

164 BARDEN RESERVOIR

BARDEN RESERVOIR DAM, SCITUATE (164)

GZA reviewed available DEM files associated with Barden Reservoir Dam (Figure 1), including records of an inspection by the DEM in January, 2000, and a U.S. Army Corps (COE) Phase I Report dated March, 1980. The dam has historically been classified by DEM as having a **Significant Hazard** potential, including in the COE Report, for potential damages to Ponaganset Road and Route 102 and the loss of the reservoir for water supply purposes.

1.00 SUMMARY OF SITE AND POTENTIAL DOWNSTREAM IMPACT AREA

In addition to compiling background information and GIS mapping data, GZA performed field reconnaissance of the dam and its associated downstream area (Figure 2). GZA representatives William L. Ladd, P.E., and David M. Leone visited the site and the downstream river valley on April 30, 2002. A field checklist from the reconnaissance is provided in **Attachment I** and selected photographs are provided in **Attachment II**.

1.10 Site Description

Barden Reservoir Dam is located on Ponaganset River in the Town of Scituate, Kent County, Rhode Island (See Locus Map, Figure 1). The following identification numbers are associated with the dam:

- Army Corps of Engineers Number RI03003
- DEM ID Number 164

The dam has a total length of approximately 612 feet, and a maximum height of approximately 31 feet. The dam consists primarily of an earthen embankment with an 82-foot wide arch-shaped broad crested masonry spillway near the right abutment. There are two gatehouses at the dam: one at the left spillway abutment and another located about 20 feet upstream of the approximate center line of the dam. At the time of GZA's field visit, the dam was undergoing repairs / modifications to provide additional spillway capacity and address other dam safety issues. Pertinent engineering data, as obtained from the DEM dam information database, is provided in **Table 1**.

Barden Reservoir is utilized by the Providence Water Supply Board (PWSB) for water supply purposes. It is located less than 0.5 miles upstream of the headwaters of Scituate Reservoir in surrounding lands which are, in part, owned by the PWSB.

TABLE 1. Pertinent Engineering Data

Dam	
Type	Earth Embankment
Length	Approximately 612 feet
Height	31 feet
Drainage Area	33 sq.mi.
Elevation (feet above approximate MSL)	
Normal Pool (Spillway)	345.1
Top of Dam	352.2
Storage (Acre-feet)	
Normal Pool	2,620
Top of Dam	4,320
Main Spillway	
Type	Masonry Broad Crested
Length of Weir	82 feet

Note: Elevation data obtained from U.S. Army Corps of Engineers Phase I Report

1.20 Downstream Description

Barden Reservoir Dam is located on the Ponaganset River, which flows through the Town of Scituate. The immediate downstream area consists of property owned by the PWSB. The Ponaganset Road crossing is located about 380 ft downstream

1.21 Downstream Dams

Scituate Reservoir (Gainer Memorial) Dam (161) is not expected to be adversely affected by a dam failure at Barden Reservoir. See Section 2.30 for additional information

1.22 Downstream Bridges

Ponaganset Road is supported by piers as it crosses the Ponaganset River about 380 ft downstream of the dam. Additionally, a box culvert is located beneath Route 102 (Plainfield Pike) as it traverses the headwaters of the Scituate Reservoir, about 3,500 ft downstream of Barden Reservoir Dam.

1.23 Downstream Development

The land use of the floodplain of the Ponaganset River between Barden Reservoir and the Scituate Reservoir is wooded. A majority of the land is owned and controlled by the PWSB for water quality control and conservation purposes.

2.00 DAM HAZARD POTENTIAL ASSESSMENT

To further evaluate the extent of flooding due to a potential dam failure, GZA performed a limited hydraulic investigation of the hypothetical dam break flood. The analysis was performed with the National Weather Service (NWS) Simplified Dam Break (SMPDBK) model, which estimates the peak dam break flood outflow, peak water surface elevations, and the timing of the flood wave as it travels downstream, given breach characteristics specific to the dam and the geometry of the downstream channel and overbank. SMPDBK output summaries are provided in **Attachment III**.

