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AERIAL HISTORICAL PHOTOGRAPHIC ANALYSIS,
LAND USE/LAND COVER ANALYSIS, AND WETLANDS/DRAINAGE
ANALYSIS OF CENTREDALE MANOR RESTORATION PROJECT
STUDY AREA

Johnston, Rhode Island

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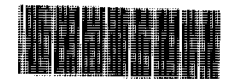
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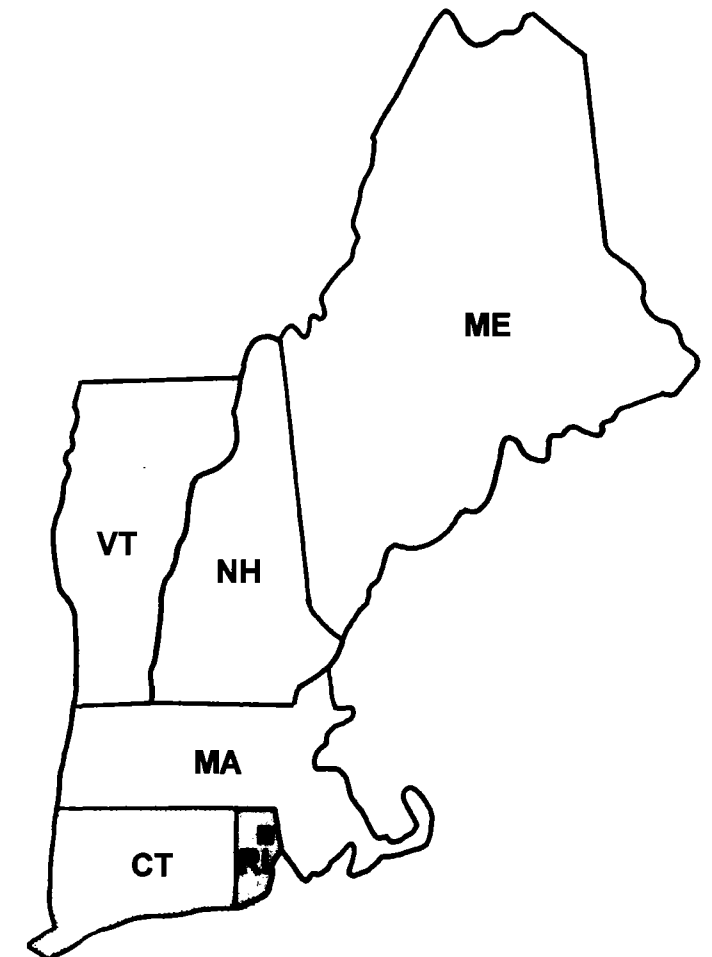


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AERIAL HISTORICAL PHOTOGRAPHIC ANALYSIS, LAND USE/LAND COVER ANALYSIS, AND WETLANDS/DRAINAGE ANALYSIS OF CENTERDALE MANOR RESTORATION PROJECT STUDY AREA Johnston, Rhode Island

EPA Region 1



NOTICE

This document has undergone a technical and quality control/assurance review and has been approved for publication by personnel of the U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, Landscape Ecology Branch at Las Vegas, Nevada. It is for internal Agency use and distribution only.

ABSTRACT

This report presents the results of three aerial photographic analyses of the Centredale Manor Restoration Project study area in Johnston, Rhode Island. These analyses include a historical photographic analysis, a land use/land cover analysis, and a wetlands/drainage analysis of the study area. The study area covers approximately 40 hectares (100 acres) along the west side of Lyman Mill Pond and contains residential, commercial, mixed forest, and wetland/upland within the Woonasquatucket River basin. The study area is bounded to the north by Allendale Way, to the west by State Route 128, to the south by Lyman Avenue, and on its eastern side by the approximate center of Lyman Mill Pond.

Of specific interest to the Region 1 Office of the U.S. Environmental Protection Agency (EPA) are the wetlands, on the west shore of Lyman Mill Pond, that were filled as a result of man-made activities. The three aerial photographic analyses presented in the report, funded under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), were prepared to determine when these wetland areas were filled and whether the fill contained any waste materials. The report will aid EPA field investigators to develop field sampling strategies.

