RESULTS OF THE TNT AREA B REMEDIAL INVESTIGATION AT THE FORMER PLUM BROOK ORDNANCE WORKS

Presented to

The Restoration Advisory Board

September 22, 1999

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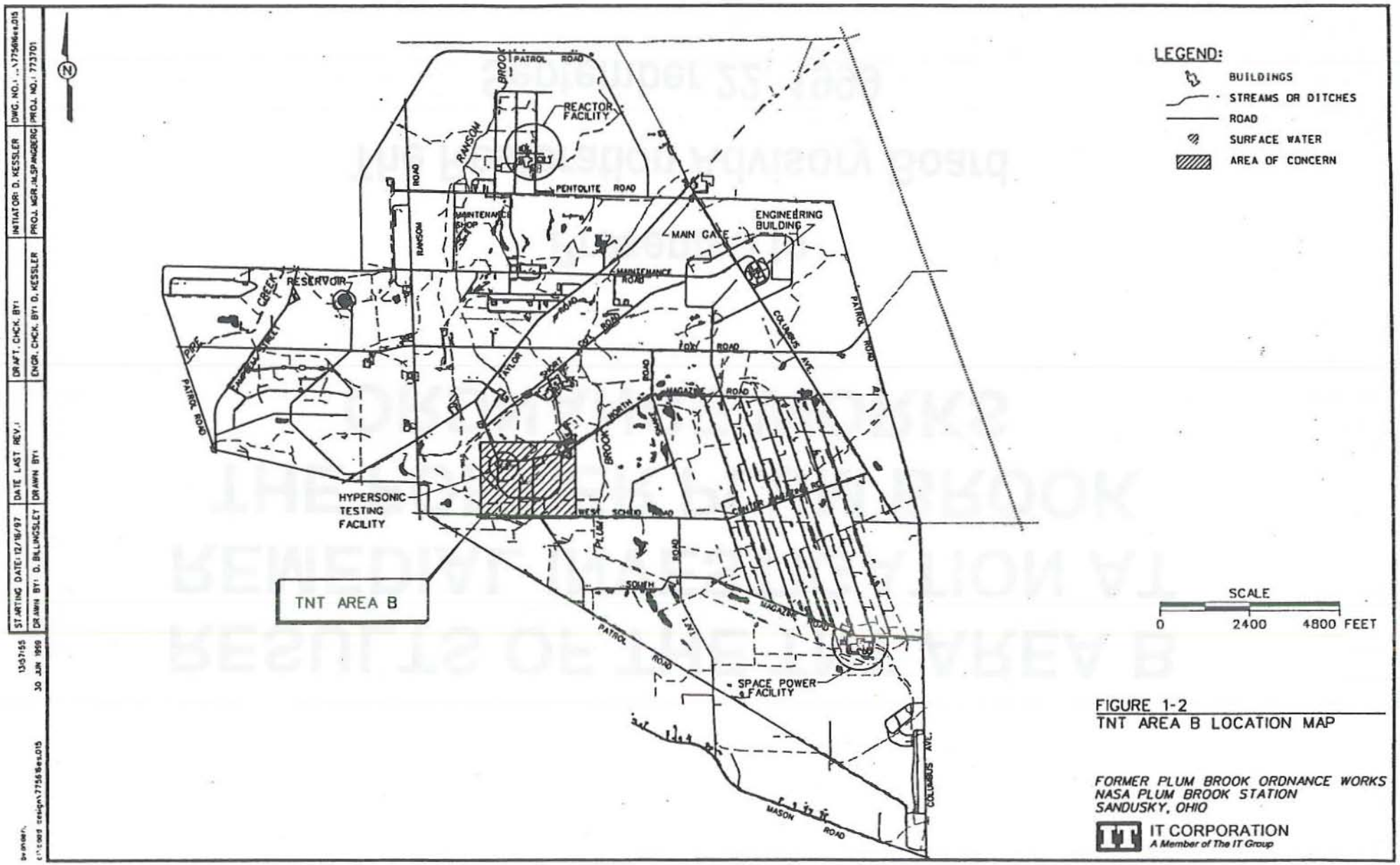

FIGURE 1-2
TNT AREA B LOCATION MAP

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Purpose and Objectives

- Define site physical features and characteristics
- Determine the nature and extent of source areas
- Determine whether contaminant distribution consistent with past DOD site activities
- Characterize risk to current and future human and / or ecological receptors

NOTE: TNT Area B Remedial Investigation Report issued as draft in June 1999. Therefore, findings, recommendations, and conclusions presented herein are subject to revision.

