EA Engineering, Science, and Technology, Inc.

2350 Post Road
Warwick, RI 02886
Telephone: 401-736-3440
Fax: 401-736-3423
www.eaest.com

12 February 2007

Joseph Bachand, Resource Conservationist
Natural Resources Conservation Service
60 Quaker Lane, Suite 46
Warwick, RI 02886

VIA E-MAIL

RE: Sediment Sampling Summary - Woonasquatucket River Fish Passage Projects, Providence, Rhode Island
EA Project Nos. 62130.01 and 62130.02

Dear Mr.Bachand:

EA Engineering, Science, and Technology, Inc. (EA) is pleased to present our assessment of the results of the United States Environmental Protection Agency (EPA) sediment sampling activities at the Paragon, Riverside, and Dyerville Dams on the Woonasquatucket River. The characteristics of these sediments are anticipated to be utilized by the USDA Natural Resources Conservation Service (NRCS), the Woonasquatucket River Watershed Council (WRWC) and other project partners to inform the direction of fish passage improvement projects at the individual dams. Sediment sampling was conducted by EPA, with coordination by EA and the WRWC. The WRWC contacted analytical services and provided EA with analytical results as an electronic data deliverable (EDD) on 1 February 2007.

1. INTRODUCTION AND OBJECTIVES

The Dyerville, Atlantic (Riverside) Mills, and Paragon dams in Providence, Rhode Island represent three of the four most downstream flow barriers on the Woonasquatucket River. Together with the Rising Sun Mills Dam (the first dam on the river and on which installation of a fishway structure is planned for late summer 2007), these dams restrict anadromous fish passage to the lower and middle reaches of the Woonasquatucket River. Preliminary surveys by state and federal fisheries biologists have found suitable habitat and conditions for river herring (blueback herring and alewife) and possibly American shad in various reaches of the river. Current projects include restoration of fish passage at the three lowest dams and possible future improvements at upstream locations, all of which require the characterization of sediment associated with each dam structure. EPA undertook a separate sediment sampling program through a separate agreement with the WRWC; EA provided assistance in coordinating sampling locations, strategy, and efforts as needed.

2. SEDIMENT SAMPLING AND ANALYTICAL METHODS

2.1 SEDIMENT SAMPLING PROCEDURES

Sample kits, which are coolers containing chain-of custody forms, custody seals, sample containers (with preservatives, if needed), and packing material, were provided by Severn Trent Laboratory (STL). The collection and submittal of the samples was conducted according to the procedures outlined in the "Lower Woonasquatucket River QAPP" (EPA, October 2006) and led by Jerry Keefe, EPA Field Team Leader for the project. A sediment sampling plan was submitted to the Rhode Island Department of Environmental Management (RIDEM) for review on 27 October 2006.

Sampling consisted of a total of five (5) sediment collections from cores taken at the locations shown on Figures 1 through 3. Two samples, one upstream and one downstream, were be collected at Paragon Dam and Riverside Dam, and one sample was collected upstream of Dyerville Dam. Sampling was initiated on 20 November and completed on 21 November 2006. According to the United States Geologic Service's (USGS) Centerdale stream gage (located approximately 1.5 miles upstream of the Atlantic Mills Dam) river flows during the sampling period were approximately 165 cubic feet per second (cfs).

The locations of the sediment samples were recorded with a portable Global Positioning System (GPS) unit and are shown on Figures 1 through 3. Sampling was conducted in areas that have the potential to be disturbed during restoration activities, and exhibited physical characteristics conducive to available sampling methods. Samples were collected using a hand-operated sediment corer to a maximum depth of 22 inches, or refusal by hard bottom. A summary of core depths is provided in Table 2-1.