For the historical photographic analysis, nine dates of historical aerial photographs, spanning the period from 1951 through 2006, were reviewed and selected for inclusion in this report. The analysis identified nine sites in the Centredale Manor Restoration Project study area where persistent features and/or conditions of environmental significance were observed. The findings of the historical photographic analysis indicate that by 1951 no development had occurred on the "pond side" of the railroad track that runs along the western perimeter of Lyman Mill Pond. A solid waste disposal facility (Site 1) was noted near the northern end, and a sand and gravel quarry pits (Sites 2, 3, and 4) were observed in the central portion of the study area. By 1963 the

railroad track had been abandoned and development had started along the western shore of Lyman Mill Pond. Two automobile junkyards (Sites 6 and 8) had been established in the central portion of the study area. The northern junkyard (Site 8) had been expanded by filling and leveling the wetlands along the western shore of Lyman Mill Pond. By 1970 the sand and gravel quarry pits (Site 2) had merged to cover most of the central portion of the site. The northern junkyard (Site 8) had been enlarged by 1976 with additional filling and leveling of the wetlands along the western shore of Lyman Mill Pond. In addition a construction company (Site 5) in the southern portion of the study area had also filled and leveled land along the western shore of Lyman Mill Pond. Dark-toned mounded material, probable derelict tires, were noted at the northern junkyard (Site 8) along the western shore of Lyman Mill Pond in 1976, 1981, and 1995. The northern junkyard was partially dismantled by 2003. By 2006 the northern junkyard had been closed and was partially revegetated.

The land use/land cover analysis was performed using photography dated 1951 and 2006. Findings of the land use/land cover analysis determined that in 1951 the study area consisted of predominantly residential land use and undeveloped mixed forest land. Between 1951 and 2006 the establishment of commercial junkyard operations, the expansion of quarry excavations, and the construction of additional residences accounted for the largest changes in the land use/land cover. By 2006 quarry excavations and commercial junkyard operations had replaced large sections of the undeveloped mixed forest land observed in 1951.

The wetlands/drainage analysis was performed using photography dated 1951, 1963, and 2006. Findings of the wetlands/drainage analysis determined that portions of the wetlands along the western shore of Lyman Mill Pond and along other drainageways were filled as a result of commercial and residential development.

The EPA Environmental Sciences Division, Landscape Ecology Branch in Las Vegas, Nevada, prepared this report for the EPA Region 1 Hazardous Waste Management Division in Boston, Massachusetts, and the EPA Office of Superfund Remediation Technology Innovation in Washington, D.C.

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INTRODUCTION

This report presents the results of three aerial photographic analyses of the Centredale Manor Restoration Project study area in Johnston, Rhode Island. These analyses include a historical photographic analysis, a land use/land cover analysis, and a wetlands/drainage analysis of the study area. The study area covers approximately 40 hectares (100 acres) along the west side of Lyman Mill Pond and contains residential, commercial, mixed forest, and wetland/upland within the Woonasquatucket River basin. The study area is bounded to the north by Allendale Way, to the west by State Route 128, to the south by Lyman Avenue, and on its east side by the approximate center of Lyman Mill Pond. The study area is at an elevation of approximately 30 meters (100 feet) above sea level.

Of specific interest to the Region 1 Office of the U.S. Environmental Protection Agency (EPA) are the wetlands, on the west shore of Lyman Mill Pond, that were filled as a result of man-made activities. The three aerial photographic analyses presented in the report, funded under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), were prepared to determine when these wetland areas were filled and whether the fill contained any waste materials. The report will aid EPA field investigators to develop field sampling strategies.

Drainageways that empty into Lyman Mill Pond are pathways by which potential pollutants may enter the wetlands. These include the Woonasquatucket River via the Allendale Dam north of the study area, the Assapumpset Brook from the west via a culvert under State Route 128 near Dexter Street, and an unnamed tributary from the east that reaches Lyman Mill Pond via a ditch near Humbert Street. Lyman Mill Pond is dammed at its south end, parallel to Lyman Avenue.

For the historical photographic analysis, nine dates of historical aerial photographs, spanning the period from 1951 through 2006, were reviewed and selected for inclusion in this report. The analysis identified nine sites in the Centredale Manor Restoration Project study area where persistent features and/or conditions of environmental significance were observed. The findings of the historical photographic analysis indicate that by 1951 no development had occurred on the "pond side" of the railroad track along the western perimeter of Lyman Mill Pond. A solid waste disposal facility (Site 1) was noted near the northern end, and a sand and gravel quarry pits (Sites 2, 3, and 4) were observed in the central portion of the study area. By 1963 the railroad track had been abandoned and development had started along the western shore of Lyman Mill Pond. Two automobile junkyards (Sites 6 and 8) had been established in the central portion of the study area. The northern junkyard (Site 8) had been expanded by filling and leveling the wetlands along the western shore of Lyman Mill Pond. By 1970 the sand and gravel quarry pits (Site 2) had merged to cover most of the central portion of the site. The northern junkyard (Site 8) had been enlarged by 1976 with additional filling and leveling of the wetlands along the western shore of Lyman Mill Pond. In addition a construction company (Site 5) in the southern portion of the study area had also filled and leveled land along the western shore of Lyman Mill Pond. Dark-toned mounded material, probable derelict tires, were noted at the northern junkyard (Site 8) along the western shore of Lyman Mill Pond in 1976, 1981, and 1995. The northern junkyard was partially dismantled by 2003. By 2006 the northern junkyard had been closed and was partially revegetated.

