bioconcentration Factor	Concentrations in Plants Due to Surficial Soils (mg/kg)
VOLATILES				
Benzene	4.13E-01	78	26.94	1 11E+01
Carbon Disulfide	1.07E-01	76	28.66	3.07E+00
1,1-Dichloroethane	9.30E-01	99	15.25	1 42E+01
1,2-Dichloroethene (total)	1 90E-01	97	16.02	3.04E+00
Ethylbenzene	5 84E-01	106	12.96	7 57E+00
Tetrachloroethene	1 66E-01	166	4.45	7.38E-01
Toluene	4.13E-01	92	18.17	7 50E+00
Trichloroethene	4.13E-01	131	7 82	3 23E+00
Xylene (total)	1.19E+01	106	12 96	1 55E+02
SEMI-VOLATILES				
Acenaphthene	1.88E+00	154	5.32	9.98E+00
Acenaphthylene	1 70E+00	152	5 49	9 34E+00
Anthracene	1 72E+00	178	3 76	6 46E+00
Benzo(a)anthracene	1 58E+00	228	2 09	3 30E+00
Benzo(b)fluoranthene	1 62E+00	252	1 64	2 66E+00
Benzo(k)fluoranthene	1 72E+00	252	1 64	2.82E+00
Benzoic acid	8 33E+00	122	9.27	7.72E+01
Benzo(a)pyrene	1 60E+00	252	1.64	2 63E+00
Butylbenzylphthalate	8.21E-01	312	0.99	8 11E-01
Chrysene	1 38E+00	228	2 09	2.87E+00
Dibenzo(a,h)anthracene	1 [illegible]E+00	278	1 30	2.23E+00
2,4-Dimethylphenol	1.75E+00	122	9 27	1 62E+01
bis(2-Ethylhexyl)phthalate	3.03E+00	391	0.58	1 75E+00
Fluoranthene	2.73E+00	202	2.78	7.61E+00
Fluorene	1.75E+00	116	10.45	1.83E+01
Indeno(1,2,3-cd)pyrene	1 71E+00	276	1 32	2 26E+00
2-Methylnaphthalene	6 77E+00	142	6 45	4 37E+01
2-Methylphenol	1.72E+00	108	12.40	2 13E+01
4-Methylphenol	1 71E+00	108	12.40	2 12E+01
Naphthalene	1.56E+00	128	8.27	1.29E+01
Di-n-octylphthalate	1.76E+00	391	0.58	1 02E+00
Phenanthrene	3.43E+00	178	3.76	1 29E+01
Phenol	1.72E+00	94	17.26	2.97E+01
Pyrene	2.17E+00	202	2.78	6.05E+00
INORGANICS				
Arsenic	2.69E+01	75	0.01	2.69E-01
Cadmium	1.66E+00	112	0.30	4 97E-01
Lead	8.98E+02	207	0 07	6 28E+01
Mercury	2.87E-01	201	0 40	1 15E-01
Zinc	3.55E+02	65	0.40	1 42E+02
PESTICIDES/PCBs				
PCB-1242	5 17E-01	267	1 43	7 40E-01
PCB-1254	1 45E+01	328	0 88	1 27E+01
PCB-1260	1.12E+01	376	0.63	7.08E+00
PCB-1248	1.68E+01	300	1.08	1.82E+01
TOTALS:				
TOTAL ORGANICS	1.14E+02			5.59E+02
TOTAL INORGANIC	1.28E+03			2.06E+02

TABLE 4-13
Area A - Contaminant Concentration in Subsurface Soil
And Predicted Concentration in Vegetation

	95% Conf. Group I Arith. Mean (mg/kg)	Molecular Weight (g/mole)	Plant Bioconcentration Factor	Concentration in Plants Due to Subsurface Soils (mg/kg)
VOLATILES				
Benzene	4 66E-01	78	26.94	1.26E+01
Carbon Disulfide	4 66E-01	76	28.66	1 34E+01
1,1-Dichloroethane	4.65E-01	99	15.25	7 09E+00
1,1-Dichloroethene	4.66E-01	97	16 02	7 46E+00
1,2-Dichloroethene (total)	6 32E-01	97	16 02	1 01E+01
Ethylbenzene	3 80E+00	106	12 96	4 93E+01
Tetrachloroethene	4 65E-01	166	4 45	2 07E+00
Toluene	4 66E-01	92	18.17	8.47E+00
Trichloroethene	3.65E-01	131	7.82	2 85E+00
1,1,1-Trichloroethane	4 65E-01	133	7.54	3.51E+00
Xylene (total)	2.45E+01	106	12.96	3.18E+02
SEMIVOLATILES				
Acenaphthene	7.11E-01	154	5.32	3.78E+00
Anthracene	6.78E-01	178	3.76	2 55E+00
Benzo(a)anthracene	1 36E+00	228	2 09	2.84E+00
Benzo(b)fluoranthene	2.54E+00	252	1 64	4 18E+00
Benzo(k)fluoranthene	1 59E+00	252	1 64	2.61E+00
Butylbenzylphthalate	7.11E-01	312	0.99	7 02E-01
Chrysene	2 16E+00	228	2 09	4 51E+00
1,2-Dichlorobenzene	7 11E-01	147	5 94	4 22E+00
1,4-Dichlorobenzene	7 11E-01	147	5.94	4 22E+00
Fluoranthene	3.32E+00	202	2 78	9 24E+00
Fluorene	3 66E+00	116	10 45	3 83E+01
2-Methylnaphthalene	3 31E+01	142	6.45	2.14E+02
4-Methylphenol	1 66E+00	108	12.40	2.05E+01
Naphthalene	7.40E+00	128	8.27	6 12E+01
N-Nitrosodiphenylamine (1)	7 11E-01	198	2 92	2 08E+00
Di-n-octylphthalate	6 76E-01	391	0.58	3.90E-01
Phenanthrene	1.17E+01	178	3 76	4 40E+01
Pyrene	4.89E+00	202	2.78	1 36E+01
1,2,4-Trichlorobenzene	7 11E-01	181	3 62	2 57E+00
INORGANICS				
Arsenic	3 83E+01	75	0 01	3 83E-01
Cadmium	1 39E+00	112	0.30	4.17E-01
Lead	2.68E+02	207	0.07	1 88E+01
Mercury	1 70E-01	201	0.40	6 80E-02
Zinc	2.47E+02	65	0.40	9.88E+01
PESTICIDES/PCBS				
Aldrin	2 60E-02	365	0.68	1.77E-02
PCB - 1242	1.97E+01	267	1.43	2.82E+01
PCB - 1254	4 89E-01	328	0.88	4 28E-01
PCB - 1260	3.92E+00	376	0.63	2.48E+00
PCB - 1248	4 77E+00	300	1 08	5 17E+00
4,4'-DDD	5.30E-02	320	0.93	4.93E-02
TOTALS:				
TOTAL ORGANICS	1.41E+02			9 06E+02
TOTAL INORGANICS	5.55E+02			1 18E+02

of Area A are trichloroethene (7.38E-01 mg/kg), butylbenyzlphthalate (8.11E-01 mg/kg), arsenic (2.69E-01 mg/kg). cadmium (4.97E-01 mg/kg), mercury (1.15E-01 mg/kg) and PCB-1242 (7.40E-01). The only contaminants not expected to bioconcentrate to levels greater than 1.0 mg/kg in the deep rooted plant tissue are butylbenzylphthalate (7.02E-01 mg/kg), di-n-octylphthalate (3.90E-01 mg/kg), arsenic (3.8E-01 mg/kg), cadmium (4.17E-01 mg/kg), mercury (6.08E-02 mg/kg), aldrin (1.77E-02 mg/kg), PCB-1254 (4.28E-01 mg/kg) and 4,4'-DDD (4.93E-02 mg/kg).

Tables 4-14 and 4-15 indicate the majority of all organic (1.34E+03 mg/kg) and inorganic (3.84E+03 mg/kg) contamination is in the surficial soil layer of Area B. The only compounds not expected to bioconcentrate to levels greater than 1.0 mg/kg in the shallow root systems of plants are arsenic (1.39E-01 mg/kg) and mercury (6.88E-02 mg/kg). Butylbenzylphthalate (6.74E-01 mg/kg), arsenic (2.93E-02 mg/kg),cadmium (2.14E-01 mg/kg), mercury (5.00E-02 mg/kg), aldrin (6.79E-03 mg/kg), PCB-1260 (9.17E-01 mg/kg) and 4,4'-DDD (2.04E-02 mg/kg) are not expected to bioconcentrate to levels above 1.0 mg/kg in the tissues of deep rooted plants found in Area B.

Organic contaminant concentrations are highest in the surficial soils (1.42E+02 mg/kg) of Area C and the inorganic contaminant concentrations are highest in the subsurface soil layer (1.58E+03 mg/kg), as illustrated in Tables 4-16 and 4-17.

TABLE 4-14
Area B - Contaminant Concentration in Surficial Soil
and Predicted Concentration in Vegetation

	Upper 95% Confidence Group I Arith Mean (mg/kg)	Molecular Weight (g/mole)	Plant Bioconcentration Factor	Concentrations in Plants Due to Surficial Soils (mg/kg)
VOLATILES				
Benzene	4.41E-01	78	26.94	1 19E+01
Carbon Disulfide	3.88E-01	76	28.66	1 11E+01
1,1-Dichloroethane	3.88E-01	99	15.25	5 92E+00
1,2-Dichloroethene (total)	5.95E-01	97	16.02	9 53E+00
Ethylbenzene	3.88E-01	106	12.96	5.03E+00
Tetrachloroethene	1.55E+00	166	4 45	6.89E+00
Toluene	3.88E-01	92	18.17	7.05E+00
Trichloroethene	2.74E+00	131	7.82	2.15E+01
Xylene (total)	3.88E-01	106	12 96	5 03E+00
SEMI-VOLATILES				
Acenaphthene	1.67E+01	154	5 32	8 90E+01
Acenaphthylene	1 67E+01	152	5.49	9 18E+01
Anthracene	1.67E+01	178	3.76	6 30E+01
Benzo(a)anthracene	1.67E+01	228	2.09	3 49E+01
Benzo(b)fluoranthene	1.67E+01	252	1.64	2 75E+01
Benzo(k)fluoranthene	1.67E+01	252	1.64	2 75E+01
Benzoic acid	8 12E+01	122	9.27	7.52E+02
Benzo(a)pyrene	1 67E+01	252	1.64	2.75E+01
Butylbenzylphthalate	1 67E+01	312	0.99	1.65E+01
Chrysene	1 67E+01	228	2 09	3 49E+01
Dibenzo(a,h)anthracene	1 67E+01	278	1.30	2.18E+01
2,4-Dimethylphenol	7 76E+01	122	9 27	7 19E+02
bis(2-Ethylhexyl)phthalate	4 49E+01	391	0.58	2.59E+01
Fluoranthene	1 67E+01	202	2.78	4.66E+01
Fluorene	1 67E+01	116	10.45	1 75E+02
Indeno(1,2,3-cd)pyrene	1 67E+01	276	1.32	2.21E+01
2-Methylnaphthalene	4 15E+00	142	6.45	2.68E+01
2-Methylphenol	5 69E+01	108	12.40	7.05E+02
4-Methylphenol	4 27E+02	108	12.40	5.29E+03
Naphthalene	1 69E+01	128	8.27	1.40E+02
Di-n-octylphthalate	1.65E+01	391	0.58	9.49E+00
Phenanthrene	2.48E+00	178	3.76	9.35E+00
Phenol	2.50E+02	94	17.26	4.32E+03
Pyrene	1.64E+01	202	2 78	4.58E+01
INORGANICS				
Arsenic	1.39E+01	75	0 01	1.39E-01
Cadmium	9.33E+00	112	0.30	2.80E+00
Lead	2.45E+03	207	0.07	1.72E+02
Mercury	1 72E-01	201	0.40	6 88E-02
Zinc	1.36E+03	65	0.40	5 45E+02
PESTICIDES/PCBs				
PCB-1242	1.66E+01	267	1.43	2.37E+01
PCB-1254	3.83E+01	328	0.88	3.36E+01
PCB-1260	3.66E+01	376	0.63	2.32E+01
PCB-1248	3.44E+01	300	1.08	3.73E+01
TOTALS:				
TOTAL ORGANICS	1.34E+03			1.29E+04
TOTAL INORGANICS	3.84E+03			7.20E+02