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Scope of the TNT Area B RI

- Grid layout / development
- Surface and subsurface soil sampling
- Field screening for nitroaromatic compounds in site soils using Ion Mobility Spectroscopy (IMS)
- Confirmation analysis of selected samples at fixed-base laboratory
- Surface water and sediment sampling
- Land surveying

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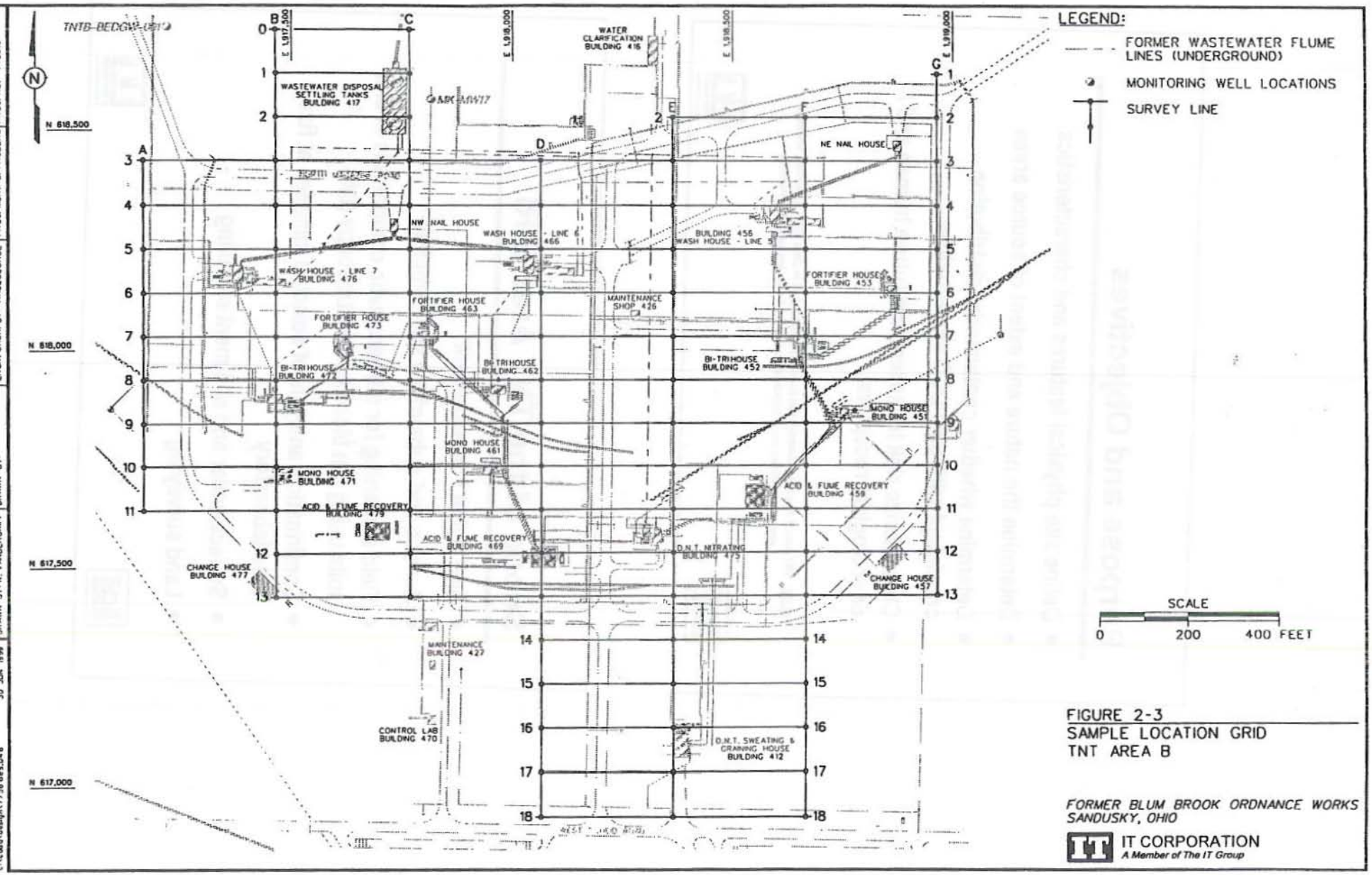