This report contains a land use/land cover analysis of the study area that was conducted using historical aerial photographic interpretation and is based on the Anderson land use and land cover classification system (see References page). Two dates of photography, 1951 and 2006, were analyzed to document land use/land cover change at the study area. The classifications of land use/land cover were performed using a Level II classification and results are annotated on overlays to the aerial photographs. Findings determined that by 1951 the study area consisted of predominantly residential land use and undeveloped mixed forest land. The establishment of commercial junkyard operations, the expansion of quarry excavations, and the construction of additional residences accounted for the largest changes in the land use/land cover. By 2006 quarry excavations and commercial junkyard operations had replaced large sections of the undeveloped mixed forest land observed in 1951.

The wetlands/drainage analysis of the study area was performed using aerial photographs taken in 1951, 1963, and 2006. Analysis of the photography reveals the extent of the wetland conditions and vegetation at the time the photographs were taken. The findings of the analysis are annotated on overlays to the aerial photographs and reflect the observed changes in wetlands resulting from man-made modifications to the natural landscape frequently associated with development. Findings of the wetlands analysis determined that wetlands along the western shore of Lyman Mill Pond and along other drainageways were filled as a result of commercial and residential development.

A Glossary, defining features or conditions identified in this report, follows the Historical Photographic Analysis section. Sources for all maps, aerial photographs, and collateral data used in the production of this report are listed in the References section. A list of all aerial photographs that were identified and evaluated for potential application to this study can be obtained by contacting the EPA Work Assignment Manager. Historical aerial photographs used in the analysis of this site have been digitally scanned and printed for use in this report. A transparent overlay with interpretative data is affixed to each of the digital prints. See the Methodology section for a discussion of the scanning and printing procedures.

The EPA Environmental Sciences Division, Landscape Ecology Branch in Las Vegas, Nevada, prepared this report for the EPA Region 1 Hazardous Waste Management Division in Boston, Massachusetts, and the EPA Office of Superfund Remediation Technology Innovation in Washington, D.C.

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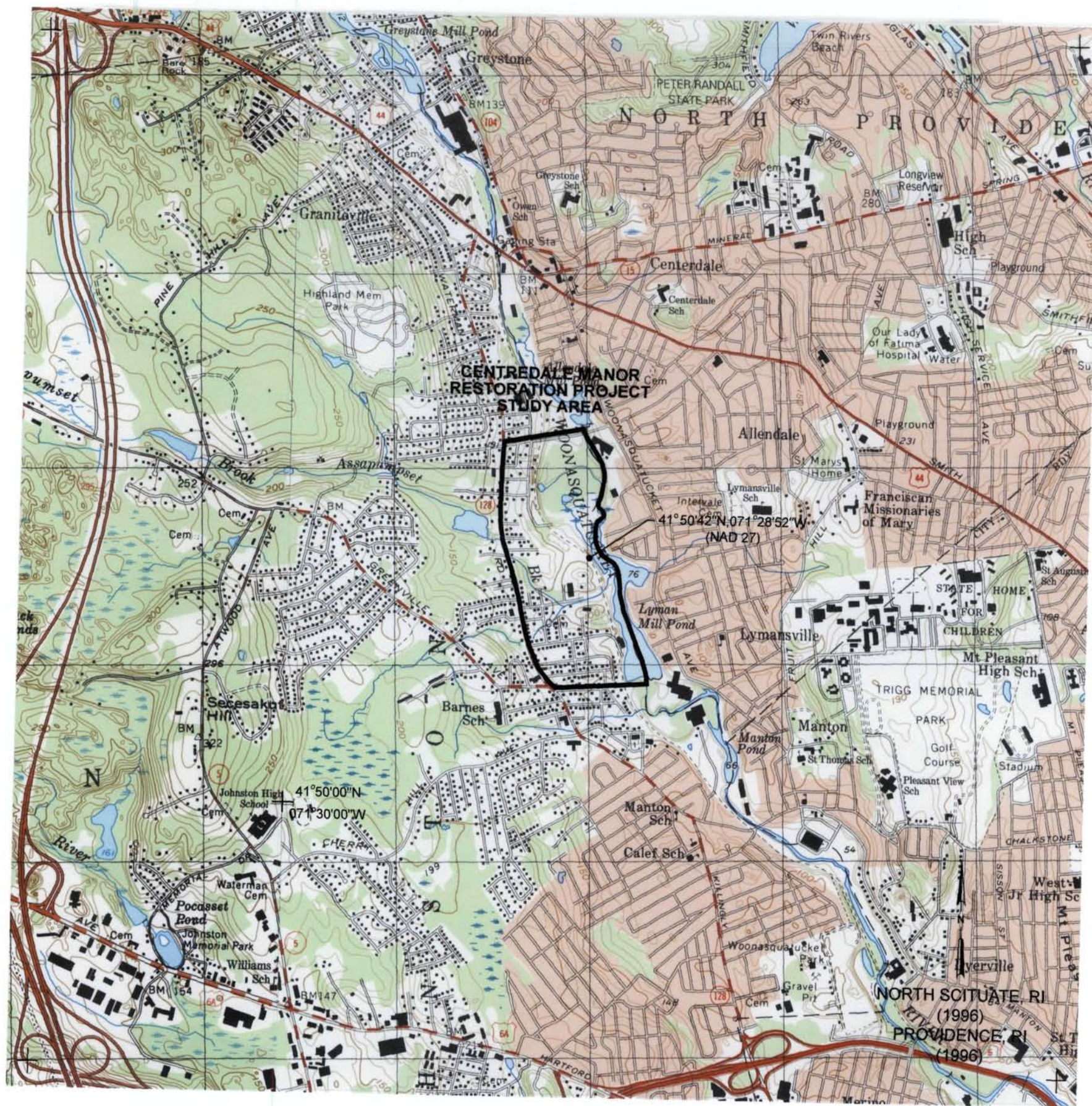