TABLE 4-15
Area B - Contaminant Concentration in Subsurface Soil
And Predicted Concentration in Vegetation

	95% Conf. Group I Arith. Mean (mg/kg)	Molecular Weight (g/mole)	Plant Bioconcentration Factor	Concentration in Plants Due to Subsurface Soils (mg/kg)
VOLATILES				
Benzene	4 14E-01	78	26.94	1.12E+01
Carbon Disulfide	4 12E-01	76	28 66	1 18E+01
1,1-Dichloroethane	4 13E-01	99	15.25	6 30E+00
1,1-Dichloroethene	4 12E-01	97	16 02	6 60E+00
1,2-Dichloroethene (total)	7 64E+00	97	16.02	1 22E+02
Ethylbenzene	6.35E+00	106	12.96	8 24E+01
Tetrachloroethene	1 58E+00	166	4 45	7 02E+00
Toluene	7.05E+00	92	18.17	1 28E+02
Trichloroethene	4.12E-01	131	7.82	3.22E+00
1,1,1-Trichloroethane	1.09E+00	133	7.54	8.20E+00
Xylene (total)	3 51E+01	106	12.96	4.55E+02
SEMIVOLATILES				
Acenaphthene	6.83E-01	154	5.32	3 63E+00
Anthracene	6.83E-01	178	3.76	2 57E+00
Benzo(a)anthracene	6.83E-01	228	2.09	1 42E+00
Benzo(b)fluoranthene	6.83E-01	252	1.64	1.12E+00
Benzo(k)fluoranthene	6.83E-01	252	1.64	1 12E+00
Butylbenzylphthalate	6 83E-01	312	0.99	6 74E-01
Chrysene	6.83E-01	228	2 09	1 42E+00
1,2-Dichlorobenzene	6.83E-01	147	5.94	4 06E+00
1,4-Dichlorobenzene	6 83E-01	147	5.94	4.06E+00
Fluoranthene	6.83E-01	202	2.78	1 90E+00
Fluorene	1 13E+00	116	10 45	1 18E+01
2-Methylnaphthalene	1.72E+01	142	6 45	1.11E+02
4-Methylphenol	6.83E-01	108	12.40	8.47E+00
Naphthalene	1.03E+01	128	8 27	8.55E+01
N-Nitrosodiphenylamine (1)	1.62E+00	198	2.92	4.73E+00
Di-n-octylphthalate	4 59E-01	391	0.58	2 65E-01
Phenanthrene	2 02E+00	178	3 76	7 61E+00
Pyrene	6.83E-01	202	2 78	1 90E+00
1,2,4-Trichlorobenzene	1.00E+00	181	3 62	3.63E+00
INORGANICS				
Arsenic	2.93E+00	75	0 01	2 93E-02
Cadmium	7 13E-01	112	0 30	2 14E-01
Lead	1.22E+02	207	0.07	8.51E+00
Mercury	1.25E-01	201	0 40	5.00E-02
Zinc	7.61E+01	65	0.40	3.04E+01
PESTICIDES/PCBS				
Aldrin	1.00E-02	365	0.68	6.79E-03
PCB - 1242	5.31E+00	267	1.43	7.60E+00
PCB - 1254	1.20E+00	328	0.88	1.05E+00
PCB - 1260	1 45E+00	376	0.63	9 17E-01
PCB - 1248	2.10E+00	300	1.08	2.28E+00
4,4'-DDD	2.20E-02	320	0 93	2.04E-02
TOTALS				
TOTAL ORGANICS	1.13E+02			1 11E+03
TOTAL INORGANICS	2.01E+02			3.93E+01

TABLE 4-16
Area C - Contaminant Concentration in Surficial Soil
and Predicted Concentration in Vegetation

	Upper 95% Confidence Group I Arith Mean (mg/kg)	Molecular Weight (g/mole)	Plant Bioconcentration Factor	Concentrations in Plants Due to Surficial Soils (mg/kg)
VOLATILES				
Benzene	4 00E-03	78	26.94	1 08E-01
Carbon Disulfide	5.00E-03	76	28.66	1 43E-01
1,1-Dichloroethane	3.00E-03	99	15.25	4 58E-02
1,2-Dichloroethene (total)	6.50E-02	97	16.02	1 04E+00
Ethylbenzene	6.00E-03	106	12.96	7.78E-02
Tetrachloroethene	7 00E-03	166	4.45	3 11E-02
Toluene	1.40E-02	92	18.17	2 54E-01
Trichloroethene	1.90E-02	131	7.82	1 49E-01
Xylene (total)	3.60E-02	106	12.96	4 67E-01
SEMI-VOLATILES				
Acenaphthene	1 41E+00	154	5.32	7 48E+00
Acenaphthylene	1.41E+00	152	5 49	7 71E+00
Anthracene	1 41E+00	178	3 76	5 29E+00
Benzo(a)anthracene	1 41E+00	228	2.09	2 93E+00
Benzo(b)fluoranthene	1 80E+00	252	1.64	2 96E+00
Benzo(k)fluoranthene	8.10E-01	252	1.64	1.33E+00
Benzoic acid	6.82E+00	122	9.27	6.32E+01
Benzo(a)pyrene	1 41E+00	252	1.64	2.31E+00
Butylbenzylphthalate	1 3 E+00	312	0 99	1 39E+00
Chrysene	1 10E+00	228	2 09	2.29E+00
Dibenzo(a,h)anthracene	1 41E+00	278	1 30	1 83E+00
2,4-Dimethylphenol	7 50E-01	122	9.27	6.95E+00
bis(2-Ethylhexyl)phthalate	8 20E+00	391	0.58	4 73E+00
Fluoranthene	1.50E+00	202	2.78	4.18E+00
Fluorene	1 41E+00	116	10 45	1.47E+01
Indeno(1,2,3-cd)pyrene	1.41E+00	276	1.32	1 86E+00
2-Methylnaphthalene	1.10E+00	142	6 45	7 10E+00
2-Methylphenol	1.41E+00	108	12.40	1 74E+01
4-Methylphenol	1.41E+00	108	12.40	1 74E+01
Naphthalene	1.41E+00	128	8.27	1.16E+01
Di-n-octylphthalate	1.41E+00	391	0 58	8 10E-01
Phenanthrene	1.70E+00	178	3 76	6.40E+00
Phenol	1.41E+00	94	17 26	2.43E+01
Pyrene	1.90E+00	202	2 78	5.29E+00
INORGANICS				
Arsenic	2.12E+01	75	0.01	2 12E-01
Cadmium	2.40E+00	112	0 30	7 20E-01
Lead	7 44E+02	207	0 07	5.21E+01
Mercury	2.30E-01	201	0.40	9.20E-02
Zinc	3.43E+02	65	0.40	1.37E+02
PESTICIDES/PCBs				
PCB-1242	1.45E+00	267	1.43	2.08E+00
PCB-1254	5.57E+01	328	0.88	4.88E+01
PCB-1260	6.23E+00	376	0.63	3.94E+00
PCB-1248	3.32E+01	300	1.08	3.60E+01
TOTALS:				
TOTAL ORGANICS	1.42E+02			3.15E+02
TOTAL INORGANICS	1.11E+03			1.90E+02

TABLE 4-17
Area C - Contaminant Concentration in Subsurface Soil
And Predicted Concentration in Vegetation

	95% Conf Group I Arith. Mean (mg/kg)	Molecular Weight (g/mole)	Plant Bioconcentration Factor	Concentration in Plants Due to Subsurface Soils (mg/kg)
VOLATILES				
Benzene	3.26E-01	78	26 94	8 78E+00
Carbon Disulfide	3 25E-01	76	28 66	9 31E+00
1,1-Dichloroethane	3 26E-01	99	15 25	4 97E+00
1,1-Dichloroethene	3 26E-01	97	16 02	5 22E+00
1,2-Dichloroethene (total)	5 50E-01	97	16.02	8 81E+00
Ethylbenzene	1 75E-01	106	12.96	2.27E+00
Tetrachloroethene	3 41E-01	166	4.45	1.52E+00
Toluene	2.61E-01	92	18.17	4.74E+00
Trichloroethene	3.30E-01	131	7.82	2 58E+00
1,1,1-Trichloroethane	3.26E-01	133	7.54	2.46E+00
Xylene (total)	1 05E+00	106	12.96	1 35E+01
SEMIVOLATILES				
Acenaphthene	1 55E+00	154	5 32	8.22E+00
Anthracene	1.55E+00	178	3 76	5.82E+00
Benzo(a)anthracene	1.55E+00	228	2 09	3.23E+00
Benzo(b)fluoranthene	1.55E+00	252	1 64	2 54E+00
Benzo(k)fluoranthene	1.55E+00	252	1.64	2 54E+00
Butylbenzylphthalate	1 55E+00	312	0.99	1 53E+00
Chrysene	1 34E+00	228	2.09	2 79E+00
1,2-Dichlorobenzene	4 16E-01	147	5 94	2 47E+00
1,4-Dichlorobenzene	3 17E-01	147	5 94	1.88E+00
Fluoranthene	5.17E-01	202	2.78	1.44E+00
Fluorene	1.54E+00	116	10.45	1 61E+01
2-Methylnaphthalene	3.56E+00	142	6.45	2.30E+01
4-Methylphenol	5.93E-01	108	12.40	7 35E+00
Naphthalene	1.74E+00	128	8.27	1.44E+01
N-Nitrosodiphenylamine (1)	1.55E+00	198	2.92	4.52E+00
Di-n-octylphthalate	1 54E+00	391	0 58	8 88E-01
Phenanthrene	3.05E+00	178	3 76	1.15E+01
Pyrene	1.53E+00	202	2.78	4 25E+00
1,2,4-Trichlorobenzene	1 55E+00	181	3 62	5.59E+00
INORGANICS				
Arsenic	1.56E+01	75	0 01	1.56E-01
Cadmium	2.18E+00	112	0.30	6 53E-01
Lead	1.19E+03	207	0.07	8 30E+01
Mercury	1.44E-01	201	0.40	5.76E-02
Zinc	3.74E+02	65	0.40	1 50E+02
PESTICIDES/PCBS				
Aldrin	7.90E-02	365	0.68	5.36E-02
PCB - 1242	7.09E-01	267	1.43	1 01E+00
PCB - 1254	1.56E+01	328	0.88	1.37E+01
PCB - 1260	9.46E+00	376	0.63	5.98E+00
PCB - 1248	2.10E+01	300	1.08	2.28E+01
4,4'-DDD	1.64E-01	320	0.93	1.52E-01
TOTALS:				
TOTAL ORGANICS	7.99E+01			2 28E+02
TOTAL INORGANICS	1.58E+03			2.33E+02

Contaminants not expected to bioconcentrate to levels greater than 1.0 mg/kg in the shallow root plants include benzene (1.08E-01 mg/kg), carbon disulfide (1.43E-01 mg/kg), 1,1-dichloroethane (4.58E-02 mg/kg), ethylbenzene (7.78E-02 mg/kg), tetrachloroethene (3.11E-02 mg/kg), toluene (2.54E-01 mg/kg), trichloroethene (1.49E-01 mg/kg), total xylenes (4.67E-01 mg/kg), di-n-octylphthalate (8.10E-01 mg/kg), arsenic (2.12E-01 mg/kg), cadmium (7.20E-01 mg/kg) and mercury (9.20E-01 mg/kg). Contaminants not expected to bioconcentrate to levels above 1.0 mg/kg in deep root plants include di-n-octylphthalate (8.88E-01 mg/kg), arsenic (1.56E-01 mg/kg), cadmium (6.53E-01 mg/kg), mercury (5.76E-02 mg/kg), Aldrin (5.36E-02 mg/kg) and 4,4'-DDD (1.52E-01 mg/kg).