FIGURE 2-3
SAMPLE LOCATION GRID
TNT AREA B

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Grid Layout / Development

- Preliminary gridlines staked to locate positions of former buildings based on historical site maps
- Gridlines spaced at 300 feet with nodes at 100 feet
- Gridlines surveyed to establish coordinates
- Initial sampling locations based on historical detections and locations of potential source areas

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Soil Sampling

- Surface Soil Sampling
  - ➢ 395 surface soil samples collected for IMS field screening
  - ➢ One sediment sample collected for IMS field screening
  - ➢ Twenty-nine confirmation surface soil samples collected for IMS field screening and off-site analysis
- Subsurface Soil Sampling
  - ➢ 87 subsurface samples collected using direct-push methods
    - 63 samples collected for IMS field screening
    - 24 samples collected for IMS field screening and off-site analysis

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Analytical Parameters

- **IMS Field Screening**
  - Alternative to colorimetric screening (Method 8515)
  - Multiple target compounds (2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-Amino-4,6-DNT, and 4-Amino-2,6-DNT)
- **Confirmation Analyses**
  - Nitroaromatic compounds
  - Volatile (VOC) and semivolatile organic compounds (SVOC)
  - Polychlorinated biphenyls (PCBs)
  - Metals

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IMS Field Screening

- **Sampled Areas**
  - DNT Process Buildings

Building	Name	Surface Samples	Subsurface Samples
412	DNT Sweating and Graining Building	20	2
415	DNT Nitrating Building	11	0

  - Wastewater Settling Tanks and Pipelines

Building	Name	Surface Samples	Subsurface Samples
417	Wastewater Disposal Settling Tanks	25	2
	Wastewater Pipelines	5	10

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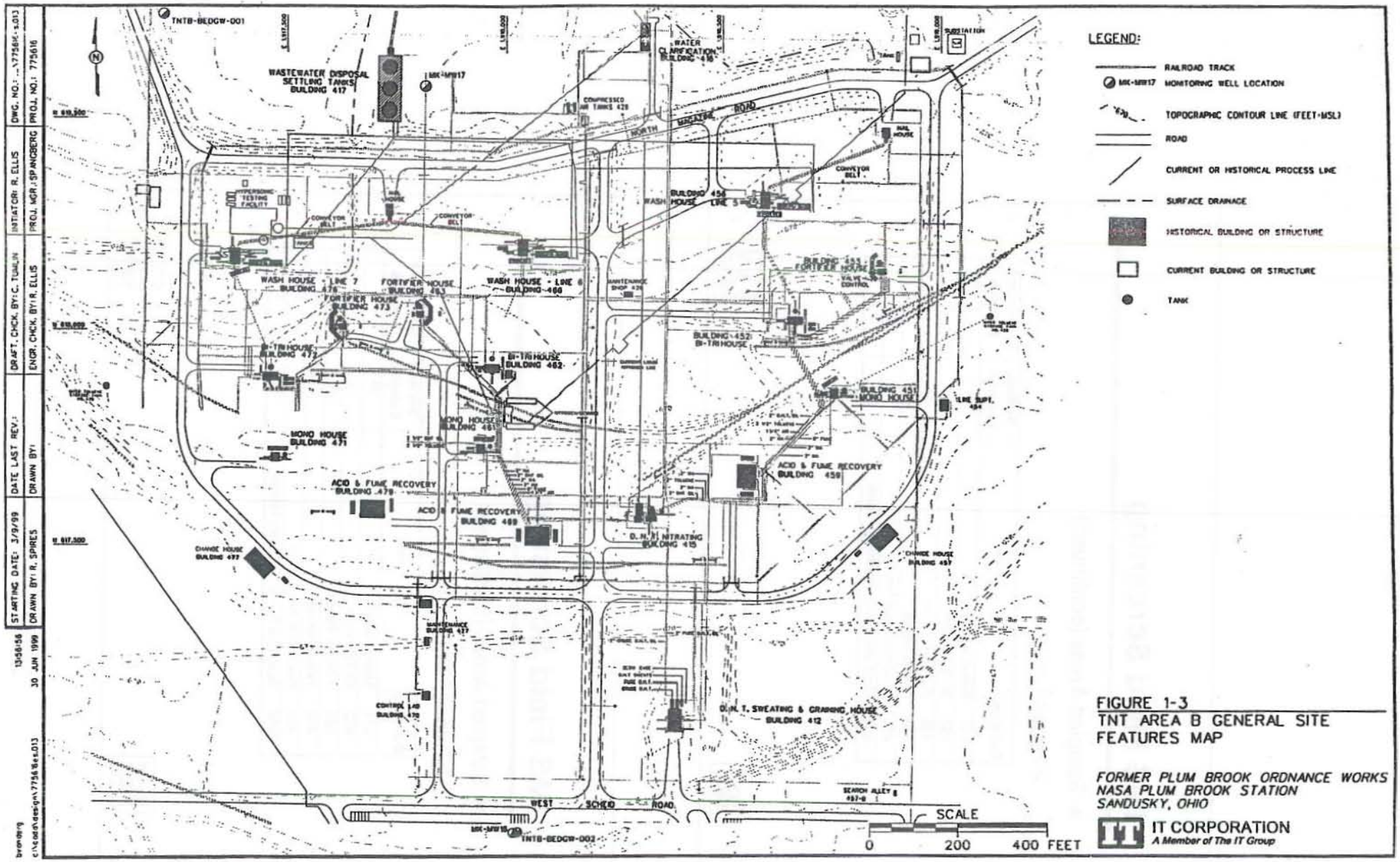