Figure 2. Local study area location map, North Scituate, RI (USGS, 1996) and Providence, RI (USGS, 1996). Approximate scale 1:24,000.

METHODOLOGY

This report was prepared using a standard methodology that includes the following steps:

- data identification and acquisition,
- photographic analysis and interpretation, and
- graphics and text preparation.

These steps are described below. Subsections also address details related to specific kinds of analyses that may be required to identify environmental features such as surface drainage and wetlands. All operational steps and processes used to perform this work (including data identification and acquisition, photographic analysis and interpretation, and graphics and text preparation) adhere to strict QA/QC guidelines and standard operating procedures (SOPs). These guidelines and procedures are documented in the Master Quality Assurance Project Plan (QAPP) prepared for Remote Sensing Support Services Contract No. EP-D-05-088 (LMS, 2006).

Data identification and acquisition included a search of government and commercial sources of historical aerial film for the study area. Photographs with optimal spatial and temporal resolution and image quality were identified for acquisition. In addition, U.S. Geological Survey (USGS) topographic maps were obtained to show the study area location and to provide geographic and topographic context.

To conduct this analysis, the analyst examined diapositives (transparencies) of historical aerial photographs showing the study area. Diapositives are most often used for analysis instead of prints because the diapositives have superior photographic resolution. They show minute details of significant environmental features that may not be discernible on a paper print.

A photographic analyst uses a stereoscope to view adjacent, overlapping pairs of diapositives on a backlit light table. In most cases, the stereoscope is capable of various magnifications up to 60 power. Stereoscopic viewing

involves using the principle of parallax (observing a feature from slightly different positions) to observe a three-dimensional representation of the area of interest. The stereoscope enhances the photo interpretation process by allowing the analyst to observe vertical as well as horizontal spatial relationships of natural and cultural features.

The process of photographic analysis involves the visual examination and comparison of many components of the photographic image. These components include shadow, tone, color, texture, shape, size, pattern, and landscape context of individual elements of a photograph. The photo analyst identifies objects, features, and "signatures" associated with specific environmental conditions or events. The term "signature" refers to a combination of components or characteristics that indicate a specific object, condition, or pattern of environmental significance. The academic and professional training, photo interpretation experience gained through repetitive observations of similar features or activities, and deductive logic of the analyst as well as background information from collateral sources (e.g., site maps, geologic reports, soil surveys) are critical factors employed in the photographic analysis.

The analyst records the results of the analysis by using a standard set of annotations and terminology to identify objects and features observed on the diapositives. Significant findings are annotated on overlays attached to the photographic or computer-reproduced prints in the report and discussed in the accompanying text. Annotations that are self-explanatory may not be discussed in the text. The annotations are defined in the legend that accompanies each print and in the text when first used.

Objects and features are identified in the graphics and text according to the analyst's degree of confidence in the evidence. A distinction is made between certain, probable, and possible identifications. When the analyst believes the identification is unmistakable (certain), no qualifier is used. Probable is used when a limited number of discernible characteristics allow the analyst to be reasonably sure of a particular identification. Possible is used when only a few characteristics are discernible, and the analyst can only infer an identification.

The prints in this report have been reproduced, either by photographic or computer methods, from the original film. Reproductions are made from the original film and may be either contact (the same size) prints or enlargements, depending on the scale of the original film. Any computer-produced prints used in this report are generated from scans of the film at approximately 1,300 dots per inch (dpi) and printed at 720 dpi. Although the reproductions allow effective display of the interpretive annotations, they may have less photographic resolution than the original film. Therefore, some of the objects and features identified in the original image and described in the text may not be as clearly discernible on the prints in this report.

Study area boundaries shown in this report were determined from aerial photographs or collateral data and do not necessarily denote legal property lines or ownership.