Results obtained from surficial and subsurface soil samples taken from Area D indicate that the highest inorganic (3.67E+04 mg/kg) and organic (2.90E+03 mg/kg) contaminant concentrations are found in the subsurface soil layer. (See Table 4-18). Shallow root plants are not expected to bioaccumulate the following contaminants:

benzene (8.08E-02 mg/kg),
carbon disulfide (8.60E-02 mg/kg),
1,1-dichloroethane (4.58E-02 mg/kg),
total 1,2-dichloroethene (4.80E-02 mg/kg),
ethylbenzene (3.89E-02 mg/kg),
tetrachloroethene (1.33E-02 mg/kg),
toluene (5.45E-02 mg/kg),
trichloroethene (2.35E-02 mg/kg),
total xylenes (3.89E-02 mg/kg),
acenaphthene (2.16E-01 mg/kg),
acenaphthylene (7.68E-02 mg/kg),
anthracene (3.28E-01 mg/kg),
benzo(a)anthracene (8.47E-01 mg/kg),
benzo(k)fluoranthene (6.67E-01 mg/kg),

TABLE 4-18
Area D - Contaminant Concentration in Surficial Soil
and Predicted Concentration in Vegetation

	Upper 95% Confidence Group I Arith Mean (mg/kg)	Molecular Weight (g/mole)	Plant Bioconcentration Factor	Concentrations in Plants Due to Surficial Soils (mg/kg)
VOLATILES				
Benzene	3.00E-03	78	26.94	8.08E-02
Carbon Disulfide	3.00E-03	76	28.66	8.60E-02
1,1-Dichloroethane	3.00E-03	99	15.25	4.58E-02
1,2-Dichloroethene (total)	3.00E-03	97	16.02	4.80E-02
Ethylbenzene	3.00E-03	106	12.96	3.89E-02
Tetrachloroethene	3.00E-03	166	4.45	1.33E-02
Toluene	3.00E-03	92	18.17	5.45E-02
Trichloroethene	3.00E-03	131	7.82	2.35E-02
Xylene (total)	3.00E-03	106	12.96	3.89E-02
SEMI-VOLATILES				
Acenaphthene	4.06E-02	154	5.32	2.16E-01
Acenaphthylene	1.40E-02	152	5.49	7.68E-02
Anthracene	8.70E-02	178	3.76	3.28E-01
Benzo(a)anthracene	4.06E-01	228	2.09	8.47E-01
Benzo(b)fluoranthene	1.50E+00	252	1.64	2.46E+00
Benzo(k)fluoranthene	4.06E-01	252	1.64	6.67E-01
Benzoic acid	2.00E-01	122	9.27	1.85E+00
Benzo(a)pyrene	9.90E-01	252	1.64	1.63E+00
Butylbenzylphthalate	4.06E-01	312	0.99	4.01E-01
Chrysene	1.20E+00	228	2.09	2.50E+00
Dibenzo(a,h)anthracene	1.20E-01	278	1.30	1.56E-01
2,4-Dimethylphenol	4.06E-01	122	9.27	3.76E+00
bis(2-Ethylhexyl)phthalate	3.30E+00	391	0.58	1.90E+00
Fluoranthene	2.20E+00	202	2.78	6.13E+00
Fluorene	4.06E-01	116	10.45	4.24E+00
Indeno(1,2,3-cd)pyrene	9.00E-01	276	1.32	1.19E+00
2-Methylnaphthalene	1.20E-01	142	6.45	7.74E-01
2-Methylphenol	4.06E-01	108	12.40	5.03E+00
4-Methylphenol	4.06E-01	108	12.40	5.03E+00
Naphthalene	6.80E-02	128	8.27	5.62E-01
Di-n-octylphthalate	4.06E-01	391	0.58	2.34E-01
Phenanthrene	6.20E-01	178	3.76	2.33E+00
Phenol	4.06E-01	94	17.26	7.01E+00
Pyrene	1.30E+00	202	2.78	3.62E+00
INORGANICS				
Arsenic	8.07E+01	75	0.01	8.07E-01
Cadmium	2.90E+00	112	0.30	8.70E-01
Lead	4.69E+02	207	0.07	3.28E+01
Mercury	3.10E-01	201	0.40	1.24E-01
Zinc	9.40E+02	65	0.40	3.76E+02
PESTICIDES/PCBs				
PCB-1242	9.80E-02	267	1.43	1.40E-01
PCB-1254	1.98E-01	328	0.88	1.74E-01
PCB-1260	1.98E-01	376	0.63	1.25E-01
PCB-1248	9.80E-02	300	1.08	1.06E-01
TOTALS:				
TOTAL ORGANICS	1.69E+01			5.39E+01
TOTAL INORGANICS	1.49E+03			4.11E+02

butylbenzylphthalate (4.01E-01 mg/kg),
dibenzo(a,h)anthracene (1.56E-01 mg/kg),
2-methylnaphthalene (7.74E-01 mg/kg),
naphthalene (5.62E-01 mg/kg),
di-n-octylphthalate (2.34E-01 mg/kg),
arsenic (8.07E-01 mg/kg),
cadmium (8.70E-01 mg/kg),
mercury (1.24E-01 mg/kg),
PCB-1242 - PBC-1260 (1.06E-01 - 1.74E-01 mg/kg).

Table 4-19 indicates that, overall, organic contaminants in the subsurface soils, are predicted to bioaccumulate on terrestrial plants in Area D, with the exception of aldrin (2.28E-01 mg/kg) and 4,4'-DDD (6.25E-01 mg/kg). In addition, arsenic (3.21E-01 mg/kg) and mercury are not expected to bioaccumulate in the subsurface soils of this area.

Reliable methods for the mathematical prediction of plant (Calamari et al., 1987; topp et al., 1986; Van Hook, 1978) and fish (Insard and Lambert, 1988; Lyman et al., 1982; Schurman and Klein, 1988) tissue concentrations from environmental contaminant levels and the physical/chemical properties of contaminants have been developed and are well documented. In contrast, the relationship between soil contaminant concentrations and tissue levels in terrestrial animals is not well documented, simple mathematical methods for estimating bioconcentration factors (BCFs) for terrestrial animals have not been developed.

The lack of data regarding the relationship between soil contamination and tissue levels in terrestrial animals may be attributed to the complex ecological interactions involved in the

TABLE 4-19
Area D - Contaminant Concentration in Subsurface Soil
And Predicted Concentration in Vegetation

	95% Conf Group I Arith. Mean (mg/kg)	Molecular Weight (g/mole)	Plant Bioconcentration Factor	Concentration in Plants Due to Subsurface Soils (mg/kg)
VOLATILES				
Benzene	3 58E+00	78	26 94	9.64E+01
Carbon Disulfide	4.74E+00	76	28.66	1 36E+02
1,1-Dichloroethane	1.79E+01	99	15.25	2 73E+02
1,1-Dichloroethene	4.74E+00	97	16.02	7 58E+01
1,2-Dichloroethene (total)	1.91E+02	97	16.02	3 06E+03
Ethylbenzene	8.95E+01	106	12.96	1 16E+03
Tetrachloroethene	2.62E+02	166	4.45	1.17E+03
Toluene	3.58E+02	92	18.17	6.50E+03
Trichloroethene	2.03E+02	131	7.82	1.59E+03
1,1,1-Trichloroethane	2.62E+01	133	7.54	1.98E+02
Xylene (total)	4 65E+02	106	12.96	6 03E+03
SEMIVOLATILES				
Acenaphthene	1.90E+01	154	5.32	1 01E+02
Anthracene	4 12E+00	178	3.76	1.55E+01
Benzo(a)anthracene	4 10E+00	228	2 09	8.55E+00
Benzo(b)fluoranthene	4.09E+00	252	1 64	6 72E+00
Benzo(k)fluoranthene	4 09E+00	252	1 64	6 72E+00
Butylbenzylphthalate	1 17E+01	312	0 99	1 16E+01
Chrysene	8 05E+00	228	2 09	1.68E+01
1,2-Dichlorobenzene	7.66E-00	147	5 94	4 57E+01
1,4-Dichlorobenzene	9.98E-01	147	5.94	5.93E+00
Fluoranthene	7.06E+00	202	2.78	1.97E+01
Fluorene	4.09E+00	116	10.45	4 27E+01
2-Methylnaphthalene	1 67E+02	142	6 45	1 08E+03
4-Methylphenol	7 16E+02	108	12 40	8 87E+03
Naphthalene	9.06E+01	128	8.27	7 49E+02
N-Nitrosodiphenylamine (1)	3.86E+00	198	2.92	1 13E+01
Di-n-octylphthalate	4.09E+00	391	0.58	2.36E+00
Phenanthrene	6 40E+01	178	3.76	2 41E+02
Pyrene	6.53E+01	202	2 78	1 82E+02
1,2,4-Trichlorobenzene	4 09E+00	181	3 62	1 48E+01
INORGANICS				
Arsenic	3.21E+01	75	0.01	3.21E-01
Cadmium	2.29E+01	112	0.30	6.88E+00
Lead	3.30E+04	207	0.07	2.31E+03
Mercury	2.01E+00	201	0.40	8 03E-01
Zinc	3.61E+03	65	0 40	1 44E+03
PESTICIDES/PCBS				
Aldrin	3.36E-01	365	0.68	2.28E-01
PCB - 1242	1.08E+01	267	1 43	1 55E+01
PCB - 1254	2.16E+01	328	0.88	1.89E+01
PCB - 1260	7.37E+00	376	0.63	4 66E+00
PCB - 1248	4.58E+01	300	1 08	4 97E+01
4,4'-DDD	6.72E-01	320	0 93	6.25E-01
TOTALS.				
TOTAL ORGANICS	2.90E+03			3 18E+04
TOTAL INORGANICS	3.67E+04			3 76E+03

exposure to and uptake to contaminants by these animals. Terrestrial animals often range over a particular area and are relatively more mobile than either plants or aquatic animals. Therefore, their exposure will vary according to their position relative to the contaminated area or source. This may be particularly true for the Booth Oil Site given the relatively small size of the site. Further, terrestrial animals may take in contaminants through inhalation of airborne contaminants, dermal contact with contaminated soil and water, and ingestion of contaminated soil, water and food. Unlike aquatic species, pollutant partitioning between the organism and the ambient environment is not a significant source of bioconcentration for most terrestrial organisms. Instead, ingestion appears to be the route of concern for contaminant uptake by terrestrial species; and for strongly lipophilic compounds, food appears to be a more significant source than ingested water in natural systems (Walker, 1987).

Morgan and Morgan (1988) examined the relationship between concentrations of cadmium, copper, lead and zinc in soils at contaminated and uncontaminated sites and tissue levels of these metals in earthworms (Lumbricus rubellus and Dendrodrilus rubidus) inhabiting the soil. The authors found that tissue concentrations of cadmium consistently exceeded the cadmium concentrations in the soil (i.e., BCF_{worm} >1.0), while tissue concentrations of copper and lead were generally lower than those of the soil (i.e., BCF_{worm} <

1.0). Zinc appeared to be bioaccumulated at soil concentrations below 900 ug/g, while above this value, tissue concentrations were lower than soil levels (i.e., $BCF_{worm} < 1.0$).