FIGURE 1-3
TNT AREA B GENERAL SITE FEATURES MAP

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IMS Field Screening

- Sampled Areas (continued)
  - Process Line 5

Building	Name	Surface Samples	Subsurface Samples
451	Mono House	21	6
452	Bi-Tri House	32	6
453	Fortifier House	10	2
456	Wash House	39	2
458	Northeast Nail House	19	0
459	Acid and Fume Recovery House	11	0

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IMS Field Screening

- Sampled Areas (continued)
  - Process Line 6

Building	Name	Surface Samples	Subsurface Samples
461	Mono House	10	7
462	Bi-Tri House	13	2
463	Fortifier House	6	6
466	Wash House	23	4
468	Northeast Nail House	18	1
469	Acid and Fume Recovery House	14	1

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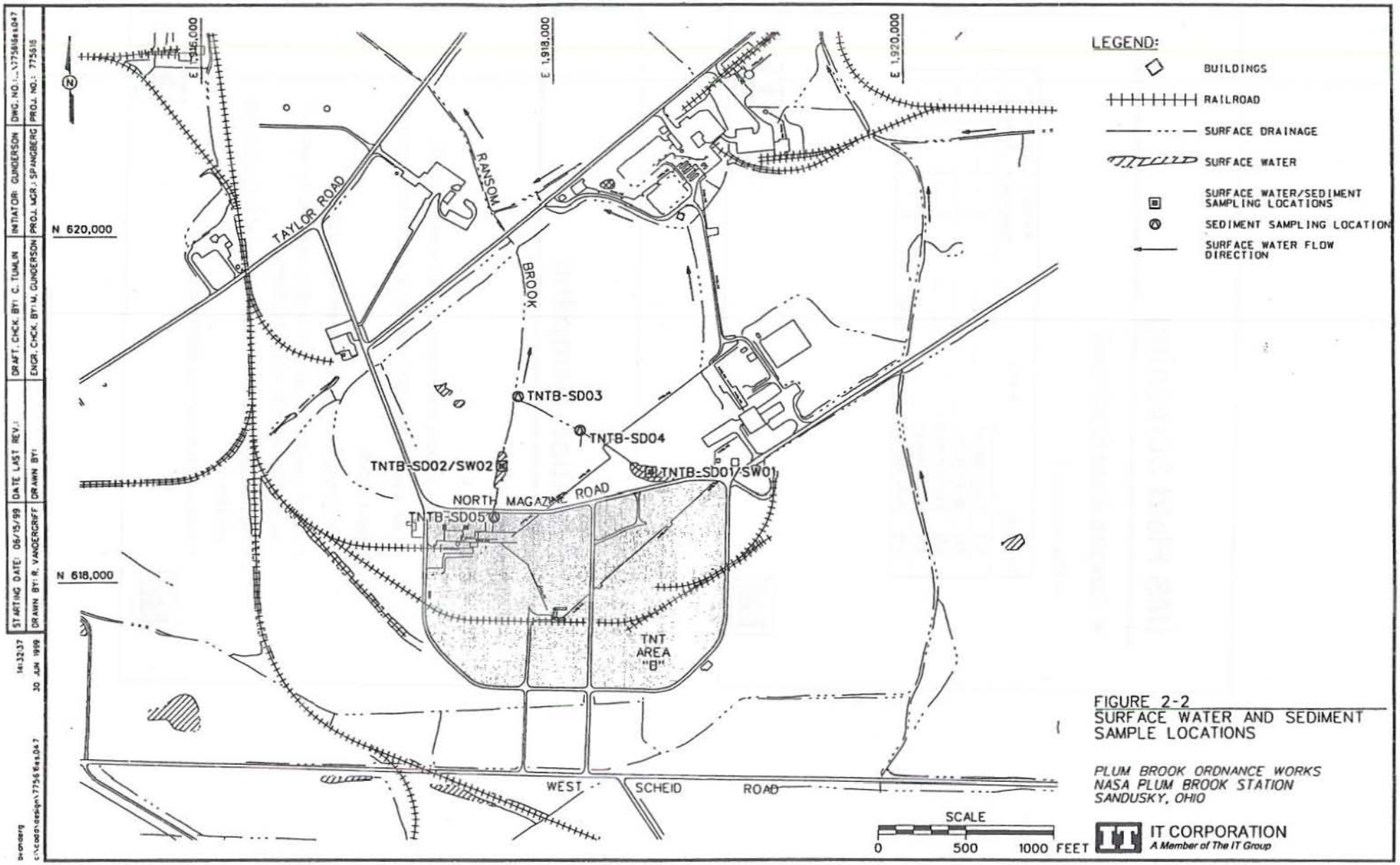