Digital Diapositives

Some film vendors no longer supply analog film products (e.g., diapositive transparencies) to their customers. Digital files, created by scanning the original analog film products, are provided. The digital file, a representation of an original analog film product, can be analyzed either by computer viewing techniques or by creating a secondary diapositive from the digital file and viewing the secondary diapositive on a light table. The result of this process of converting an analog diapositive image to a digital file may be a reduction in the photographic resolution. A potential consequence of this in the realm of aerial photographic analysis is a lower confidence in the identification of features or conditions of environmental significance. For example, what may have been identified with certainty as "a drum" on the analog version of the diapositive may, on the digital diapositive, only be determined to be "a probable drum."

Color Infrared Photographs

Some photographs used for this analysis were made from color infrared film. Normal color film records reflected energy in the blue, green, and red portions of the electromagnetic spectrum. Color infrared film differs in that

it is sensitive not only to reflected blue, green, and red energy, but also to reflected energy in the infrared portions of the electromagnetic spectrum; however, the blue energy is filtered out and only the green, red, and infrared energy is recorded. When color infrared film is processed, it displays "false" colors that do not correspond with the true colors of the features photographed. For example, features that are highly reflective in the infrared portion of the spectrum, such as healthy vegetation, appear red to magenta on color infrared film. The false color displayed by a feature is produced in accordance with the proportions of green, red, and infrared energy it reflects. These proportions are referred to as the "spectral reflectance characteristics" of the feature. To interpret the true color of a particular feature accurately from color infrared film, a knowledge of the spectral reflectance characteristics of that feature is required. This information is not readily available for the majority of features identified in this report. Therefore, unless otherwise indicated, no attempt has been made to interpret the true colors of the features identified on the color infrared film analyzed for this report.

Land Use/Land Cover Analysis

Land use/land cover analysis is conducted by analyzing aerial photographs in conjunction with the Anderson Classification System (Anderson 1976). The classification system is hierarchical in nature beginning with Level I, the broadest classification of land use/land cover types. Examples of these are residential, commercial, and industrial. Level II consists of more detailed categories of land use such as single versus multiple residential dwelling units. The classification scheme can be customized to create Levels III and IV depending on project requirements. Land use/land cover data are displayed on clear acetate overlays attached to photographs or USGS topographic maps.

Wetland Analysis

The most general type of wetland analysis involves differentiating wetland and nonwetland areas. An analyst utilizes aerial photographs, soil surveys, hydric soils data, National Wetland Survey maps, and other available data to identify wetland boundaries and drainage networks within a study area. More

detailed analyses are conducted using the Cowardin Classification System (Cowardin 1979) to provide information regarding vegetation types and hydrologic regimes. Analyses of photography from several years can be compiled to assess changes in wetland areas and measurements can be conducted to quantify results. Field checking of final products can confirm and refine mapping results and aid in compliance with jurisdictional and legal requirements. Results of wetlands analysis are presented on clear acetate overlays attached to photographs or USGS topographic maps.

Surface Drainage

The surface drainage analysis produced for this report identifies the direction and potential path that a liquid spill or surface runoff would follow based on the topography of the terrain and the presence of discernible obstacles to surface flow. The analyst determines the direction of surface drainage by stereoscopic analysis of the aerial photographs and by examining USGS topographic maps. Site-specific surface drainage patterns are annotated on the map or photo overlay. Where the direction of subtle drainage cannot be determined, an indeterminate drainage line symbol is used. Regional surface flow is ascertained from the USGS topographic maps.

HISTORICAL PHOTOGRAPHIC ANALYSIS

The Centredale Manor Restoration Project study area is located on the west side of Lyman Mill Pond. Within the study area are several sites where earthmoving and/or filling activity, sand and gravel quarry operations, or waste disposal activity have occurred. These sites are potential sources of silt and/or contaminants that can enter the natural drainage system or pose a threat to the wetlands along the western shoreline of Lyman Mill Pond.

Assapumpset Brook trends southeast across the study area and empties into Lyman Mill Pond northeast of the end of Armento Street. The brook, which flows adjacent to a large quarry operation and through a large junkyard, is of particular concern as it could potentially transport contaminants into Lyman Mill Pond.

The sites identified in this analysis are numbered from north to south, in the order that they were first observed. The annotated sites denote the extent of observed activity and do not represent legal property boundaries. The size of several sites is modified over time and show how the land use within the study area has changed.

OCTOBER 26, 1951 (FIGURE 3)

Site 1 - A waste disposal pit is observed along the southern side of Allendale Way. The waste pit is accessed via Railroad Avenue and is bounded to the east by the raised railroad bed of the adjacent railroad (R/R). Dark-toned solid waste (DT SW) is visible along the rim and within this pit. A bottom-lining material is not discerned in the pit. Surface runoff that does not enter the disposal pit would drain south. Runoff leaving this disposal area is likely to flow to the southeast, along the base of the raised railroad bed, and eventually into Lyman Mill Pond.