TABLE 2-1: SEDIMENT CORE DESCRIPTIONS

Sample ID	Location Description	Core Depth	Core Description
DYER1	40 ft. above/upstream of Dyerville dam, 30 ft. from west shore.	18"	Fine, dark brown silt
ATLAN1	75 ft. above/upstream of Riverside/Atlantic Mill dam, 25 ft. from west shore.	14"	Soft black/brown sediment w/ some 1/2" stones & twigs.
ATLAN2	In center of river, 100 ft. below Riverside/ Atlantic Mill dam.	20"	Sand with 2" stones and fine brown silt in layers down to 20".
PARA1	25 ft. above/upstream of Paragon dam; 50 ft. from west shore.	22"	0-6" = brown silt with leaves; 6"-12" = medium light brown sand; 12"-22" = dark brown silt.
PARA2	50 ft. below Paragon dam, 15 ft. from (side of) wall.	8"	Fine brown silt and sand with some small to large cobbles and stones. Some broken glass.

Sediment was collected to sufficient volume and homogenized in a decontaminated stainless-steel mixing bowl before being distributed into laboratory-supplied containers. Samples were stored between 0 and 4°C during shipment to the laboratory for analysis. The sampling equipment was

decontaminated before the first sample and between subsequent samples. The decontamination procedure was as follows:

1. Rinse with Woonasquatucket River impoundment water to remove large particles
2. Scrub with Liquinox
3. Rinse with deionized water
4. Rinse with hexane
5. Rinse with isopropyl alcohol
6. Rinse with deionized water.

After samples were collected, they were split as necessary among containers with the proper preservatives for the specific analyses to be run. Each container was provided with a sample label that is filled out at the time of collection. At that time, a chain-of-custody form was initiated. The collected samples were cooled, and returned to the laboratory by express parcel delivery to ensure that holding times were met.

2.2 ANALYTICAL METHODS

Sediment samples were submitted to STL on 21 November 2006 by EPA following proper chain-of-custody procedures for the following analyses:

TABLE 2-2: ANALYTICAL METHODS

Analyte	Method
17 2,3,7,8-Substituted Dioxin Congeners + Homolog Totals	EPA 1613B
PCBs	SW846 8082
TCL Semivolatile Organic Compounds	SW846 8270C
TTLC list, 16 Metals, includes digestion	6010B / 7000
TCLP Metals (8), includes extraction	6010B / 7000
TCLP Preparation/Extraction	SW846 1311
Pesticides	SW846 8081A
Diesel Range Organics (DRO)	SW846 8015
Gasoline Range Organics (GRO)	SW846 8260B
Volatile Organic Compounds	SW846 8260B
Preparation for Volatile Tests (8260)	SW846 5035
Cyanide	SW846 9012A
Hexavalent Chromium	SW846 7196A
% Moisture	
Particle Size Analysis (sieve-based analysis)	ASTM D422 Modified

2.3 DATA RESULTS

Physical characteristics of the sediment samples are summarized in Table 2-3.

TABLE 2-3: SUMMARY OF PHYSICAL ANALYSIS

Grain Size	DYER1	ATLAN1	ATLAN2	PARA1	PARA2
Gravel	13.2	5.0	22.7	7.5	39.1
Sand	24.4	68.4	76.5	87.5	58.9
Coarse Sand	1.1	2.2	8.8	3.5	32.6
Medium Sand	2.5	5.6	49.3	29.2	16.0
Fine Sand	20.8	60.5	18.4	54.7	10.3
Fines	62.4	26.6	0.8	5.0	2.0
Description	Silt loam	Very gravelly fine sandy loam	Gravelly sand	Sand	Sand

Chemical analytical results are summarized in Table 2-4. Only those analytes with at least one detected concentration above available standards are shown. Highlighted values indicate where RIDEM Residential Soil exposure exceedances occur.