FIGURE 2-2
SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS

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IMS Field Screening

- **Sampled Areas (continued)**
  - ➢ Process Line 7

Building	Name	Surface Samples	Subsurface Samples
471	Mono House	7	0
472	Bi-Tri House	12	7
473	Fortifier House	8	5
476	Wash House	17	0
479	Acid and Fume Recovery House	11	0

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Confirmation Sampling

- **Sampled Areas**
  - ➢ TNT Area B
    - Sample locations selected based on field screening results
    - Data used to confirm IMS results and to support risk assessments
  - ➢ Ransom Brook
    - Ten surface water and ten sediment samples planned
    - Sample quantity reduced to five surface water and five sediment samples following site walk by risk assessors
    - Filed conditions precluded collection of three of five surface water samples
    - Data used to support risk assessments

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TNT Area B RI Results

- **Nitroaromatic Compounds**
  - ➢ DNT Process Buildings
    - Building 412, DNT Sweating and Graining Building
      - ⇨ 2,4-DNT detected in 3 of 20 IMS surface soil samples at up to 23 mg/kg
      - ⇨ 2,4-DNT detected in 1 of 2 IMS subsurface soil samples at 17.3 mg/kg
      - ⇨ Confirmation samples were not collected
    - Building 415, DNT Nitrating Building
      - ⇨ 2,4,6-TNT detected at up to 0.15 mg/kg in 2 of 11 IMS surface samples
      - ⇨ Subsurface samples were not collected
      - ⇨ Confirmation samples were not collected

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Building 417, Wastewater Settling Tanks
    - Nitroaromatics detected in 22 of 25 IMS surface soil samples
      - ⇨ 2,4,6-TNT up to 6.1 mg/kg; 19 samples below 1 mg/kg
      - ⇨ 4A2,6-DNT detected in 13 samples at up to 1.4 mg/kg
    - 2,4,6-TNT detected in 1 of 2 IMS subsurface samples at 0.28 mg/kg
    - Five confirmation surface soil samples consistent with IMS samples
    - Tanks appear to have been properly decontaminated based on low levels of TNT in subsurface soils