Please note that the approximate extent of hypothetical dam break flooding generated with SMPDBK is not applicable for emergency planning nor other hydraulic design purposes. Detailed hydraulic modeling using state-of-the-practice unsteady flow models such as the NWS DAMBRK or FLDWAV computer programs, which is not in the scope of this study, should be performed when generating inundation maps for Emergency Action Plans or for use in spillway design / inflow design flood (IDF) studies.

2.10 Potential Dam Failure Mechanisms and Breach Description

As specified by the DEM, the simplified hypothetical dam failure analysis assumed starting pool elevations in the impoundment coincident with the top of dam elevation and average stream flow conditions prevailing (i.e., assumed about 1.5 cfs per square mile of drainage area). Dam breach parameters such as time of breach formation, breach shape, and the average width of the breach were selected according to these conditions and based upon the type of materials used in constructing the dam, in accordance with the recommended range of values published in the Federal Energy Regulatory Committee (FERC) guidelines and based on engineering judgment. For Barden Reservoir Dam, primarily an earth embankment structure, a time to failure of 0.5 hrs and a trapezoidal breach shape (0.5 H : 1.0 V) was utilized. Such an earthen embankment dam is assumed to fail due to piping under fair weather circumstances. The average breach width was assumed to equal three times the height of the dam, or about 93 feet.

2.20 Estimated Peak Outflow from Dam Break

The peak outflow from the hypothetical dam break was estimated using the breach outflow approximation equation developed by the National Weather Service as part of their SMPDBK computer model (see Attachment III), using the breach parameters described above and top-of-dam pool reservoir characteristics. The estimated peak breach outflow is approximately 43,500 cfs. There are no published 100-year or 500-year flood flow estimates for the North Branch of the Pawtuxet River in the area of Barden Reservoir. However, the estimated dam breach flow is much larger than the 100-year flood estimate of 4,340 cfs and the 500-year flood estimate of 8,800 cfs for the North Branch of the Pawtuxet River near its confluence with the Pawtuxet River (proper), about 9 miles downstream.

2.30 Estimated Approximate Flood Impact Area

Several riverine cross sections, developed by GZA from USGS 7.5 minute quadrangle maps, were input into the SMPDBK model to preliminarily estimate approximate peak water surface elevations. The results of the analysis are provided as the approximate inundation area depicted in **Figure 2**.

2.31 Downstream Extent of Flooding

The Ponaganset River downstream of Barden Reservoir Dam is considerably sloped, reaching the headwaters of the Scituate Reservoir within about 0.5 miles. Typical Mannings “n” roughness coefficients used in the analysis generally ranged from 0.030 to 0.035 for the channel areas, and 0.050 to 0.085 for the overbank areas. These values are consistent with the range of values used in the FEMA Flood Insurance studies for the downstream communities.

The SMPDBK analysis was ended at Scituate Reservoir, approximately 2.7 miles downstream of Barden Reservoir Dam. The flood wave emanating from the Barden Reservoir Dam failure is expected to dissipate quickly, as a result of the availability of flood storage at the reservoir.

2.32 Potential Effects of Dam Break

Results of the analysis indicate a peak flood depth about 0.2 miles downstream of the dam of about 17 feet. As the flood wave progresses downstream, it is expected to attenuate. Thus, peak flood depths are predicted to decrease to about 2 feet at the Scituate Reservoir. The extent of flooding due to the hypothetical dam break includes flooding of the unpopulated wooded area adjacent to the Ponaganset River.

2.40 Recommended Hazard Potential Classification

GZA recommends that Barden Reservoir Dam be classified as *Significant Hazard* based on the aforementioned analyses, site / downstream valley reconnaissance, site-specific GIS mapping and other existing data, and professional judgment. A potential dam failure of Barden Reservoir Dam would likely result in no probable loss of human life, but could cause major economic losses and significant disruption of lifeline facilities. Significant damage to the Ponaganset Road Bridge may occur in the form of scour at the bridge piers, and overtopping of the Route 102 crossing is also possible, which may limit or prohibit its use during and after the dam break flooding. Barden Reservoir would also be lost to the PWSB for water supply purposes and the resulting dam break flood wave could affect the availability of the 114,000 acre-foot Scituate Reservoir for water supply purposes due to water quality impairment, which may jeopardize the availability of potable water for the PWSB service area.