Site 2 - An active sand and gravel quarry (S&G), with associated earthmoving vehicles, is visible on the west side of Lyman Mill Pond at the eastern end of Armento Street. Mounds of earth (not annotated) and stockpiles (SP) of sand and gravel are observed at the quarry. A storage yard (SY) for equipment and vehicles is on the western portion of the quarry adjacent to Trieste Street. The quarry is bounded on the east by the raised railroad bed that runs parallel to the western perimeter of Lyman Mill Pond. This raised railroad bed diverts drainage leaving the quarry south to the culvert under the tracks. Once through the culvert (not annotated) drainage merges with the east-flowing Assapumpset Brook that empties into Lyman Mill Pond.

Site 3 - A quarry pit is observed north of Irons Avenue between Diaz and Pezzi streets. No vehicles are discerned at the pit indicating that quarrying operations have ceased. Surface runoff at this location appears to remain at the pit and accumulated standing liquid is visible in the pit.

Site 4 - An excavation (EX) is observed near the eastern end of Armento Street. No vehicles or structures are discerned at this location. The excavation contains dark-toned material (DTM) and is apparently being used as a dump area. Runoff leaving this location would drain east and likely reach Lyman Mill Pond.

Site 5 - A partially overgrown excavation is observed along the western perimeter of Lyman Mill Pond, between Irons Avenue and Lafayette Street. This excavation appears to be a construction site. No vehicles or structures are discerned. The raised railroad bed to the east forms a barrier to runoff. Consequently runoff is likely to remain within the excavation.

Site 6 - The commercial company operates a large multistory processing building (PB) and a small parking lot (not annotated). The type of processing could not be determined from the photograph. The site is of interest due to its proximity to Assapumpset Brook which flows parallel to Armento Street and enters Lyman Mill Pond. Pollutants from spillage at the site could pose a threat to the adjacent brook.