TABLE 2-4: SUMMARY OF CHEMICAL ANALYSIS

Parameter / Analyte	Units	Sample Location / ID					Comparison Criteria		
		DYER1	ATLAN1	ATLAN2	PARA1	PARA2	RIDEM Residential	EPA Region 4 PRG[2]	Eco-Risk Value[5]
TCLP[1] Metals									
Lead	mg/L	**0.15**	**0.48**	NA	**1.5**	**0.21**	0.04	NA	NA
Cadmium	mg/L	NA	**0.055**	NA	NA	NA	0.03	NA	NA
Total Metals									
Arsenic	mg/kg	**10.1**	**8.5**	NA	NA	NA	7	NA	17 [3,4]
Beryllium	mg/kg	**1.1**	**0.74**	NA	NA	NA	0.4	NA	NA
Hexavalent Chromium	mg/kg	**720**	NA	NA	NA	NA	390	30 [a]	90 [3]
Lead	mg/kg	NA	**181**	NA	**300**	NA	150	NA	91.3 [3]
Manganese	mg/kg	NA	NA	**537**	NA	NA	390	NA	NA
Dioxin									
2,3,7,8 - TCDD	pg/g	NA	**11**	**13**	**130**	**9.1**	NA	0.0039 [a] / 130 [c]	8.8 [4]
Semivolatile Organic Compounds									
Benzo(a)anthracene	ug/kg	NA	**1,800**	NA	**7,800**	NA	900	NA	385 [3]
Benzo(a)pyrene	ug/kg	**970**	**1,800**	**530**	**6,600**	**650**	400	NA	782 [3]
Benzo(b)flouranthene	ug/kg	**1,300**	**2,000**	NA	**6,400**	NA	900	NA	NA
Benzo(ghi)perylene	ug/kg	NA	NA	NA	**3,100**	NA	NA	NA	800 [4]
Benzo(k)flouranthene	ug/kg	**1,000**	**1,600**	NA	**7,000**	NA	900	NA	13,400 [4]
Chrysene	ug/kg	**1,100**	**2,100**	**580**	**8,800**	**690**	400	NA	862 [3]
Indeno(1,2,3-cd)pyrene	ug/kg	NA	**990**	NA	**4,000**	NA	900	NA	330 [4]
Dibenz(a,h)anthracene	ug/kg	NA	NA	NA	**1,200**	NA	NA	6200 [a]	100 [4]
Dibenzofuran	ug/kg	NA	NA	NA	**1,500**	NA	NA	1500 [b]	5100 [4]
Pyrene	ug/kg	NA	NA	NA	**19,000**	NA	NA	NA	875 [3]

Notes:
1. TCLP - Toxicity Characteristics Leaching Procedure criteria.
2. PRG - EPA Region 4, Preliminary Remediation Goal Levels
   a. Residential Soil - Cancer Risk, Combined Exposure
   b. Residential Soil - Chronic HQ, Combined Exposure
   c. Industrial Soil - Cancer Risk, Combined Exposure
3. PEL - Probable Effects Level
4. UET - Upper Effects Threshold
5. Screening Quick Reference Table for Inorganics in Solids (SQuiRT)

NA = Not applicable.

3. DISCUSSION

Comparison Standards

Analytical data returned from the laboratory was forwarded to EA by WRWC on 1 February 2007. The results were compared to RIDEM direct exposure criteria for residential soils (RIDEM has no sediment quality criteria) as contained in the RIDEM Remediation Regulations. Frequently, and in the case of dioxins and associated congeners, RIDEM does not have criteria for certain analytes. In the absence of RIDEM comparison data, EPA Region 4 Preliminary Remediation Goals (PRG) were used to compare sediment data with human health risk values. In addition, the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Table for Inorganics in Solids (SQuiRT) standards were used to compare sediment data with ecological risk values. Comparison to Region 4 PRGs and SQuiRT values are intended to serve only as a planning tool and do not intend to suggest that a human health or eco-risk study has been carried out.

Concentrations of dioxin do not exceeded the remediation goal of 1 ppb (dioxin concentrations provided in this summary are displayed as parts per trillion [pg/g]) which has been established at the Centerdale Manor CERCLA site upstream of the sample reach. Dioxin levels at these locations exceed EPA PRG residential soil exposure values for the protection of human health as well as NOAA ecological risk values. While certain dioxin congeners were detected in all samples, standard Toxicity Equivalency Calculations (TEC) are not being applied at this time.