Table 4-20 presents BCFs for terrestrial organisms reported by Van Hook (1978) for several inorganic compounds. It should be noted that the BCFs reported by Van Hook (1978) for cadmium, lead and zinc in terrestrial invertebrates are consistent with the findings of Morgan and Morgan (1988), discussed above. The table demonstrates that mercury bioaccumulates in the terrestrial environment, with BCF values for mammals and birds reported as 5.0 and 50.0, respectively. The table also indicates that bioaccumulation of cadmium and zinc occurs in terrestrial invertebrates, while bioconcentration of these contaminants is less significant in higher trophic levels.

The data demonstrates that these inorganic compounds detected in the soil of the areas of concern may accumulate in the biota of the Booth Oil Site. The same potential may exist for accumulation of other organic and inorganic contaminants in terrestrial organisms; however, data correlating levels of organic soil contamination with tissue concentrations on terrestrial species were not located in the available literature.

4.2 Flowing Water Habitat

TABLE 4-20

TERRESTRIAL BIOCONCENTRATION FACTORS
FOR SELECTED INORGANIC COMPOUNDS

	Arsenic	Cadmium	Mercury	Lead	Zinc
Plants	0.01	0.3	0.4	0.07	0.4
Invertebrates	0.01	17	NR	0.02	8
Mammals	0.001	0.008	5	0.001	0.6
Birds	0.001	NR	50	0.001	NR

NR - Not reported
Source: Van Hook, 1978

The major flowing water habitat, located off site but associated with the Booth Oil Site is the Little/Niagara River. In order to determine the impact on the Little/Niagara River caused by surface water runoff and sediment deposition from the Booth Oil Site, surface water and sediment samples were collected in the catch basins at the southern border of the site. This catch basin, which drains the Booth Oil Site, empties into the Little River via the Robinson Street outfall.

During the Phase I RI, three surface water samples and five sediment samples were collected from the catch basin. The surface water and sediment samples were analyzed for volatiles, semi-volatiles, inorganic and pesticides/PCBs. The results of the chemical analysis of the surface water samples are shown in Tables 4-21 through 4-24. The results of the analyses for sediment samples are summarized in Tables 4-25 through 4-28.

Representative values of surface water concentration in the catch basin were obtained by the determination of the 95% confidence level arithmetic mean for each contaminant. The actual contaminant concentrations in the catch basin sediment are used in this assessment with the exception of the pesticide and PCB analysis which employed the 95% confidence level arithmetic mean for determination of representative contaminant concentration. (See Tables 4-29 through 4-30).

mcbsw/bos-3

TABLE 4-21

Catch Basin Surface Water Results
Volatile Organic Compounds

VOLATILES	BOCB1SW 6/27/90 (mg/l)		BOCB3SW 6/27/90 (mg/l)		BOCB5SW 6/27/90 (mg/l)		NYSDEC Class A Surface Water Stds/Guidelines (mg/l)
Acetone	0.012		0.01	U	0.005	U	----
Benzene	0.0025	U	0.025		0.0025	U	0.001
1,1-Dichloroethane	0.0025	U	0.049		0.0025	U	0.05
1,2-Dichloroethene (total)	0.0025	U	0.27		0.0025	U	0.05
Ethylbenzene	0.0025	U	0.019		0.0025	U	0.05
Toluene	0.0025	U	0.089		0.0025	U	0.05
Vinyl Chloride	0.005	U	0.32		0.005	U	0.0003
Xylene (total)	0.0025	U	0.085		0.0025	U	0.05

QUALIFIERS

J: compound is present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES

ST: Standard
GV: Guidance Value
[ ] -value exceeds standard/guideline
-sample detection limit exceeds standard/guideline

Table 4-22
Catch Basin Surface Water Results
Semi-volatile Organic Compounds

SEMIVOLATILES	BOCB1SW 6/27/90 (mg/l)		BOCB3SW 6/27/90 (mg/l)		BOCB5SW 6/27/90 (mg/l)		NYSDEC Class A Surface Water Stds/Guidelines (mg/l)
Benzoic acid	0.01	J	0.025	U	0.01	J	----
Di-n-butylphthalate	**0.001**	J	**0.001**	J	**0.002**	J	----
2 4-Dimethylphenol	0.005	U	**0.052**		0.005	U	----
Fluoranthene	0.0006	J	0.005	U	0.0008	J	----
2-Methylphenol	0.002	J	**0.012**		0.005	U	----
4-Methylphenol	0.005	U	**0.069**		0.005	U	----
Di-n-octylphthalate	0.005	U	0.0008	J	0.001	J	----

QUALIFIERS

J: compound is present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES

*: value pertains to total phenols
ST: Standard
GV: Guidance Value
[ ] -value exceeds standard/guideline
▒▒▒ -sample detection limit exceeds standard/guideline

mcbsw/bos-3

Table 4-23
Catch Basin Surface Water Results
Inorganic Compounds

INORGANICS	BOCB1SW 6/27/90 (mg/l)		BOCB3SW 6/27/90 (mg/l)		BOCB5SW 6/27/90 (mg/l)		NYSDEC Class A Surface Water Stds/Guidelines (mg/l)
Aluminum	**0.336**		**0.121**	B	**0.432**		0.1 ST
Arsenic	0.001	U	0.0085	B	0.001	U	0.19 ST
Barium	0.0283	B	0.208	E	0.317	BE	----
Calcium	24.7		143		26.4		----
Chromium	0.0032	B	0.003	U	0.0073	B	0.24 ST+
Copper	0.0302		0.0058	B	0.0369		0.014 ST+
Cyanide	**0.0185**		**0.01**	U	**0.0058**		0.0052 ST
Iron	**2.57**		**2.66**		**0.938**		0.3 ST
Lead	0.0097		0.0036		**0.0121**		0.004 ST
Magnesium	3.02	B	33		3.15	B	----
Manganese	0.183		**0.447**		0.0912		----
Nickel	0.005	B	0.005	U	0.0062	B	0.11 ST+
Potassium	2.11	B	7.27		1.77	B	----
Sodium	19.4		335		12.6		----
Vanadium	0.005	B	0.006	B	0.002	U	----
Zinc	**0.0767**		0.0048	B	**0.145**		0.03 ST

QUALIFIERS

U : value is less than the instrument detection limit (IDL)
B : value is between IDL and contract required detection limit (CRDL)
E : value is estimated due to interference

NOTES

ST: Standard
GV: Guidance Value
+: Hardness Dependent Criteria
[ ] -value exceeds standard/guideline
-sample detection limit exceeds standard/guideline

mcbsw/bos3

Table 4-24
Catch Basin Surface Water Results
Pesticides and PCB's

PESTICIDES/PCBs	BOCB1SW 6/27/90 (mg/l)	BOCB3SW 6/27/90 (mg/l)	BOCB5SW 6/27/90 (mg/l)	NYSDEC Class A Surface Water Stds/Guidelines (mg/l)
gamma-Chlordane	0.00025 U	0.00063	0.00025 U	0.000002 GV

QUALIFIERS

J: compound is present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES

-value exceeds standard/guideline
-sample detection limit exceeds standard/guideline

mcbsd/bos-3

Table 4-25

Catch Basin Sediment Results
Volatile Organic Compounds

VOLATILES	BOCB1SD 6/27/90 (mg/kg)	BOCB2SD 6/27/90 (mg/kg)	BOCB3SD 6/27/90 (mg/kg)	BOCB3SDRE 6/27/90 (mg/kg)	BOCB5SD 6/27/90 (mg/kg)	Preliminary Soil Cleanup Criteria (mg/kg)
2-Butanone	NA	NA	1.1 J	2.8	NA	-
1,1-Dichloroethane	NA	NA	0.14 J	0.23 J	NA	-
1,2-Dichloroethane	NA	NA	0.564 U	0.19 J	NA	0.00057
1,2-Dichloroethene (total)	NA	NA	1.4	2	NA	0.00124
trans-1,3-Dichloropropene	NA	NA	0.564 U	0.21 J	NA	0.142
Ethylbenzene	NA	NA	1.2	1.7	NA	0.668
2-Hexanone	NA	NA	1.092 U	2.3	NA	-
Tetrachloroethene	NA	NA	0.564 U	0.68 J	NA	0.008
Toluene	NA	NA	1.5	1.6	NA	0.358
Vinyl Chloride	NA	NA	0.85 J	2.4	NA	0.023
Xylene (total)	NA	NA	3.3 B	5.5 B	NA	0.67

QUALIFIERS

J: compound is present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES:

- value exceeds standard/guideline
-sample detection limit exceeds standard/guideline

Table 4-26
Catch Basin Sediment Results
Semi- volatile Organic Compounds

SEMIVOLATILES	BOCB1SD 6/27/90 (mg/kg)	BOCB2SD 6/27/90 (mg/kg)	BOCB3SD 6/27/90 (mg/kg)	BOCB3SDRE 6/27/90 (mg/kg)	BOCB5SD 6/27/90 (mg/kg)	Preliminary Soil Cleanup Criteria (mg/kg)
Benzo(a)anthracene	NA	NA	2	1.6 J	NA	0.005
Benzo(b)fluoranthene	NA	NA	3.7	1.6 J	NA	0.055
Benzo(k)fluoranthene	NA	NA	0.97 U	1.2 J	NA	0.055
Benzo(g,h,i)perylene	NA	NA	0.83 J	0.97 U	NA	593.11
Chrysene	NA	NA	2.3	2.1	NA	0.02
bis(2-Ethylhexyl)phthalate	NA	NA	9.8 B	11 U	NA	1517.325
Fluoranthene	NA	NA	4.3	2.5	NA	22.892
2-Methylnaphthalene	NA	NA	5.2	5.1	NA	21.25
Di-n-octylphthalate	NA	NA	1.6 J	0.97 U	NA	5.965
Phenanthrene	NA	NA	6.1	4.9	NA	57.3
Pyrene	NA	NA	1.5 J	2	NA	210

QUALIFIERS

J: compound is present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES:

- value exceeds standard/guideline
- sample detection limit exceeds standard/guideline

Table 4-27

Catch Basin Sediment Results
Inorganic Compounds

INORGANICS	BOCB1SD 6/27/90 (mg/kg)		BOCB2SD 6/27/90 (mg/kg)		BOCB3SD 6/27/90 (mg/kg)		BOCB3SDRE 6/27/90 (mg/kg)		BOCB5SD 6/27/90 (mg/kg)		NJDEP Soil Action Levels (mg/kg)
Aluminum		NA		NA	8760			NA		NA	----
Antimony		NA		NA	5.6	U		NA		NA	----
Arsenic		NA		NA	7.1			NA		NA	20
Barium		NA		NA	141			NA		NA	----
Beryllium		NA		NA	1	B		NA		NA	----
Cadmium		NA		NA	2.7			NA		NA	3
Calcium		NA		NA	126000			NA		NA	----
Chromium		NA		NA	64.5			NA		NA	100
Cobalt		NA		NA	3.8	B		NA		NA	----
Copper		NA		NA	76.9	E		NA		NA	170
Cyanide		NA		NA	1.5			NA		NA	----
Iron		NA		NA	18100			NA		NA	----
Lead		NA		NA	**611**			NA		NA	100
Magnesium		NA		NA	33300			NA		NA	----
Manganese		NA		NA	701			NA		NA	----
Mercury		NA		NA	0.14	U		NA		NA	1
Nickel		NA		NA	16.8			NA		NA	100
Potassium		NA		NA	1300	B		NA		NA	----
Selenium		NA		NA	0.91	B		NA		NA	4
Silver		NA		NA	1.2	U		NA		NA	5
Sodium		NA		NA	1350	B		NA		NA	----
Thallium		NA		NA	0.63	U		NA		NA	----
Vanadium		NA		NA	16.8	E		NA		NA	----
Zinc		NA		NA	**388**			NA		NA	350