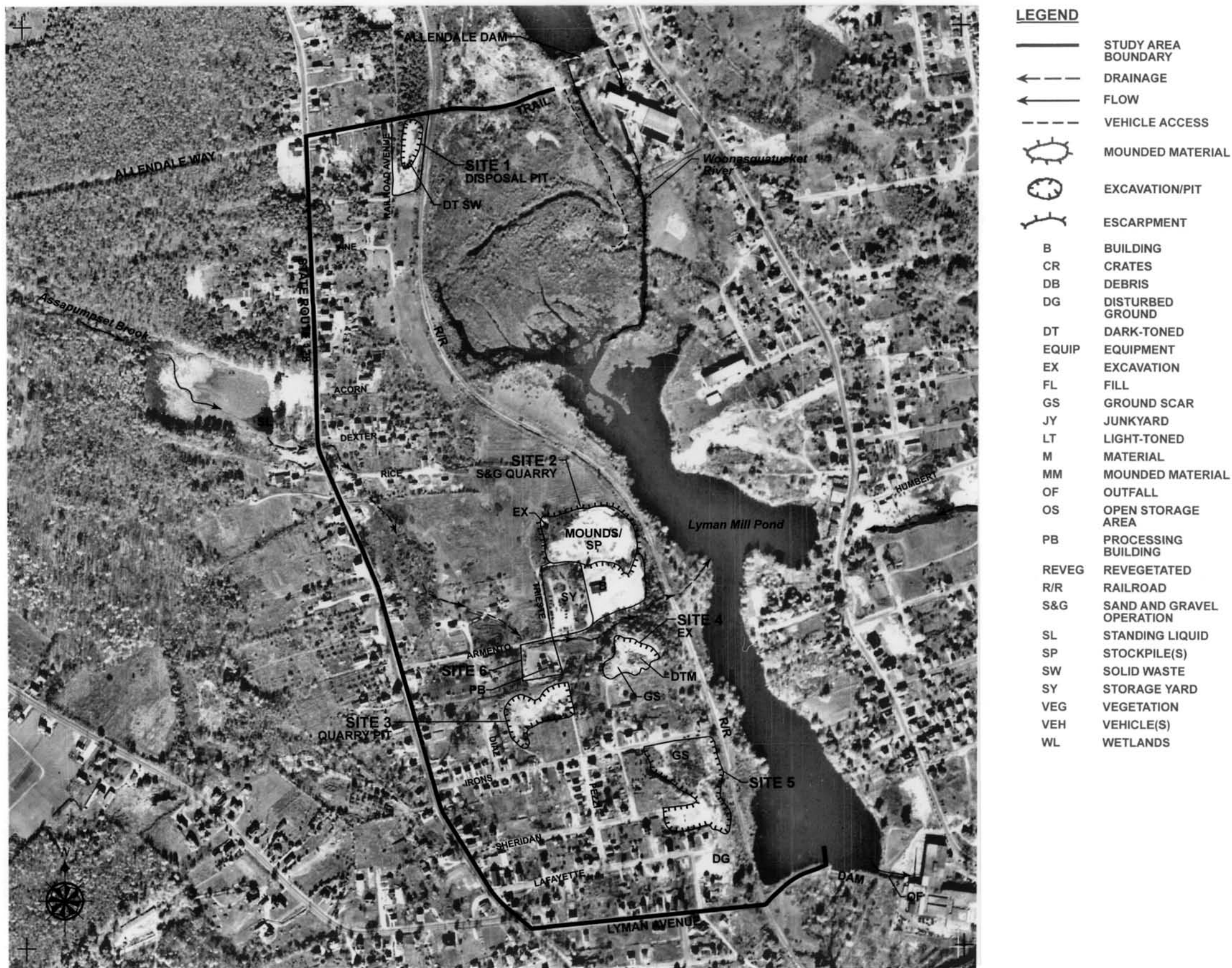


Figure 3. Centredale Manor Restoration Project study area, historical photographic analysis, October 26, 1951. Approximate scale 1:6,450.

MAY 19, 1955 (FIGURE 4)

Site 1 - The waste disposal pit remains operational and dark-toned solid waste is visible within the pit. Probable vegetation (VEG), dark-toned material, solid waste, and debris (DB) have been deposited around the rim of the pit. A bottom-lining material cannot be discerned within the pit. Southwest of Site 1 is an accumulation of possible fill or solid waste.

Site 2 - The sand and gravel quarry at the northern end of Armento Street has been expanded. The quarry pit and quarry yard with sand and gravel stockpiles (not annotated) have been extended north.

Site 2W - Another quarry pit has been dug west of Site 2, south of Rice Street.

Site 3 - The quarry pit appears to have been enlarged.

Site 4 - The view of the excavation is partially obscured by vegetation overgrowth. The dark-toned material observed in 1951 is not discerned.

Site 5 - The size of the excavation has been expanded since 1951. The view of the excavation is partially obscured by vegetation overgrowth. No vehicles or structures are discerned.

Site 6 - The commercial processing building appears to remain operational.

Site 7 - Since 1951 a junkyard (JY) has been established at the storage yard, noted in 1951 near Site 2. The junkyard is located along the north side of Armento Street and contains several derelict vehicles. Pollutants from the junkyard operations and potential spillage could enter the natural drainage via rain water transport into the nearby east-trending Assapumpset Brook that flows along the south side of Armento Street.



Figure 4. Centredale Manor Restoration Project study area, historical photographic analysis, May 19, 1955. Approximate scale 1:6,450.

SEPTEMBER 2, 1963 (FIGURE 5)

Since 1955 the railroad track that runs parallel to the western perimeter of Lyman Mill Pond appears to have been abandoned. The raised bed of this former railroad no longer appears to be maintained.

Site 1 - Waste disposal activity appears to have ceased and the pit has been filled with waste material to the level of the surrounding area. One building (B) and one shed have been constructed on the south side of the partially filled pit. Good housekeeping practices are not evident; debris, probable crates (CR), and probable solid waste litter the site and remainder of the pit.

Site 2 - The sand and gravel quarry at Armento Street has been expanded to the north and east. A large mound occupies the central portion of the site.

Site 2W - The sand and gravel quarry pit west of Site 2 has been enlarged.

Site 3 - The sand and gravel quarry pit has been enlarged.

Site 4 - The excavation noted in 1955 has been filled and the area is part of the enlarged junkyard at Site 7. The conditions at this location will be discussed under Site 7.

Site 5 - The southern portion of this excavation has been developed at the eastern end of Lafayette Street. The excavated area at this location was filled, a road was built, and five homes were constructed along the new Tyler Avenue. The remaining excavation contains ground scars and vegetation overgrowth (none annotated). The dense vegetation along the eastern side of the site prevents viewing the adjacent railroad bed and determining drainage patterns for runoff potentially leaving the site.

Site 6 - The commercial processing building appears to remain operational.

Site 7 - The junkyard adjacent to Site 2 has been enlarged to the south and east. Numerous derelict vehicles are observed throughout the site. A large building, a probable vehicle maintenance shop, has been constructed in the

southern portion of the junkyard. Potential pollutants from this site could pose a potential threat to the Assapumpset Brook which runs through the junkyard and empties into Lyman Mill Pond.

Site 8 - Another junkyard, established north and east of Rice Street, contains numerous derelict vehicles. The junkyard extends east across the abandoned railroad track to the western shore of Lyman Mill Pond on filled land that was wetland in 1955. Two large mounds of fill (MM/FL) and/or possible scrap metal are visible along the western bank of Lyman Mill Pond. Potential pollutants from junkyard operations could flow east via surface flow into Lyman Mill Pond.