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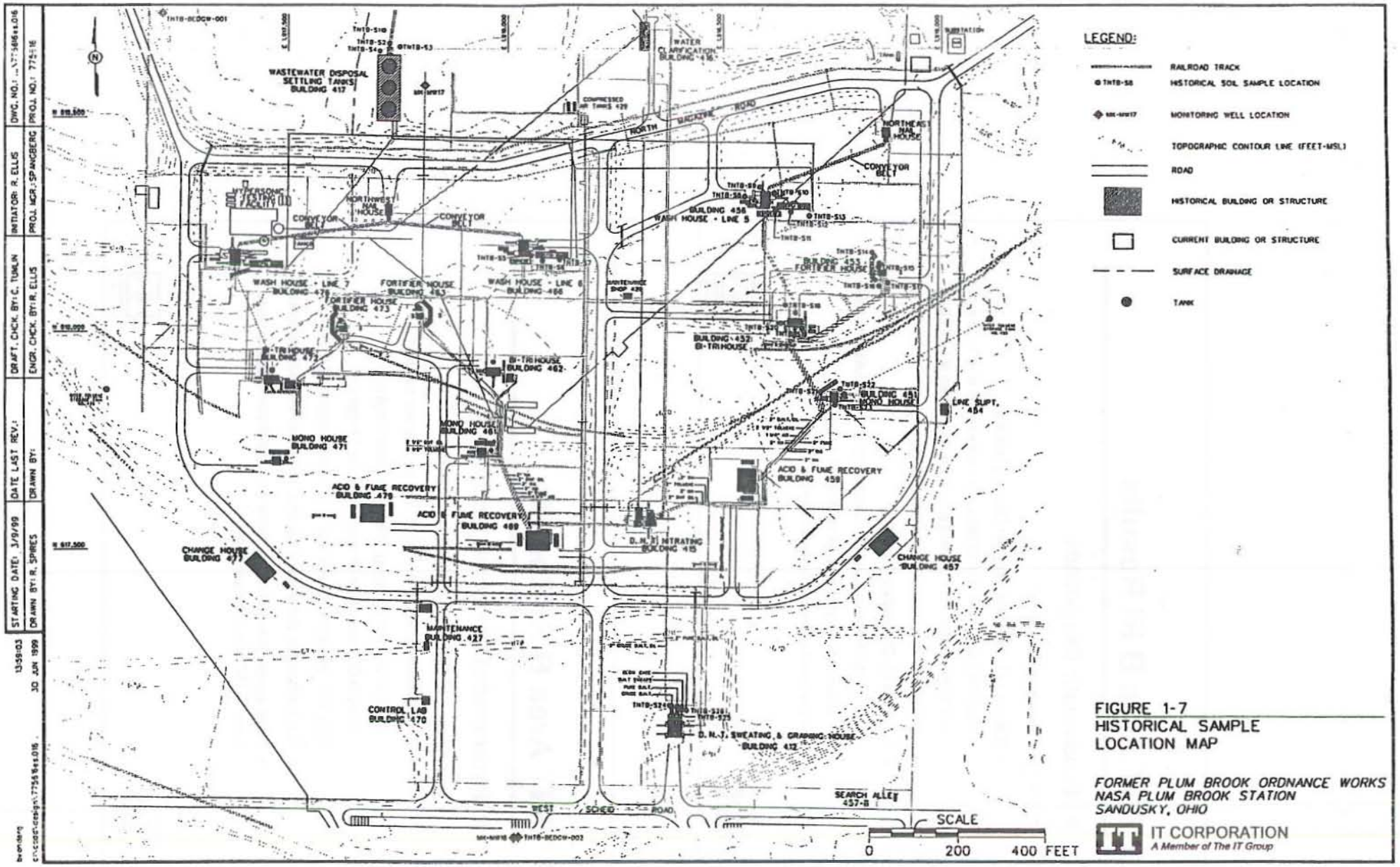

FIGURE 1-7
HISTORICAL SAMPLE LOCATION MAP

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Wastewater Disposal Pipelines
    - 2,4,6-TNT detected in 1 of 5 IMS surface soil samples at 0.12 mg/kg
    - Nitroaromatics detected in 4 of 10 IMS subsurface soil samples
      - ⇨ 2,4,6-TNT up to 25 mg/kg; 3 samples below 1 mg/kg
      - ⇨ 4A2,6-DNT detected in 3 samples at up to 0.38 mg/kg
    - Two confirmation soil samples consistent with IMS samples
    - Limited nitroaromatic contamination evident near Building 466, Wash House