QUALIFIERS

U : value is less than the instrument detection limit (IDL)
B : value is between IDL and contract required detection limit (CRDL)
E : value is estimated due to interference

NOTES

----: Not Available
[ ] - value exceeds standard/guideline
-sample detection limit exceeds standard/guideline

mcbsd/bos-3

Table 4-28

Catch Basin Sediment Results
Pesticides and PCB's

PESTICIDES/PCBs	BOCB1SD 6/27/90 (mg/kg)	BOCB2SD 6/27/90 (mg/kg)	BOCB3SD 6/27/90 (mg/kg)	BOCB3SDRE 6/27/90 (mg/kg)	BOCB5SD 6/27/90 (mg/kg)	NJDEP SOIL ACTION LEVELS (mg/kg)
PCB-1242	0.123 U	13	13	NA	1.9	0.085
PCB-1254	0.246 U	31	4.6	NA	1.2	0.275
PCB-1260	4.5	140	6.8	NA	2.2	-

QUALIFIERS

J: compound is present below the detection limit
B: compound is found in the blank as well as the sample
U: compound analyzed for but not detected (reported conc. is 1/2 sample detection limit)
UB: reported concentration is 1/2 the sample detection limit

NOTES

- value exceeds standard/guideline
-sample detection limit exceeds standard/guideline

Table 4-29

Catch Basin Surface Water Results
Mean Contaminant Concentrations

VOLATILES	Arith. Mean (mg/l)	Upper 95% Confidence Arith. Mean (mg/l)
Acetone	0.009	0.012
Benzene	0.010	0.022
1,1-Dichloroethane	0.018	0.043
1,2-Dichloroethene (tota	0.092	0.234
Ethylbenzene	0.008	0.017
Toluene	0.031	0.077
Vinyl Chloride	0.110	0.278
Xylene (total)	0.030	0.074

Table 4-29 (cont'd)
Catch Basin Surface Water Results
Mean Contaminant Concentrations

SEMIVOLATILES	Arith. Mean (mg/l)	Upper 95% Confidence Arith. Mean (mg/l)
Benzoic acid	0.015	0.023
Di-n-butylphthalate	0.001	0.002
2,4-Dimethylphenol	0.021	0.046
Fluoranthene	0.002	0.004
2-Methylphenol	0.006	0.011
4-Methylphenol	0.026	0.060
Di-n-octylphthalate	0.002	0.004

Table 4-29 (cont'd)

Catch Basin Surface Water Results
Mean Contaminant Concentrations

INORGANICS	Arith. Mean (mg/l)	Upper 95% Confidence Arith. Mean (mg/l)
Aluminum	0.296	0.443
Arsenic	0.004	0.008
Barium	0.184	0.319
Calcium	64.700	127.358
Chromium	0.005	0.007
Copper	0.024	0.039
Cyanide	0.011	0.017
Iron	2.056	2.952
Lead	0.008	0.013
Magnesium	13.057	29.015
Manganese	0.240	0.411
Nickel	0.005	0.006
Potassium	3.717	6.564
Sodium	122.333	292.531
Vanadium	0.004	0.006
Zinc	0.076	0.140

Table 4-29 (cont'd)

Catch Basin Surface Water Results
Mean Contaminant Concentrations

PESTICIDES/PCBs	Arith. Mean (mg/l)	Upper 95% Confidence Arith. Mean (mg/l)
gamma-Chlordane	0.0004	0.001

Table 4-30
Catch Basin Sediment Results
Mean Contaminant Concentrations

VOLATILES	Arith. Mean (mg/kg)
2-Butanone	1.100
1,1-Dichloroethane	0.140
1,2-Dichloroethane	0.564
1,2-Dichloroethene (total)	1.400
trans-1,3-Dichloropropene	0.564
Ethylbenzene	1.200
2-Hexanone	1.092
Tetrachloroethene	0.564
Toluene	1.500
Vinyl Chloride	0.850
Xylene (total)	3.300

Table 4-30 (cont'd)
Catch Basin Sediment Results
Mean Contaminant Concentrations

SEMIVOLATILES	Arith. Mean (mg/kg)
Benzo(a)anthracene	2.000
Benzo(b)fluoranthene	3.700
Benzo(k)fluoranthene	0.970
Benzo(g,h,i)perylene	0.830
Chrysene	2.300
bis(2-Ethylhexyl)phthalate	9.800
Fluoranthene	4.300
2-Methylnaphthalene	5.200
Di-n-octylphthalate	1.600
Phenanthrene	6.100
Pyrene	1.500

Table 4-30 (cont'd)

Catch Basin Sediment Results
Mean Contaminant Concentrations

INORGANICS	Arith. Mean (mg/kg)
Aluminum	8760.000
Antimony	5.600
Arsenic	7.100
Barium	141.000
Beryllium	1.000
Cadmium	2.700
Calcium	126000.000
Chromium	64.500
Cobalt	3.800
Copper	76.900
Cyanide	1.500
Iron	18100.000
Lead	611.000
Magnesium	33300.000
Manganese	701.000
Mercury	0.140
Nickel	16.800
Potassium	1300.000
Selenium	0.910
Silver	1.200
Sodium	1350.000
Thallium	0.630
Vanadium	16.800
Zinc	388.000

Table 4-30 (cont'd)

Catch Basin Sediment Results
Mean Contaminant Concentrations

PESTICIDES/PCBs	Arith. Mean (mg/kg)	Upper 95% Confidence Arith. Mean (mg/kg)
PCB-1242	7.006	12.912
PCB-1254	9.262	21.663
PCB-1260	38.375	95.897

4.2.1 Catch Basin Water

Table 4-31 compares the 95% confidence level arithmetic mean of the catch basin surface water contamination with the NYSDEC Ambient Water Quality Standards and Guidelines and the EPA Ambient Water Quality Criteria for the Protection of Freshwater Aquatic Life for acute and chronic effects. The Ambient Water Quality Criteria for the Protection of Freshwater Aquatic Life are developed from acute and chronic toxicity data and information on bioaccumulation by aquatic plants and animals, as well as their wildlife consumers (EPA, 1986a). The criteria for acute effects reflect the highest 1-hour average concentration that should not result in unacceptable effects in aquatic organisms or their consumers (EPA, 1986a). Similarly, the criteria for chronic effects are the highest 4-day average concentration that should not result in unacceptable effects in aquatic plants and animals (EPA, 1986a). The NYSDEC Ambient Water Quality Standards and Guidelines for Class A waters are based on protection of drinking water. The Little/Niagara River is currently classified as a Class A waterway. Therefore, the Class A standards are included in this assessment for the evaluation of surface water in the Little/Niagara River.

Table 4-31 indicates that the 95% confidence level arithmetic mean concentrations of copper (3.90E-02 mg/l) and zinc (1.40E-01 mg/l) detected in the catch basin water exceed their respective EPA Ambient Water Quality Criteria for the Protection of Aquatic Life

for acute effects. In addition, the 95% confidence level arithmetic mean concentrations of copper (3.90E-02 mg/l), iron (2.95E+00 mg/l), lead (1.30E-02 mg/l), zinc (1.40E-01 mg/l), cyanide (1.70E-02 mg/l) and gamma-chlordane (1.00E-03 mg/l) detected in the catch basin water exceeded their respective EPA Ambient Water Quality Criteria for the Protection of Aquatic Life for chronic effects.

Further review of Table 4-31 indicates that the 95% confidence level arithmetic mean concentrations of benzene (2.20E-02 mg/l), aluminum (4.43E-01 mg/l), copper (3.90E-02 mg/l), iron (2.95E+00 mg/l), lead (1.30E-02 mg/l), zinc (1.40E-01 mg/l), cyanide (1.70E-02 mg/l) and gamma-chlordane (1.00E-03 mg/l) detected on the catch basin water exceeded their respective NYSDEC Ambient Water Quality Standards/Guidelines for Class A waters.

It must be noted that neither EPA Ambient Water Quality Criteria nor NYSDEC Water Quality Standards/Guidelines have been developed for the following contaminants detected in the catch basin water: acetone, 1,1-dichloroethane, vinyl chloride, xylenes (total), benzoic acid, di-n-butylphthalate, 2-methylphenol, 4-methylphenol, barium, calcium, magnesium, manganese, potassium, sodium, and vanadium. Therefore, the impacts of the concentrations of these contaminants detected in the catch basin on aquatic life cannot be assessed by this screening method.

Because the catch basin, which drains the Booth Oil Site,

TABLE 4-31

CONTAMINANT CONCENTRATIONS IN THE CATCH BASIN AND
EPA AND NYSDEC AMBIENT WATER QUALITY CRITERIA

	Upper 95% Confidence Arith. Mean (mg/l)	EPA WATER QUALITY CRITERIA ACUTE (mg/l)		CHRONIC (mg/l)		NYSDEC STANDARDS/ GUIDELINES CLASS A WATERS AQUATIC LIFE (mg/l)	
VOLATILES							
Acetone	1.20E-02	-		-		-	
Benzene	2.20E-02	5.30E+00	*	-		6.00E-03	G
1,1-Dichloroethane	4.30E-02	-		-		-	
1,2-Dichloroethene	2 34E-01	1 18E+02	*	2.00E+01	*	-	
Ethylbenzene	1.70E-02	3.20E+01	*	-		-	
Toluene	7.70E-02	1.75E+01	*	-		-	
Vinyl Chloride	2.78E-01	-		-		-	
Xylene (total)	7 40E-02	-		-		-	
SEMIVOLATILES							
Benzoic acid	2 30E-02	-		-		-	
Di-n-butylphthalate	2 00E-03	-		-		-	
2,4-Dimethylphenol	4 60E-02	2.12E+00	*	-		-	
Fluoranthene	4 00E-03	3.98E+00	*	-		-	
2-Methylphenol	1 10E-02	-		-		-	
4-Methylphenol	6 00E-02	-		-		-	
INORGANICS							
Aluminum	4 43E-01	-		-		1.00E-01	S
Arsenic	8.00E-03	3.60E-01		1.90E-01		1.90E-01	S
Barium	3 19E-01	-		-		-	
Calcium	1 27E+02	-		-		-	
Chromium	7.00E-03	2.02E+00	+	2.40E-01		2.40E-01	S+
Copper	3 90E-02	2.10E-02	+	1.40E-02	+	1.40E-02	S+
Iron	2 95E+00	-		1.00E+00		3.00E-01	S
Lead	1 30E-02	1.03E-01	+	4.00E-03	+	4.00E-03	S
Magnesium	2 90E+01	-		-		-	
Manganese	4.11E-01	-		-		-	
Nickel	6.00E-03	1.66E+00	+	1.84E-01		1 10E-01	S+
Potassium	6 56E+00	-		-		-	
Sodium	2.93E+02	-		-		-	
Vanadium	6.00E-03	-		-		1.40E-02	S
Zinc	1.40E-01	1 37E-01	+	1.24E-01		3.00E-02	S
Cyanide	1 70E-02	2.20E-02		5.20E-03		5.20E-03	S
PESTICIDES/PCBs							
gamma-Chlordane	1 00E-03	2.40E-03		4.30E-06		2.00E-06	G

[ ] - value exceed standard/guideline

empties directly into the Little River via the Robinson Street outfall, an analysis of the potential impact of the abovementioned contaminant concentrations was performed. Because of the lack of available flow rate data for the Little River, this analysis was performed to estimate the required flow rate for adequate dilution of the contaminant concentrations that exceed their respective water quality standards It is important to note that the following analysis was performed for contaminants which exceeded the EPA and NYSDEC water quality standards in the catch basin surface water. In order to assess the impact of the contaminant concentrations present in the catch basin surface water on the Little River, the following conservative assumption were made relative to storm water runoff from the site. Appendix A contains the stormwater runoff analysis data sheets.