ATTACHMENT I
FIELD RECONNAISSANCE CHECKLIST

DAM HAZARD POTENTIAL FIELD CHECKLIST

Name of Dam:	Barden Reservoir Dam	RI DEM ID NO.	164
Location:	Scituate Town / County		Ponaganset River River or Stream
	Scituate Downstream Communities		Scituate Reservoir Major Confluence
Classification Data:	Intermediate Size		1883 Date Built
PHYSICAL DATA:	Earth Embankment Type of Dam	31 ft Height of Dam	612 Length of Dam
	Broad crested masonry Type of Spillway	82 ft Length of Spillway	
	Water Supply Purpose of Dam	Several ft below crest Pool at Inspection	2,620 ac-ft Normal Pool Storage Capacity
	U/S: 2.5:1 D/S: 2.5:1 Embankment Slopes (H:V)	Likely bedrock Foundation (if known, note rock/soil surroundings)	4,320 ac-ft Maximum Pool Storage Capacity
Name	Title/Position		
William Ladd, P.E.	Sr. Project Mgr / Engineer		
David M. Leone	Asst. Project Mgr / Hydrologist		
DATE OF INSPECTION:	4/30/2002		
WEATHER:	Partly Cloudy		
	TEMPERATURE: 55 deg. F		

Name of Dam:

Barden Reservoir Dam

I.D. No.: 164

Inspection Date: 30-Apr-02

STRUCTURAL CONDITION	1	Concrete Condition	Masonry: fair condition; dam under construction
	2	Outlet Condition	Not observed; dam under construction
	3	Unusual Movement	None observed
	4	Seepage / Wet Area	None observed
	5	Embankment Slides/Erosion	None observed
DAM & IMMEDIATE DOWNSTREAM AREA	6	Vegetation / Pest Control	Dam under construction; grassed embankment
	7	Vicinity Description	PWSB-owned lands upstream of Scituate Reservoir
	8	Dam Roads & Utilities	None-Reservoir is a water supply source
	9	Discharge Channel	To natural bedrock channel.
	10	Structures (Gatehouses, etc.)	Gatehouse at centerline about 20 ft upstream of dam under repair
	11	Adjacent Land Use	Wooded / PWSB land
	12	Adjacent Population Density	None
	13	Downstream Constrictions	None; Ponagansett Road bridge, supported by piers, little constriction
	14	Downstream Access / Use	None; PWSB owned conservation land
	15	Property / Infrastructure / Utility Description & Distance	Scituate Reservoir is downstream of dam; No property in intervening lands
GENERAL DOWNSTREAM AREA	17	Land Use Classification	Wooded / water quality conservation
	18	Population Density	None.
	19	Property / Infrastructure	None. PWSB owns downstream property.
	21	Downstream Dams	Scituate Reservoir upstream limits less than 0.5 miles downstream of Barden Reservoir Dam.
	22	Downstream Bridges	Ponagansett Road supported by piers
	23	Upstream Dams	N/A
	24	Channel Description (depth, Manning's n, width, overbank)	Bedrock channel, about 50 ft wide. Considerable gradient (riffle / run) to headwaters of the Scituate Reservoir. Steep, wooded banks; uninhabited overbanks.
	ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE		

ATTACHMENT II
FIELD PHOTOGRAPHS



Description: Photo 1. View of dam from right abutment.



Description: Photo 2. View of spillway crest and downstream channel.



Description: Photo 3. Overview of embankment under repair.



Description: Photo 4. View of downstream channel from top of dam.