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Process Line 5
    - Building 451, Mono House
      - ⇨ Nitroaromatics detected at low concentrations in limited number of surface and subsurface soil samples (< 1 mg/kg)
      - ⇨ No discernable pattern of nitroaromatic contamination evident
    - Building 452, Bi-Tri House
      - ⇨ Nitroaromatics detected in half of surface soil samples at up to 66 mg/kg; most samples below 1 mg/kg
      - ⇨ Nitroaromatics detected in most subsurface soil samples; elevated 2,4,6-TNT at 6100 mg/kg at 7 feet bgs at one location
      - ⇨ Nitroaromatic contamination appears limited to one subsurface location

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Process Line 5 (continued)
    - Building 453, Fortifier House
      - ⇨ Nitroaromatics detected in 2 of 10 surface samples at up to 18 mg/kg
      - ⇨ 2,4,6-TNT at elevated concentration of 2200 mg/kg in 1 of 2 subsurface soil sample (4 - 5 feet bgs)
      - ⇨ Nitroaromatic contamination appears limited to one subsurface location
    - Building 456, Wash House
      - ⇨ Nitroaromatics detected in most surface soil samples; TNT at up to 2800 mg/kg
      - ⇨ 2,4,6-TNT detected in 2 subsurface soil samples (up to 56 m/kg)
      - ⇨ Contamination extends around south side of former catch basin

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Process Line 5 (continued)
    - Building 458, Northeast Nail House
      - ⇨ Nitroaromatics detected in limited number of surface samples at up to 7.6 mg/kg
      - ⇨ No discernable pattern of contamination is evident
    - Building 459, Acid and Fume Recovery House
      - ⇨ Low levels of nitroaromatic contaminants detected in limited number of surface soil samples; 2,4-DNT at maximum of 7 mg/kg
      - ⇨ No discernable pattern of contamination is evident

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Process Line 6
    - Building 461, Mono House
      - ⇨ Nitroaromatics detected at low concentrations in most surface soil samples (up to 1.2 mg/kg) and two subsurface samples (up to 2.4 mg/kg)
      - ⇨ No discernable pattern of nitroaromatic contamination evident
    - Building 462, Bi-Tri House
      - ⇨ Nitroaromatics detected in most surface and subsurface soil samples at up to 0.90 mg/kg
      - ⇨ No discernable pattern of nitroaromatic contamination evident

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Process Line 6 (continued)
    - Building 463, Fortifier House
      - ⇨ Nitroaromatics detected in all surface samples at low concentrations (up to 0.50 mg/kg); higher concentrations in subsurface samples (up to 254.4 mg/kg)
      - ⇨ Nitroaromatic contaminants in subsurface on south side of foundation
    - Building 466, Wash House
      - ⇨ Nitroaromatics detected below 1 mg/kg in most surface soil samples
      - ⇨ Higher concentrations in 2 subsurface soil samples (up to 620 m/kg)
      - ⇨ Contamination evident in subsurface on south side of catch basin

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Process Line 6 (continued)
    - Building 468, Northwest Nail House
      - ⇨ Nitroaromatics detected in most surface samples; only two samples exceeded 1 mg/kg with concentrations up to 23 mg/kg
      - ⇨ Contamination limited to area associated with former conveyor belt near Building 466, Wash House
    - Building 469, Acid and Fume Recovery House
      - ⇨ Low levels of nitroaromatic contaminants detected in 7 of 14 surface soil samples; 2,4-DNT at maximum of 4.3 mg/kg
      - ⇨ No discernable pattern of contamination is evident

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Process Line 7
    - Building 471, Mono House
      - ⇨ 2,4,6-TNT detected at 0.11 mg/kg in one surface soil sample
      - ⇨ No discernable pattern of nitroaromatic contamination evident
    - Building 472, Bi-Tri House
      - ⇨ Nitroaromatics detected in 5 surface soil samples at up to 0.25 mg/kg
      - ⇨ Four subsurface soil samples exhibited nitroaromatic compounds at up to 27 mg/kg
      - ⇨ Subsurface soils exhibit limited impacts by nitroaromatic contaminants