1 - The entire Booth Oil Site drains to the catch basin where the samples were collected.
2 - No other site is contributing to the storm sewer system except the Booth Oil Site.
3 - Contaminant concentration upstream of the Robinson Street outfall is zero.
4 - Flow in the Little River is adequate to promote thorough mixing.
5 - Contaminant concentrations at the storm sewer outfall are equal to those measured in the catch basin.

Based on these assumptions, the flow rate in the Little River required to dilute the contaminant concentrations measured in the catch basin to acceptable levels was estimated. The calculated required flow rates were then divided by the actual flow rate of the Niagara River to obtain the percent flow rate of the Niagara River necessary to meet the water quality standards for each compound. The flow rate in the Niagara River is 62,000 cubic feet per second, as per telecommunications with the Divrka and Bartilucci.

Tables 4-32 lists the 95% confidence level arithmetic mean contaminant concentrations in the catch basin water which exceeded their respective chronic and acute EPA Water Quality Criteria and the flow rate required in the Little River to dilute these concentrations to acceptable levels. Of all contaminants analyzed, the maximum flow rate required for adequate dilution is 14.47 cubic feet per second, as required to meet the chronic EPA Water Quality Criteria for gamma-chlordane. The maximum percent flow rate of the Niagara River flow rate required to provide dilution to meet the EPA Water Quality Criteria is, therefore, 0.023%.

Table 4-33 indicates the contaminant concentrations in the catch basin water which exceeded their respective NYSDEC Standards/Guidelines for Class A Water aquatic Life and the flow rate required in the Little River to dilute these concentrations to acceptable levels. Of all contaminants analyzed, the maximum flow

TABLE 4-32

CONTAMINANT CONCENTRATIONS IN THE CATCH BASIN AND FLOW RATE REQUIRED TO MEET EPA AMBIENT WATER QUALTY CRITERIA

	Upper 95% Confidence Arith. Mean (mg/l)	EPA WATER QUALITY CRITERIA ACUTE (mg/l)		CHRONIC (mg/l)		REQUIRED DILUTION FLOW ACUTE (ft3/s)	CHRONIC (ft3/s)	PERCENT OF NIAGARA RIVER FLOW REQUIRED PRODUCE DILUTION FLOW ACUTE (%)	CHRONIC (%)
INORGANICS									
Copper	3.90E-02	2.10E-02	+	1.40E-02	+	5.36E-02	1.12E-01	0.000086	0.000180
Iron	2.95E+00	-		1.00E+00		-	1.22E-01	-	0.000197
Lead	1.30E-02	1.03E-01	+	4.00E-03	+	-	1.41E-01	-	0.000227
Zinc	1.40E-01	1.37E-01	+	1.24E-01		1.37E-03	8.07E-03	0.000002	0.000013
Cyanide	1.70E-02	2.20E-02		5.20E-03		-	1.42E-01	-	0.000229
PESTICIDES/PCBs									
gamma-Chlordane	1.00E-03	2.40E-03		4.30E-06		-	1.45E+01	-	0.023343

[ ] - value exceed standard

TABLE 4-33

CONTAMINANT CONCENTRATIONS IN THE CATCH BASIN AND FLOW RATE REQUIRED TO MEET NYSDEC AMBIENT WATER QUALITY CRITERIA

	Upper 95% Confidence Arith. Mean (mg/l)	NYSDEC STANDARDS/ GUIDELINES CLASS A WATERS AQUATIC LIFE (mg/l)		REQUIRED DILUTION FLOW (ft3/s)	PERCENT OF NIAGARA RIVER FLOW REQUIRED TO PRODUCE DILUTION FLOW (%)
VOLATILES					
Benzene	2.20E-02	6.00E-03	G	1.67E-01	0.000269
INORGANICS					
Aluminum	4.43E-01	1.00E-01	S	2.14E-01	0.000346
Copper	3.90E-02	1.40E-02	S+	1.12E-01	0.000180
Iron	2.95E+00	3.00E-01	S	5.52E-01	0.000890
Lead	1.30E-02	4.00E-03	S	1.41E-01	0.000227
Zinc	1.40E-01	3 00E-02	S	2.23E-01	0.000360
Cyanide	1.70E-02	5.20E-03	S	1.42E-01	0.000229
PESTICIDES/PCBs					
gamma-Chlordan	1.00E-03	2.00E-06	G	3.12E+01	0.050302

[ ] - values exceed standards/guidelines

rate required for adequate dilution is 31.19 cubic feet per second, as required to meet the NYSDEC Surface Water Standard for gamma-chlordane. The maximum percent flow of the Niagara River flow rate required in the Little River to provide adequate dilution to meet the NYSDEC water quality standards is 0.050%.

These analyses suggest, for those contaminants that exceeded their respective federal or state water quality standard, the catch basin water, as stormwater runoff from the Booth Oil Site will not have a significant impact on the contaminant loading in the Little River. The percentage of the Niagara River flow rate required is minuscule, compared to what is potentially diverted into the Little River.

4.2.2 Catch Basin Sediments

In order to assess the potential impact of contaminant concentrations in the catch basin sediments a water equilibrium concentration analysis was performed using the organic carbon partition coefficient(K_{oc}). The equilibrium water concentration is determined by the formula:

$$C_{swi} = \frac{0.0849 * K_{oc}}{C_{sd1}}$$

where:

C_{swi} = equilibrium concentration in water of contaminant i (mg/l)

K_{oc} = organic carbon partition coefficient

C_{sdi} = concentration of contaminant i in sediment (mg/kg)

A review Table 4-34 indicates that the predicted equilibrium concentrations of contaminants released from the catch basin sediment into the aqueous environment do not exceed the EPA Water Quality Criteria, with the exception of PCB-1260 which has a predicted equilibrium water concentration of 1.54E+05 mg/l.

Table 4-35 indicates that the NYSDEC Standards/Guidelines for the protection of aquatic life in Class A waters will not be exceeded by the calculated equilibrium water concentration with the exception of PCB-1242 (2.07E-06 mg/l), PCB-1254 (3.47E-06 mg/l) and PCB-1260 (1.54E-05 mg/l).

In order to assess the impact of the calculated equilibrium water concentrations caused by the catch basin sediment on the Little River, the above mentioned dilution analysis was performed. It should be noted that this analysis was performed for

TABLE 4-34
CALCULATED EQUILIBRIUM WATER
CONCENTRATION USING Koc AND EPA WATER QUALTIY CRITERIA

	Arith. Mean (mg/kg)	Koc (ml/g)	Equilibrium Water Conc. (mg/l)	EPA Water Quality Criteria Acute (mg/l)		Chronic (mg/l)	
VOLATILES							
2-Butanone	1.10E+00	4.50E+00	2.08E-02	-		-	
1,1-Dichloroethane	1.40E-01	3.00E+01	3.96E-04	-		-	
1,2-Dichloroethene (to	1.40E+00	5.90E+01	2.01E-03	1.18E+02	*	2.00E+01	*
trans-1,3-Dichloroprop	5.64E-01	4.80E+01	9.98E-04	6.06E+00	*	2.44E-01	*
Ethylbenzene	1.20E+00	1.10E+03	9.26E-05	3.20E+01	*		
2-Hexanone	1.09E+00	NR	NR	-		-	
Tetrachloroethene	5.64E-01	3.64E+02	1.32E-04	5.28E+00	*	8.40E-01	*
Toluene	1.50E+00	3.00E+02	4.25E-04	1.75E+01	*		
Vinyl Chloride	8.50E-01	5.70E+01	1.27E-03	-		-	
Xylene (total)	3.30E+00	2.40E+02	1.17E-03	-		-	
SEMIVOLATILES							
Benzo(a)anthracene	2.00E+00	1.38E+06	1.23E-07	-		-	
Benzo(b)fluoranthene	3.70E+00	5.50E+05	5.71E-07	-		-	
Benzo(k)fluoranthene	9.70E-01	5.50E+05	1.50E-07	-		-	
Chrysene	2.30E+00	2.00E+05	9.76E-07	-		-	
bis(2-Ethylhexyl)phtha	9.80E+00	1.49E+08	5.58E-09	-		-	
Fluoranthene	4.30E+00	3.80E+04	9.61E-06	3.98E+00	*	-	
2-Methylnaphthalene	5.20E+00	9.67E+03	4.57E-05	-		-	
Di-n-octylphthalate	1.60E+00	4.12E+08	3.30E-10	-		-	
Phenanthrene	6.10E+00	1.40E+04	3.70E-05	-		-	
Pyrene	1.50E+00	3.80E+04	3.35E-06	-		-	
INORGANICS							
Aluminum	8.76E+03	N/A	N/A	-		-	
Antimony	5.60E+00	N/A	N/A	9.00E+00	*	1.60E+00	*
Arsenic	7.10E+00	N/A	N/A	3.60E-01		1.90E-01	
Barium	1.41E+02	N/A	N/A	-		-	
Beryllium	1.00E+00	N/A	N/A	1.30E-01	*	5.30E-03	
Cadmium	2.70E+00	N/A	N/A	4.82E-03	+	1.31E-03	+
Calcium	1.26E+05	N/A	N/A	-		-	
Chromium	6.45E+01	N/A	N/A	2.02E+00	+	2.40E-01	+
Cobalt	3.80E+00	N/A	N/A	-		-	
Copper	7.69E+01	N/A	N/A	2.10E-02	+	1.40E-02	+
Iron	1.81E+04	N/A	N/A	-		1.00E+00	
Lead	6.11E+02	N/A	N/A	1.03E-01	+	4.00E-03	+
Magnesium	3.33E+04	N/A	N/A	-		-	
Manganese	7.01E+02	N/A	N/A	-		-	
Mercury	1.40E-01	N/A	N/A	2.40E-03		1.20E-05	
Nickel	1.68E+01	N/A	N/A	1.66E+00	+	1.84E-01	
Potassium	1.30E+03	N/A	N/A	-		-	
Selenium	9.10E-01	N/A	N/A	2.60E-01		3.50E-02	
Silver	1.20E+00	N/A	N/A	5.55E-03	+	1.20E-04	
Sodium	1.35E+03	N/A	N/A	-		-	
Thallium	6.30E-01	N/A	N/A	1.40E+00	*	4.00E-02	*
Vanadium	1.68E+01	N/A	N/A	-		-	
Zinc	3.88E+02	N/A	N/A	1.37E-01		5.20E-03	
Cyanide	1.50E+00	N/A	N/A				
PESTICIDES/PCBS **							
PCB-1242	1.29E+01	5.30E+05	2.07E-06	2.00E-03		1.40E-05	
PCB-1254	2.17E+01	5.30E+05	3.47E-06	2.00E-03		1.40E-05	
PCB-1260	9.59E+01	5.30E+05	1.54E-05	2.00E-03		1.40E-05	