ATTACHMENT III
SMPDBK OUTPUT SUMMARY

***** DISTANCE TO PRIMARY POINT OF INTEREST MOVED TO THE CROSS SECTION
 ***** CLOSEST TO THIS LOCATION (MI 2.69)

DATA FOR THIS DAM IS AS FOLLOWS:

TYPE OF DAM (IDAM)	EARTH	
DAM BREACH ELEVATION (HDE)		346.00 FT
FINAL BREACH ELEVATION (BME)		315.00 FT
SURFACE AREA OF RESERVOIR (SA)		240.00 ACRES
FINAL BREACH WIDTH (BW)		93.00 FT
TIME OF DAM FAILURE (TFM)		30.00 MINUTES
NON-BREACH FLOW (QO)		50.00 CFS
DISTANCE TO PRIMARY PT OF INTEREST (DISTTN)		2.69 MILES
DEAD STORAGE EQUIV. MANN. N (CMS)		.50

CROSS SECTION NO. 1
 FLOOD DEPTH (FLD) .00 FT

ELEV.(FT) (HS)	315.0	346.0	360.0	370.0
TWIDTHS(FT) (BS)	93.0	500.0	600.0	700.0
INACTIVE TW(FT) (BSS)	.0	.0	.0	.0
MANNING N (CM)	.035	.035	.085	.085

CROSS SECTION NO. 2
 REACH LENGTH (D) .19 MI
 FLOOD DEPTH (FLD) .00 FT

ELEV.(FT) (HS)	298.0	300.0	310.0	320.0
TWIDTHS(FT) (BS)	.0	10.0	350.0	600.0
INACTIVE TW(FT) (BSS)	.0	.0	.0	.0
MANNING N (CM)	.035	.035	.085	.085

CROSS SECTION NO. 3
 REACH LENGTH (D) .89 MI
 FLOOD DEPTH (FLD) .00 FT

ELEV.(FT) (HS)	284.0	286.0	290.0	310.0
TWIDTHS(FT) (BS)	550.0	570.0	700.0	1200.0
INACTIVE TW(FT) (BSS)	.0	.0	.0	.0
MANNING N (CM)	.035	.035	.085	.085

CROSS SECTION NO. 4
 REACH LENGTH (D) 2.69 MI
 FLOOD DEPTH (FLD) .00 FT

ELEV.(FT) (HS)	283.9	286.0	300.0	310.0
TWIDTHS(FT) (BS)	1900.0	1970.0	2200.0	2500.0
INACTIVE TW(FT) (BSS)	.0	.0	.0	.0
MANNING N (CM)	.035	.035	.085	.085