Relationship to Current Projects

The quality of sediments associated with the sampling sites will be an important factor in determining the trajectory of current and future fish passage restoration projects on the Woonasquatucket River. All of the samples contained exceedances for RIDEM residential soil exposure standards. These standards are used by RIDEM in the evaluation of sediment disposal and management options. Exceedances of metals and semivolatile organic compounds (SVOC) as were observed at all sample locations are not unexpected in an urban setting such as the Lower Woonasquatucket River Watershed. In EA's opinion the exceedances of these standards does not preclude in-stream work, but does require specific measures be implemented during and after construction (i.e., treating water from dewatering activities, proper disposal of contaminated sediments, etc.) to ensure adequate protection of sensitive receptors.

In addition to exceedances of metals and SVOC standards, sediment sampled from the Atlantic Mills and Paragon Dam sites contained trace amounts of the dioxin, 2,3,7,8-TCDD (among other dioxin congeners). The absence of dioxin at the Dyerville location could be attributed to the breached nature of this former dam (i.e., not providing a barrier to sediment migration), and/or a function of the sample size at this location (n=1).

The current (30%) design at the Atlantic Mills dam includes the installation of a technical fishway (Denil ladder) which through design, is not expected to change existing sediment transport dynamics, or require substantial dredging of impacted sediments.

The current proposal at the Paragon Dam includes the partial removal (breaching) of this structure. Previous field investigations conducted by EA indicate that approximately 1,000 yd^3 of loose sediment are present in the immediate project area. Analytical results indicate that at least a portion of this material has concentrations of dioxins above the reviewed risk values. Based on our conversation on 8 February 2007, in which we discussed these data, NRCS expressed interest in continuing the pursuit of a partial breach of the Paragon dam. Therefore, EA will begin to evaluate breach designs to meet the following objectives:

- Maximum removal of the existing dam structure;
- Restoration of anadromous fish passage, and;
- Stabilization of existing impounded sediments.

EA will review the hydraulic model for the Paragon Dam reach to determine the maximum removal/breach potential for the dam while balancing needs for stabilizing impacted impounded sediments. Particular attention will need to be given to changes in flow velocity and sheer stress as it relates to the migration of sediments and overall channel and bank stability.

EA has initiated coordination efforts with RIDEM through a request for a pre-application meeting, to discuss on-going project activity and next steps; no coordination with EPA has been initiated. Please do not hesitate to contact me with any questions at 401-736-3440 ext. 219.