** Upper 95% Confidence Arithmetic Mean Used For Pesticides/PCBs

- value exceeds standard

TABLE 4-35
CALCULATED EQUILIBRIUM WATER CONCENTRATION USING Koc
AND NYSDEC STANDARDS/GUIDELINES

	Arith. Mean (mg/kg)	Koc (ml/g)	Equilibrium Water Conc. (mg/l)	NYSDEC Standards/ Guidelines Class A Waters Aquatic Life (mg/l)	
VOLATILES					
2-Butanone	1.10E+00	4.50E+00	2.08E-02	-	
1,1-Dichloroethane	1.40E-01	3.00E+01	3.96E-04	-	
1,2-Dichloroethene (total)	1.40E+00	5.90E+01	2.01E-03	-	
trans-1,3-Dichloropropen	5.64E-01	4.80E+01	9.98E-04	-	
Ethylbenzene	1.20E+00	1.10E+03	9.26E-05	-	
2-Hexanone	1.09E+00	NR	NR	-	
Tetrachloroethene	5.64E-01	3.64E+02	1.32E-04	1.00E-03	G
Toluene	1.50E+00	3.00E+02	4.25E-04	-	
Vinyl Chloride	8.50E-01	5.70E+01	1.27E-03	-	
Xylene (total)	3.30E+00	2.40E+02	1.17E-03	-	
SEMIVOLATILES					
Benzo(a)anthracene	2.00E+00	1.38E+06	1.23E-07	-	
Benzo(b)fluoranthene	3.70E+00	5.50E+05	5.71E-07	-	
Benzo(k)fluoranthene	9.70E-01	5.50E+05	1.50E-07	-	
Chrysene	2.30E+00	2.00E+05	9.76E-07	-	
bis(2-Ethylhexyl)phthalat	9.80E+00	1.49E+08	5.58E-09	6.00E-04	S
Fluoranthene	4.30E+00	3.80E+04	9.61E-06	-	
2-Methylnaphthalene	5.20E+00	9.67E+03	4.57E-05	-	
Di-n-octylphthalate	1.60E+00	4.12E+08	3.30E-10	-	
Phenanthrene	6.10E+00	1.40E+04	3.70E-05	-	
Pyrene	1.50E+00	3.80E+04	3.35E-06	-	
INORGANICS					
Aluminum	8.76E+03	N/A	N/A	1.00E-01	S
Antimony	5.60E+00	N/A	N/A	-	
Arsenic	7.10E+00	N/A	N/A	1.90E-01	S
Barium	1.41E+02	N/A	N/A	-	
Beryllium	1.00E+00	N/A	N/A	1.10E+00	S
Cadmium	2.70E+00	N/A	N/A	1.31E-03	S
Calcium	1.26E+05	N/A	N/A	-	
Chromium	6.45E+01	N/A	N/A	2.40E-01	S
Cobalt	3.80E+00	N/A	N/A	5.00E-03	S
Copper	7.69E+01	N/A	N/A	1.40E-02	S
Iron	1.81E+04	N/A	N/A	3.00E-01	S
Lead	6.11E+02	N/A	N/A	4.00E-03	S
Magnesium	3.33E+04	N/A	N/A	-	
Manganese	7.01E+02	N/A	N/A	-	
Mercury	1.40E-01	N/A	N/A	2.00E-04	G
Nickel	1.68E+01	N/A	N/A	1.10E-01	S
Potassium	1.30E+03	N/A	N/A	-	
Selenium	9.10E-01	N/A	N/A	1.00E-03	S
Silver	1.20E+00	N/A	N/A	5.55E-03	S
Sodium	1.35E+03	N/A	N/A	-	
Thallium	6.30E-01	N/A	N/A	8.00E-03	S
Vanadium	1.68E+01	N/A	N/A	1.40E-02	S
Zinc	3.88E+02	N/A	N/A	3.00E-02	S
Cyanide	1.50E+00	N/A	N/A	5.20E-03	S
PESTICIDES/PCBS *					
PCB-1242	1.29E+01	5.30E+05	2.07E-06	1.00E-06	
PCB-1254	2.17E+01	5.30E+05	3.47E-06	1.00E-06	
PCB-1260	9.59E+01	5.30E+05	1.54E-05	1.00E-06	

* Upper 95% Confidence Arithmetic Mean Used For Pesticides/PCBs

[ ] - value exceed standard/guideline

conmtaminant concentrations that exceeded the EPA or NYSDEC water quality criteria. The result are summarized in Tables 4-36 and 4-37.

Table 4-36 indicates the calculated equilibrium water concentration in the catch basin water which exceeded the EPA Water Quality Criteria and the flow rate required on the Little River to dilute this concentration to acceptable levels. The maximum flow rate required for adequate dilution is 0.00625 cubic feet per second, as required to meet the EPA Water Quality Criteria for PCB-1260. The maximum percent flow of the Niagara River flow rate required in the Little River to provide adequate dilution is 0.000010%.

Table 4-37 indicates the calculated equilibrium water concentration on the catch basin water which exceeded the NYSDEC Water Quality Standards/Guidelines for the Protection of Aquatic Life in Class A Waters and the flow rate required in the Little River to dilute these concentrations to acceptable levels. The maximum flow rates required for adequate dilution of PCB-1242, PCB-1254 and PCB-1260 are 0.066 cubic feet per second, 0.154 cubic feet per second and 0.9 cubic feet per second, respectively.

These percentages are minor compared to the maximim flow rate that if potentially diverted into the Little River from the Niagara River. This suggests that calculated equilibrium water

TABLE 4-36

CONTAMINANT CONCENTRATIONS IN THE CATCH BASIN AND FLOW RATE REQUIRED TO MEET EPA AMBIENT WATER QUALTY CRITERIA

	Upper 95% Confidence Arith. Mean (mg/l)	EPA WATER QUALITY CRITERIA ACUTE (mg/l)	EPA WATER QUALITY CRITERIA CHRONIC (mg/l)	REQUIRED DILUTION FLOW ACUTE (ft3/s)	REQUIRED DILUTION FLOW CHRONIC (ft3/s)	PERCENT OF NIAGARA RIVER FLOW REQUIRED PRODUCE DILUTION FLOW ACUTE (%)	PERCENT OF NIAGARA RIVER FLOW REQUIRED PRODUCE DILUTION FLOW CHRONIC (%)
PESTICIDES/PCBs							
PCB-1260	9.59E+01	2.00E-03	1.40E-05	-	6.25E-03	-	0.000010

TABLE 4-37

CONTAMINANT CONCENTRATIONS IN THE CATCH BASIN AND FLOW RATE REQUIRED TO MEET NYSDEC AMBIENT WATER QUALITY CRITERIA

	Upper 95% Confidence Arith. Mean (mg/l)		NYSDEC STANDARDS/ GUIDELINES CLASS A WATERS AQUATIC LIFE (mg/l)		REQUIRED DILUTION FLOW (ft3/s)	PERCENT OF NIAGARA RIVER FLOW REQUIRED TO PRODUCE DILUTION FLOW (%)
PESTICIDES/PCBs						
PCB-1242	2.07E-06		1.00E-06	G	6.69E-02	0.000108
PCB-1254	3.47E-06		1.00E-06	G	1.54E-01	0.000249
PCB-1260	1.54E-05		1.00E-06	G	9.00E-01	0.001452

[ ] - value exceed standard/guideline

concentrations that exceeded their respective federal and state water quality standards, will not have a significant impact on the contaminant loading in the Little River.

It should be noted that inorganic contaminant were not included in this analysis because there are no K_{oc} values readily available in the literature. Therefore, the impact of the concentrations of these contaminants detected in the catch basin sediment on aquatic life cannot be assessed by this screening method.

Section 5

5.0 SOURCES OF UNCERTAINTY

There are a number of uncertainties associated with the performance of any environmental assessment and predicting the likely ecological impacts of contamination. General sources of uncertainty include:

- Environmental sampling
- Analytical chemistry
- Environmental parameter measurement
- Species variability in contaminant uptake
- Ecosystem dynamics
- Comparisons with published data
- Complex interactions of the above

The first three sources of uncertainty are common to any sampling and measurement routine. The uncertainties are associated with the representativeness of the sampling, as well as the analytical capabilities of the instrumentation.

Additional factors, such as seasonal variations in the amount of storm water runoff and stages in the life cycle of exposed organisms, contribute to the uncertainty in the analyses. However, the levels of contamination measured at the Booth Oil Site represent average long-term conditions as the source of the contamination has been removed. Therefore, it is expected that most

plants and animals at the site will be exposed to the current levels of contamination for much , if not all, of their life cycles. In addition, seasonal variations on the quantity of surface water runoff and sediment deposition may alter the contaminant concentrations in the catch basin, leading to further uncertainty.

Comparison of surface water contamination with EPA Ambient Water Quality Criteria and NYSDEC Water Quality Standards/Guidelines to predict toxicity in aquatic species yields another source of uncertainty. Data from published aquatic toxicity studies are used by the EPA to calculate Ambient Water Quality Criteria (EPA,1986a). Many of these standards are adopted by the NYSDEC as water quality standards/guidelines. Uncertainty lies in the derivation of the toxicity values in the literature, as well as in the review and criteria calculation procedures used by the EPA and NYSDEC. In addition, the Ambient water Quality Criteria are not intended to be protective of all aquatic species, but are intended "to protect most species in a balanced, healthy aquatic environment." (EPA, 1986a)

Further uncertainty lies in the nature of the exposures in the studies reviewed by the EPA in the development of the Ambient Water Quality Criteria as opposed to the nature of the exposure to biota at the Booth Oil Site. Toxicity studies are generally conducted for exposure to a single compound of concern. However, chemical

toxicity can be affected by the presence of other chemicals. The toxicity of a chemical may be intensified (synergism) or decreased (antagonism) in the presence of another chemical, or the individual chemicals may retain their individual toxic mechanisms (additivity). Similarly, the uptake of a contaminant may be accelerated or inhibited in the presence of other chemicals Generally, toxicity studies as well as BCF values do not account for these types of chemical interactions. Therefore, in lieu of the multiple-chemical exposures to biota at the Booth Oil Site, toxic effects to a given species may be more or less severs than predicted by the exceedence of the Ambient Water Quality Criteria.

Uncertainty also lies in the calculation of plant and animal tissue contaminant concentrations at the Booth Oil Site from the BCFs obtained from the literature. The BCF is the ratio of contaminant concentration in animal tissue to contaminant concentration in water or soil (Lyman et al., 1982). BCFs are highly site- and species-specific (EPA, 1988). Therefore, the most accurate method of determining the degree of bioconcentration in a given species is site-specific bioconcentration/bioaccumulation testing.

The BCFs presented in this assessment are obtained from the literature and are either estimated from chemical/physical properties or obtained from laboratory or field studies. Lyman et al. (1982) found that laboratory data indicate that aquatic BCFs

calculated by the standard acceptable methods may be assumed to be accurate within one order of magnitude. However, the applicability of BCFs from the literature to the specific conditions at the Booth Oil Site is a source of uncertainty. It must also be noted that the tissue concentrations calculated for the biota at the Booth Oil Site are intended to illustrate the potential for bioconcentration and bioaccumulation of contaminants, and are not meant to represent actual levels of contaminants potentially present in plants and animals at the site.

Section 6

6.0 SUMMARY AND CONCLUSIONS

Contamination of surface water, sediment and soil can result in a variety of effects within an ecosystem. Such effects range from direct mortality to a few susceptible individuals or reduction in breeding success or large scale mortality, which functions to reduce population size, to changes in the structure and function of the entire ecosystem. Qualitative evaluation of the current levels of contamination at the Booth Oil Site, as defined in the Phase I RI, indicates that adverse effects to the flora and fauna at the Booth Oil Site are probable. Effects from the contamination on and offsite, as detailed in Section 4.0 of this report, include toxicity to individual plants and animals and bioaccumulation terrestrial food webs.

The contaminants at the Booth Oil Site are expected to bioaccumulate in terrestrial plant species. As detailed in Section 4.1 of this report, organic and inorganic contaminants from the surficial and subsurface soil are predicted to bioaccumulate in terrestrial plants. The potential for contaminants to bioaccumulate in animals onsite is also indicated by BCFs reported in the literature.

Quantification of ecological impacts due to contamination at the Booth Oil Site is beyond the scope of this assessment. However,

the data indicate that the concentrations of volatile, semivolatile, inorganic and pesticides/PCBs may bioaccumulate in plant species up to 27, 17, 0.4 and 1.4 times the concentration found in onsite soils, respectively.

Impacts on aquatic plant and animal species are quantitatively assessed by comparing levels of catch basin water contamination with the EPA Ambient water Quality Criteria for the protection of Freshwater Aquatic Life and the NYSDEC Water Quality Standards/Guidelines. It must be noted that sediment also contribute to the contaminant concentrations in the catch basin water. However, this contribution, in the form of various PCBs, do not cause exceedences of water quality criteria.