AN ASTERISK (*) BESIDE A PARAMETER IMPLIES THAT A DEFAULT VALUE WAS COMPUTED

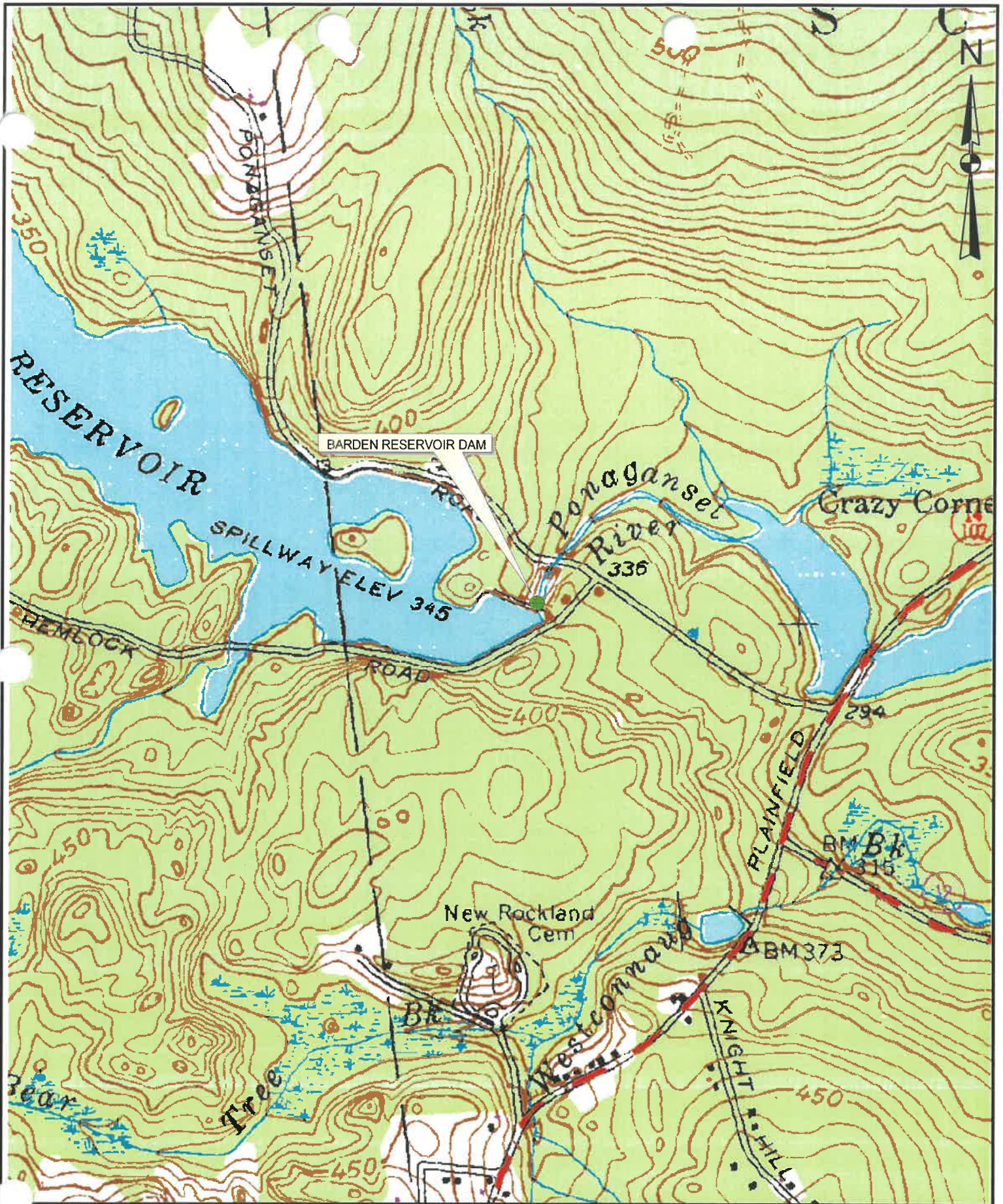
NAME OF DAM: BARDEN RES

NAME OF RIVER: PONAGANSET

RVR MILE FROM DAM	MAX FLOW (CFS)	MAX ELEV (FT-MSL)	MAX DEPTH (FT)	TIME (HR)	TIME (HR)	TIME (HR)	FLOOD DEFLOOD DEPTH (FT)
*****	*****	*****	*****	*****	*****	*****	*****
.00	43518.	326.62	11.62	.50	.00	.00	.00
.19	37747.	315.21	17.21	.52	.00	.00	.00
.89	32570.	291.80	7.80	.71	.00	.00	.00
2.69	32244.	285.90	2.00	1.12	.00	.00	.00

ANALYSIS IS COMPLETE

FIGURES



BARDEN RESERVOIR DAM

SPILLWAY ELEV 345

Ponaganset River

Crazy Corner

New Rockland Cem

PLAINFIELD

BM 373

KNIGHT HILL

SOURCE:

RIGIS

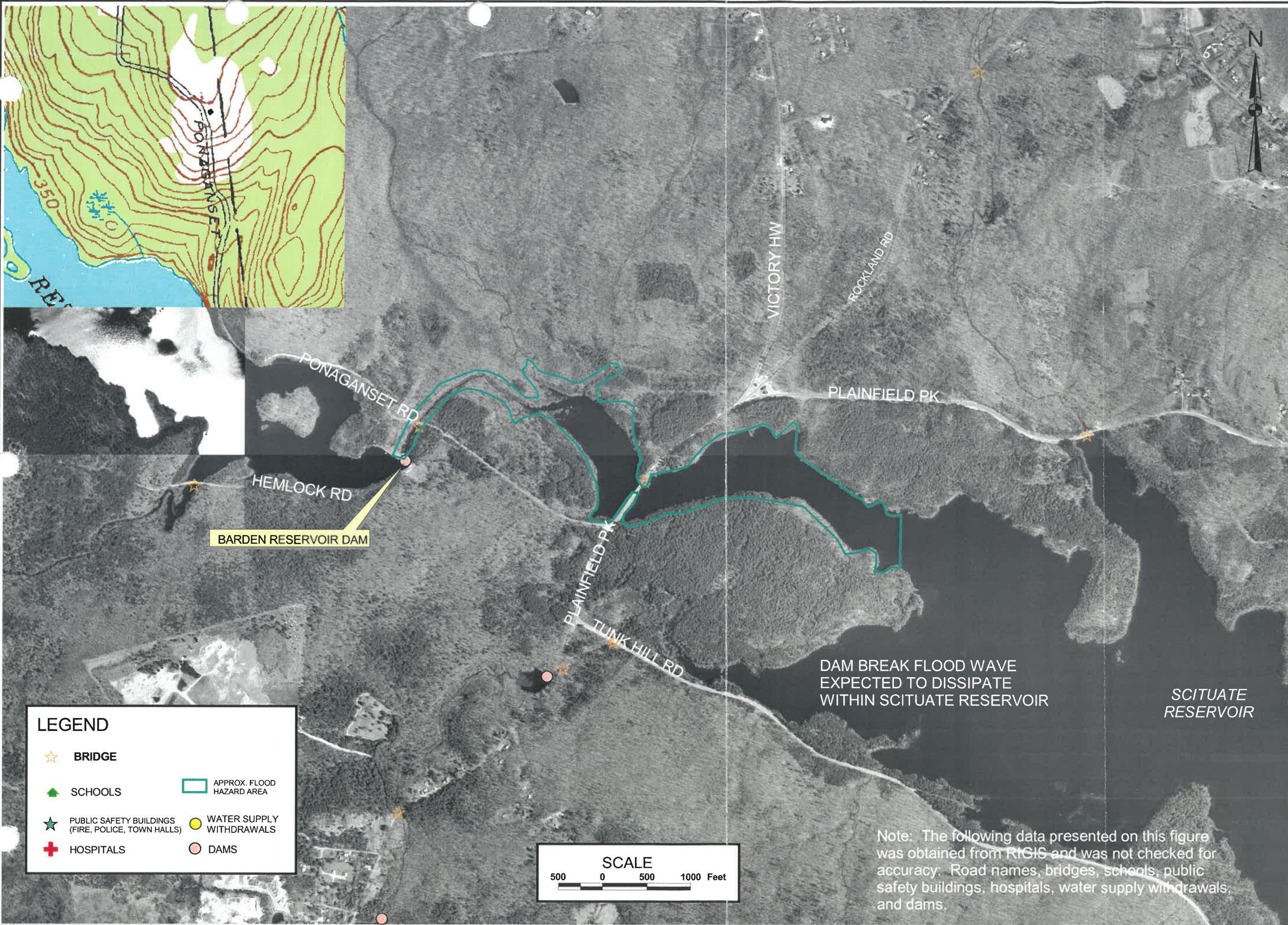
MAP DATE 1975

**FIGURE 1. LOCUS MAP
BARDEN RESERVOIR DAM
SCITUATE, RI**

SCALE
500 0 500 1000 Feet

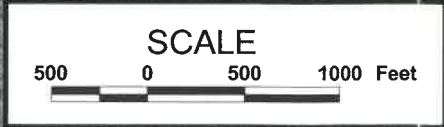
RHODE ISLAND DEM
OFFICE OF COMPLIANCE & INSPECTION

GIA



LEGEND

- ☆ BRIDGE
- ▲ SCHOOLS
- ★ PUBLIC SAFETY BUILDINGS (FIRE, POLICE, TOWN HALLS)
- ⊕ HOSPITALS
- APPROX. FLOOD HAZARD AREA
- WATER SUPPLY WITHDRAWALS
- DAMS



DAM BREAK FLOOD WAVE
EXPECTED TO DISSIPATE
WITHIN SCITUATE RESERVOIR

SCITUATE
RESERVOIR

Note: The following data presented on this figure was obtained from RIGIS and was not checked for accuracy: Road names, bridges, schools, public safety buildings, hospitals, water supply withdrawals, and dams.

SOURCE



DATE OF MAP:
APRIL 1997

DAM HAZARD POTENTIAL
CLASSIFICATION MAP

BARDEN RESERVOIR DAM
SCITUATE, RHODE ISLAND

GZA NO. 17085

FIGURE 2