Sincerely,

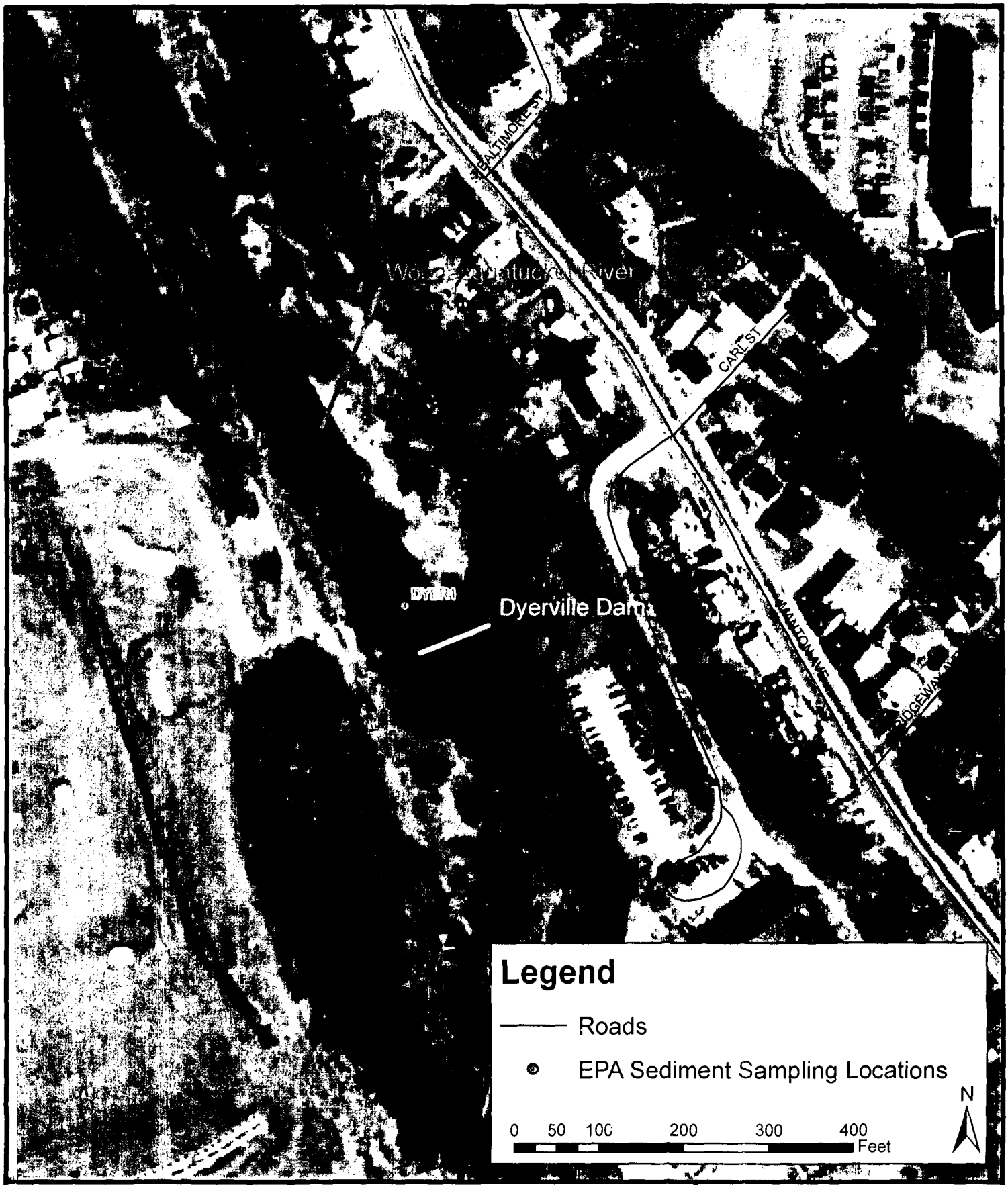
EA ENGINEERING, SCIENCE, AND
TECHNOLOGY, INC.

Jonathan Petrillo
Project Manager

JP/SW
Attachments

cc: Andrew Lipsky, NRCS
Jenny Pereira, WRWC
EA file (1 copy)