Comparison to contaminant levels detected in the catch basin surface water with the EPA Ambient Water Quality Criteria and the NYSDEC Water Quality Standards and Guidelines. Specifically, the Ambient Water Quality Criteria for chronic effects for copper, iron, lead, zinc, cyanide and gamma-chlordane are exceeded. In addition, the Ambient Water Quality Criteria for acute effects for copper and zinc are exceeded. Similarly, the NYSDEC Water Quality Standards/Guidelines for Class A waters are exceeded by benzene, aluminum, copper, iron, lead, zinc, cyanide and gamma-chlordane. Although these contaminant concentrations exceeded their respective water quality criteria in the catch basin water, analyses indicate that adequate dilution will likely occur as

runoff and sediment from the Booth Oil Site enter the Little River.

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Appendix A

APPENDIX A

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Job BOS2
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IMPACT OF BOOTH OIL SITE RUNOFF ON THE LITTLE RIVER

INTRODUCTION:

THE PURPOSE OF THE FOLLOWING CALCULATION IS TO ESTIMATE THE IMPACT OF THE STORM SEWER ON THE LITTLE RIVER.

ASSUMPTIONS:

THE FOLLOWING ASSUMPTIONS ARE USED IN ESTIMATING THE SITE RUNOFF AND THE COCENTRATION IN THE LITTLE RIVER:

1- THE ENTIRE SITE DRAINS TO THE CATCH BASIN WHERE THE SAMPLES WERE COLLECTED.

2- NO OTHER TRIBUTARY IS CONTRIBUTING TO THE STORM SEWER SYSTEM EXCEPT THE SITE IN QUESTION.

3- CONCENTRATION UP STREAM OF LITTLE RIVER IS ZERO.

4- ASSUME THE FLOW IN LITTLE RIVER IS WELL MIXED.

5- CONCENTRATION AT STORM SEWER OUTFALL IS EQUAL TO THE MEASURED COCENTRATION IN CATCH BASIN.

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ANALYSIS:

GIVEN:

1- PREDICTED EQUILIBRIUM CONCENTRATION IN CATCH BASIN SURFACE WATER FROM THE CATCH BASIN SEDIMENT FOR THE FOLLOWING COMPOUNDS:

i := 1 ..4 (i = number of compounds)

Cbasin :=
i

.0000154	PCB-1260 (epa) (mg/l)
.00000207	PCB-1242 (nys) (mg/l)
.00000347	PCB-1254 (nys) (mg/l)
.0000154	PCB-1260 (nys) (mg/l)

2- RAINFALL INTENSITY AT THE DAY OF SAMPLING (I)

I := .1

3- SITE RUNOFF (Q.site) IS EQUAL TO OUTFALL FLOW (Q.out).

4- SITE RUNOFF COEFFICIENT (C)

C := .25 (UNPAVED SITE)

5- TOTAL SITE AREA (A)

A := 2.5 (ACRES)

SADAT ASSOCIATES INC. 5 Independence Way PRINCETON, NEW JERSEY 08540 (609) 987A2500 := 2 (ACRES) SITE	Job BOS2 Sheet No 3 of 4 Calculated by HI date 12/90 Checked by AH date 12/90 File (sed.mcd)

CALCULATION:

$$Q_{site} := C \cdot I \cdot A$$

$$Q_{site} = 0.0625$$

$$Q_{out} := Q_{site}$$

$$Q_{out} = 0.0625$$

Maximum allowed concentration in river = EPA Water Quality Standards for the protection of aquatic life or NYS Class A Standards for aquatic life

$Cd_i :=$	
.000014	PCB-1260 (epa) (mg/l)
.000001	PCB-1242 (nys) (mg/l)
.000001	PCB-1254 (nys) (mg/l)
.000001	PCB-1260 (nys) (mg/l)

$$Qup_i := \frac{\left[Q_{out} \cdot Cbasin_i\right] - \left[Q_{out} \cdot Cd_i\right]}{Cd_i}$$

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REQUIRED FLOW (CFS) IN RIVER TO DILUTE THE ABOVE COMPOUNDS CONCENTRATIONS GENERATED FROM THE FIRST RAINFALL FLUSH.

Qup_i	
0.00625	PCB-1260 (epa)
0.066875	PCB-1242 (nys)
0.154375	PCB-1254 (nys)
0.9	PCB-1260 (nys)

% flow of Niagara River needed in the Little River

$Fnr := 62000$ cfs

$$Flr_i := \frac{Qup_i}{Fnr}$$

Flr_i
0.0000001
0.0000011
0.0000025
0.0000145

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IMPACT OF BOOTH OIL SITE RUNOFF ON THE LITTLE RIVER

INTRODUCTION:

THE PURPOSE OF THE FOLLOWING CALCULATION IS TO ESTIMATE THE IMPACT OF THE STORM SEWER ON THE LITTLE RIVER.

ASSUMPTIONS:

THE FOLLOWING ASSUMPTIONS ARE USED IN ESTIMATING THE SITE RUNOFF AND THE COCENTRATION IN THE LITTLE RIVER:

1- THE ENTIRE SITE DRAINS TO THE CATCH BASIN WHERE THE SAMPLES WERE COLLECTED.

2- NO OTHER TRIBUTARY IS CONTRIBUTING TO THE STORM SEWER SYSTEM EXCEPT THE SITE IN QUESTION.

3- CONCENTRATION UP STREAM OF LITTLE RIVER IS ZERO.

4- ASSUME THE FLOW IN LITTLE RIVER IS WELL MIXED.

5- CONCENTRATION AT STORM SEWER OUTFALL IS EQUAL TO THE MEASURED COCENTRATION IN CATCH BASIN.

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ANALYSIS:

GIVEN:

1- CONCENTRATION IN CATCH BASIN SAMPLED FOR THE FOLLOWING COMPOUNDS:

i := 1 ..8 (i = number of compounds)

Cbasin :=

i	
0.022	BENZENE (mg/l)
0.443	ALUMINUM (mg/l)
0.039	COPPER (mg/l)
0.017	CYANIDE (mg/l)
2.95	IRON (mg/l)
0.013	LEAD (mg/l)
0.14	ZINC (mg/l)
0.001	CHLORDANE (mg/l)

2- RAINFALL INTENSITY AT THE DAY OF SAMPLING (I)

I := .1

3- SITE RUNOFF (Q.site) IS EQUAL TO OUTFALL FLOW (Q.out).

4- SITE RUNOFF COEFFICIENT (C)

C := .25 (UNPAVED SITE)

5- TOTAL SITE AREA (A)

A := 2.5 (ACRES)

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SITE := 2 (ACRES)

CALCULATION:

$$Q_{site} := C \cdot I \cdot A$$

$$Q_{site} = 0.0625$$

$$Q_{out} := Q_{site}$$

$$Q_{out} = 0.0625$$

Maximum allowed concentration in river = NYSDEC Class A surface water Standards for protection of aquatic life

$Cd_i :=$	
.006	BENZENE (mg/l)
.100	ALUMINUM (mg/l)
.014	COPPER (mg/l)
.0052	CYANIDE (mg/l)
.300	IRON (mg/l)
.004	LEAD (mg/l)
.030	ZINC (mg/l)
.000002	CHLORDANE (mg/l)

$$Qup_i := \frac{\left[Q_{out} \cdot Cbasin_i\right] - \left[Q_{out} \cdot Cd_i\right]}{Cd_i}$$

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Job BOS2
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Calculated by HI date 12/90
Checked by AH date 12/90
File (ALNYS.mcd)

REQUIRED FLOW (CFS) IN RIVER TO DILUTE THE ABOVE COMPOUNDS CONCENTRATIONS GENERATED FROM THE FIRST RAINFALL FLUSH.

Qup i	
0.166667	BENZENE
0.214375	ALUMINUM
0.111607	COPPER
0.141827	CYANIDE
0.552083	IRON
0.140625	LEAD
0.229167	ZINC
31.1875	CHLORDANE

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File (epawqs.mcd)

IMPACT OF BOOTH OIL SITE RUNOFF ON THE LITTLE RIVER

INTRODUCTION:

THE PURPOSE OF THE FOLLOWING CALCULATION IS TO ESTIMATE THE IMPACT OF THE STORM SEWER ON THE LITTLE RIVER.

ASSUMPTIONS:

THE FOLLOWING ASSUMPTIONS ARE USED IN ESTIMATING THE SITE RUNOFF AND THE COCENTRATION IN THE LITTLE RIVER:

1- THE ENTIRE SITE DRAINS TO THE CATCH BASIN WHERE THE SAMPLES WERE COLLECTED.

2- NO OTHER TRIBUTARY IS CONTRIBUTING TO THE STORM SEWER SYSTEM EXCEPT THE SITE IN QUESTION.

3- CONCENTRATION UP STREAM OF LITTLE RIVER IS ZERO.

4- ASSUME THE FLOW IN LITTLE RIVER IS WELL MIXED.

5- CONCENTRATION AT STORM SEWER OUTFALL IS EQUAL TO THE MEASURED COCENTRATION IN CATCH BASIN.

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ANALYSIS:

GIVEN:

1- CONCENTRATION IN CATCH BASIN SAMPLED FOR THE FOLLOWING COMPOUNDS:

i := 1 ..8 (i = number of compounds)

Cbasin :=

i	
.039	COPPER (acute) (mg/l)
.039	COPPER (chronic) (mg/l)
0.017	CYANIDE (chronic) (mg/l)
2.95	IRON (chronic) (mg/l)
.013	LEAD (chronic) (mg/l)
.14	ZINC (acute) (mg/l)
.14	ZINC (chronic) (mg/l)
.001	CHLORDANE (chronic) (mg/l)

2- RAINFALL INTENSITY AT THE DAY OF SAMPLING (I)

I := .1

3- SITE RUNOFF (Q.site) IS EQUAL TO OUTFALL FLOW (Q.out).

4- SITE RUNOFF COEFFICIENT (C)

C := .25 (UNPAVED SITE)

5- TOTAL SITE AREA (A)

A := 2.5 (ACRES)

SADAT ASSOCIATES INC. 5 Independence Way PRINCETON, NEW JERSEY 08540 (609) 987A2500	:= 2 (ACRES) SITE	Job BOS2 Sheet No 3 of 4 Calculated by HI date 12/90 Checked by AH date 12/90 File (EPAWQS.mcd)

CALCULATION:

$$Q_{site} := C \cdot I \cdot A$$

$$Q_{site} = 0.0625$$

$$Q_{out} := Q_{site}$$

$$Q_{out} = 0.0625$$

Maximum allowed concentration in river = EPA Water Quality Standards for the protection of aquatic life

$Cd_i :=$	
.021	COPPER (acute) (mg/l)
.014	COPPER (chronic) (mg/l)
.0052	CYANIDE (chronic) (mg/l)
1.0	IRON (chronic) (mg/l)
.004	LEAD (chronic) (mg/l)
.137	ZINC (acute) (mg/l)
.124	ZINC (chronic) (mg/l)
.0000043	CHLORDANE (chronic) (mg/l)

$$Qup_i := \frac{\left[Q_{out} \cdot Cbasin_i\right] - \left[Q_{out} \cdot Cd_i\right]}{Cd_i}$$

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REQUIRED FLOW (CFS) IN RIVER TO DILUTE THE ABOVE COMPOUNDS CONCENTRATIONS GENERATED FROM THE FIRST RAINFALL FLUSH.

Qup i	
0.053571	COPPER (acute)
0.111607	COPPER (chronic)
0.141827	CYANIDE (chronic)
0.121875	IRON (chronic)
0.140625	LEAD (chronic)
0.001369	ZINC (acute) (
0.008065	ZINC (chronic)
14.472384	CHLORDANE (chronic)