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Process Line 7 (continued)
    - Building 473, Fortifier House
      - ⇨ Nitroaromatics detected in most surface samples at concentrations up to 4.3 mg/kg); slightly higher concentrations evident in subsurface samples (up to 6 mg/kg)
      - ⇨ Impacts from low levels of nitroaromatic contaminants in site soils
    - Building 476, Wash House
      - ⇨ Nitroaromatics detected below 1 mg/kg in most surface soil samples; one IMS surface sample exhibited 2,4,6-TNT at 720 mg/kg
      - ⇨ Subsurface soil samples could not be collected due to HTF
      - ⇨ Contamination evident in surface soil on south side of catch basin

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TNT Area B RI Results

- **Nitroaromatic Compounds (continued)**
  - ➢ Process Line 7 (continued)
    - Building 479, Acid and Fume Recovery House
      - ⇨ Trace levels of nitroaromatic contaminants detected in 3 of 11 surface soil samples (below 0.2 mg/kg)
      - ⇨ No discernable pattern of contamination is evident
  - ➢ Ransom Brook
    - Nitroaromatic compounds were not detected in surface water or sediment samples

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TNT Area B RI Results

- **VOCs and / or SVOCs**
  - ➢ Detected at low concentrations in various samples from:
    - Building 417, Wastewater Settling Tanks and Wastewater Pipelines
    - Building 451, Mono House
    - Buildings 462 and 472, Bi-Tri Houses
    - Buildings 453, 463, and 473, Fortifier Houses
    - Buildings 456, 466, and 476, Wash Houses
    - Buildings 458 and 468, Nail Hoses
    - Ransom Brook
  - ➢ Not interpreted to be related to past DOD site activities

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TNT Area B RI Results

- **PCBs**
  - ➢ Aroclor 1254 and / or Aroclor 1260 detected in samples from:
    - Building 417, Wastewater Settling Tanks and Wastewater Pipelines
    - Buildings 452 and 462, Bi-Tri Houses
    - Buildings 453, 463, and 473, Fortifier Houses
    - Buildings 456, 466, and 476, Wash Houses
    - Buildings 458 and 468, Nail Houses
  - ➢ Possibly site related; however, their use at the site during DOD operations have not been documented

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TNT Area B RI Results

- **Metals**
  - ➢ Lead above background concentrations in samples from:
    - Building 417, Wastewater Settling Tanks
    - Buildings 453 and 473, Fortifier Houses
    - Buildings 456 and 466, Wash Houses
    - Buildings 458 , Nail House
  - ➢ Copper above background levels at Building 458, Nail House
  - ➢ Beryllium above background at Building 466, Wash House
  - ➢ May or may not be site related

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TNT Area B Risk Assessments

- **Human Health Risk Assessment**
  - ➢ Groundskeeper Scenario
    - Site related Incremental Lifetime Cancer Risk (ILCR) for exposure to soil of 1.05E-04 slightly exceeds OEPA limits.
    - Hazard Index (HI) total value of 16 exceeds the OEPA limit of 1, with 2,4,6-TNT being the only significant contributor.
  - ➢ Construction Worker Scenario
    - Site related ILCR for exposure to soil of 1.47E-05 within OEPA limits.
    - Hazard Index (HI) total value of 67.4 exceeds the OEPA limit of 1, with 2,4,6-TNT being the predominant contributor, with significant contributions from 2A-4,6 DNT, 4A-2,6 DNT, 2,4-DNT and 2,6-DNT

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TNT Area B Risk Assessments

- **Human Health Risk Assessment**
  - ➢ On-Site Resident Scenario
    - Site related ILCR (1.1E-03) and HI (233) values for exposure to soil exceed OEPA limits. Contributors to site-related risk are nitroaromatics, PCB's and PAH's (as in the above scenarios).
    - Note that the HI for this scenario was calculated using potential exposure pathways for children, which involve higher ingestion and dermal contact rates than would be associated with an adult.

TNT Area B Risk Assessments

- **Ecological Risk Assessment**
  - ➢ High (>1000) Hazard Quotients (HQs) are predicted for certain receptors due to potential nitroaromatic and PCB uptake by invertebrates and plants from surface soil and sediment, combined with aluminum and iron ingestion from water, and iron uptake by fish from surface water.
  - ➢ HQs were predicted using the maximum detected values for the COPEC's utilized in performing this assessment. Therefore, the elevated HQ should be considered to be of a very conservative nature.

Recommendations

- **A feasibility study (FS) of TNT Area B should be conducted to determine:**
  - Volumes and areas requiring remediation
  - Remediation alternatives / options

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