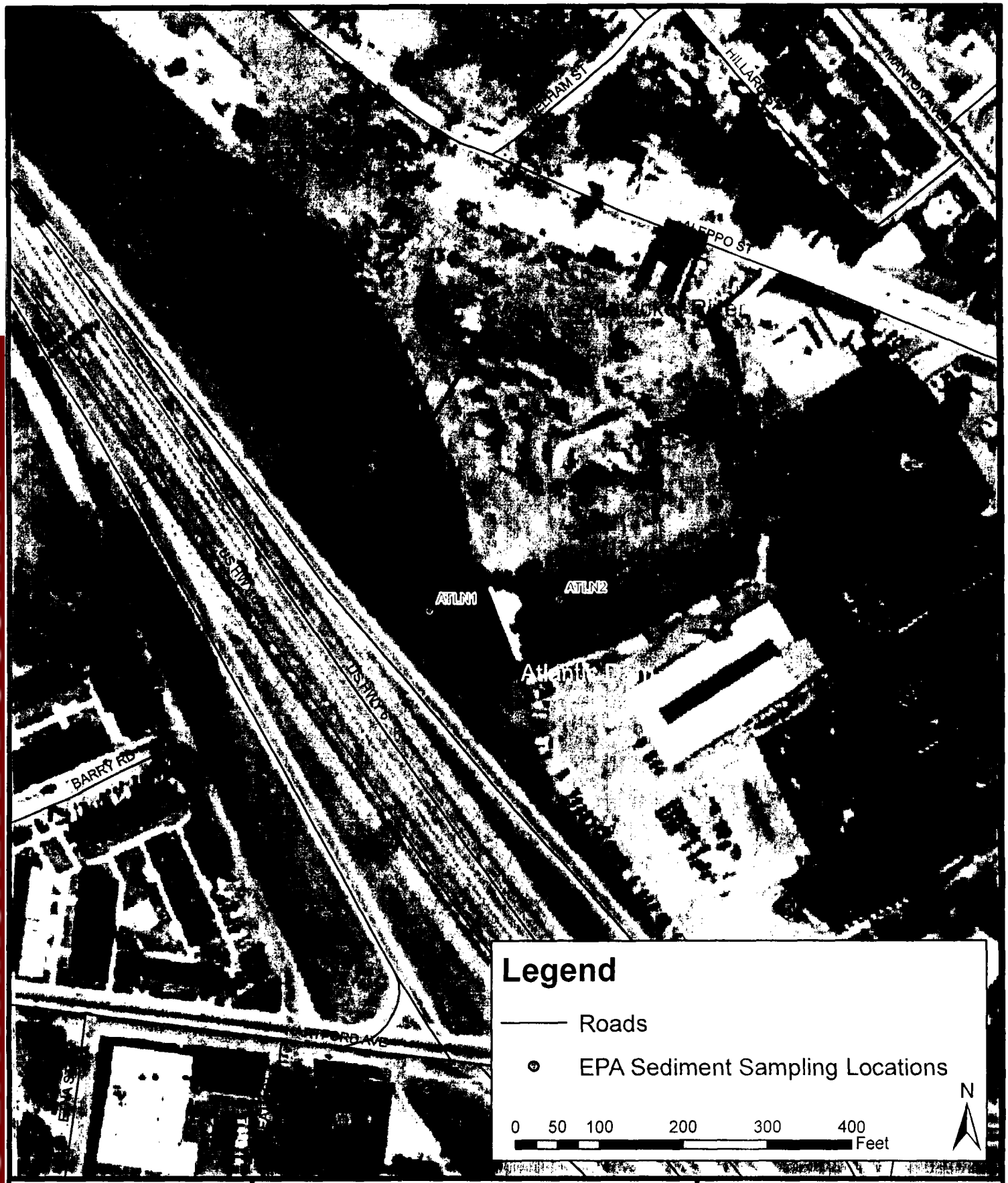
SEDIMENT SAMPLING FIGURES



WOONASQUATUCKET RIVER
FISH PASSAGE RESTORATION PROGRAM
PROVIDENCE, RI

FIGURE 1
EPA SEDIMENT SAMPLING LOCATIONS

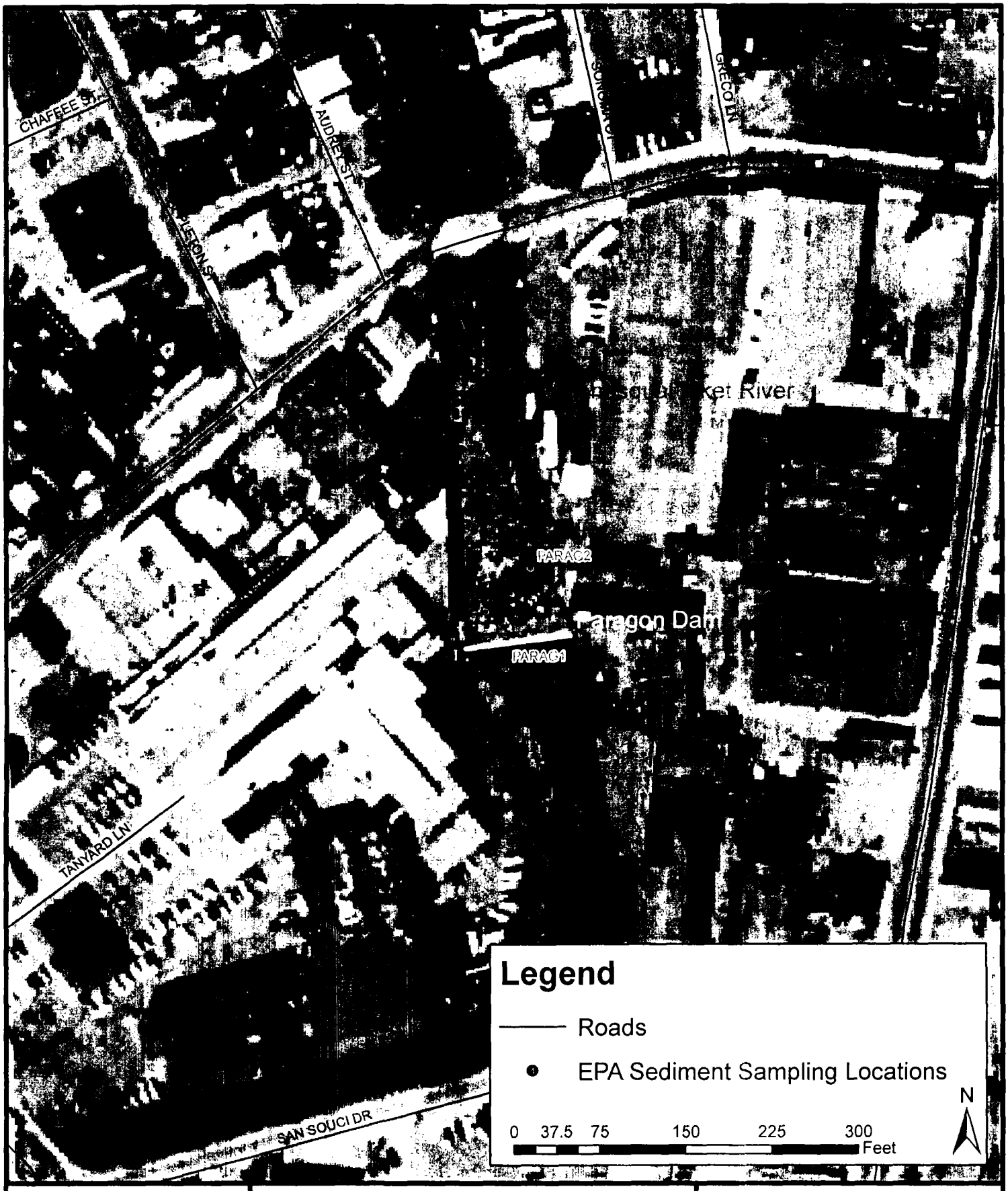
PROJECT MGR	DESIGNED BY	CREATED BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE NO
JP	TT	TT	JP	AS SHOWN	FEBRUARY 2007	3002	EPASEDIMENTDYERVILLE.MXD



WOONASQUATUCKET RIVER
FISH PASSAGE RESTORATION PROGRAM
PROVIDENCE, RI

FIGURE 2
EPA SEDIMENT SAMPLING LOCATIONS

PROJECT MGR:	DESIGNED BY:	CREATED BY	CHECKED BY:	SCALE	DATE:	PROJECT NO	FILE NO
JP	TT	TT	JP	AS SHOWN	FEBRUARY 2007	3002	EPASEDIMENTATLANTIC MXD



EA	WOONASQUATUCKET RIVER FISH PASSAGE RESTORATION PROGRAM PROVIDENCE, RI					FIGURE 3 EPA SEDIMENT SAMPLING LOCATIONS	
PROJECT MGR	DESIGNED BY	CREATED BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE NO
JP	TT	TT	JP	AS SHOWN	FEBRUARY 2007	13002	EPASEDIMENTPARAGON.MXD