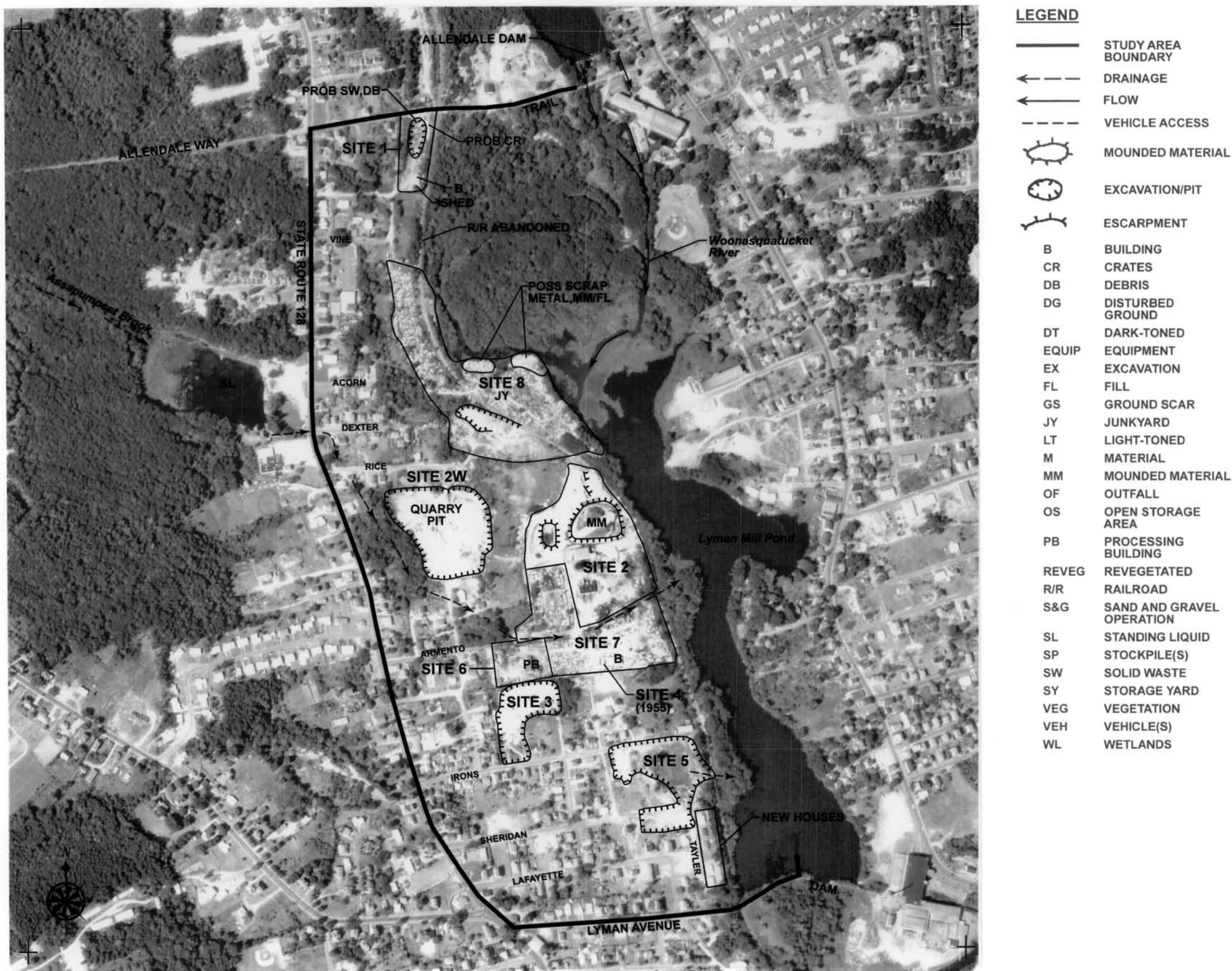


Figure 5. Centredale Manor Restoration Project study area, historical photographic analysis, September 2, 1963. Approximate scale 1:6,450.

MARCH 9, 1970 (FIGURE 6)

Site 1 - The former disposal pit has been closed and the site is probably an open storage and salvage yard. No waste disposal activity can be confirmed. Numerous vehicles are present but the probable crates, debris, and dark-toned material noted in 1963 are not discerned.

Site 2 - The two separate sand and gravel quarry pits noted in 1963, Sites 2 and 2W, located between Rice and Armento streets, have been enlarged and merged together. Large light-toned sand and gravel stockpiles have been created and large conveyor systems have been installed. The large mound observed near the eastern side of the site is a truck unloading ramp.

Site 3 - Earthmoving vehicles are observed at the northeastern portion of the pit and standing liquid is noted at the southern end of the pit.

Site 5 - Grading and leveling have continued at the construction site.

Site 6 - The parking areas has been enlarged and numerous parked trucks are observed at near the processing building.

Site 7 - The junkyard remains operational and numerous derelict automobiles are observed adjacent to the western shore of Lyman Mill Pond.

Site 8 - The extent of the junkyard has been enlarged to the northeast into the adjacent wetlands. The two large mounds of fill and/or possible scrap metal, visible along the bank of Lyman Mill Pond in 1963, are not discerned. Numerous derelict vehicles are stacked along the western bank of Lyman Mill Pond which was previously a wetland in 1963.

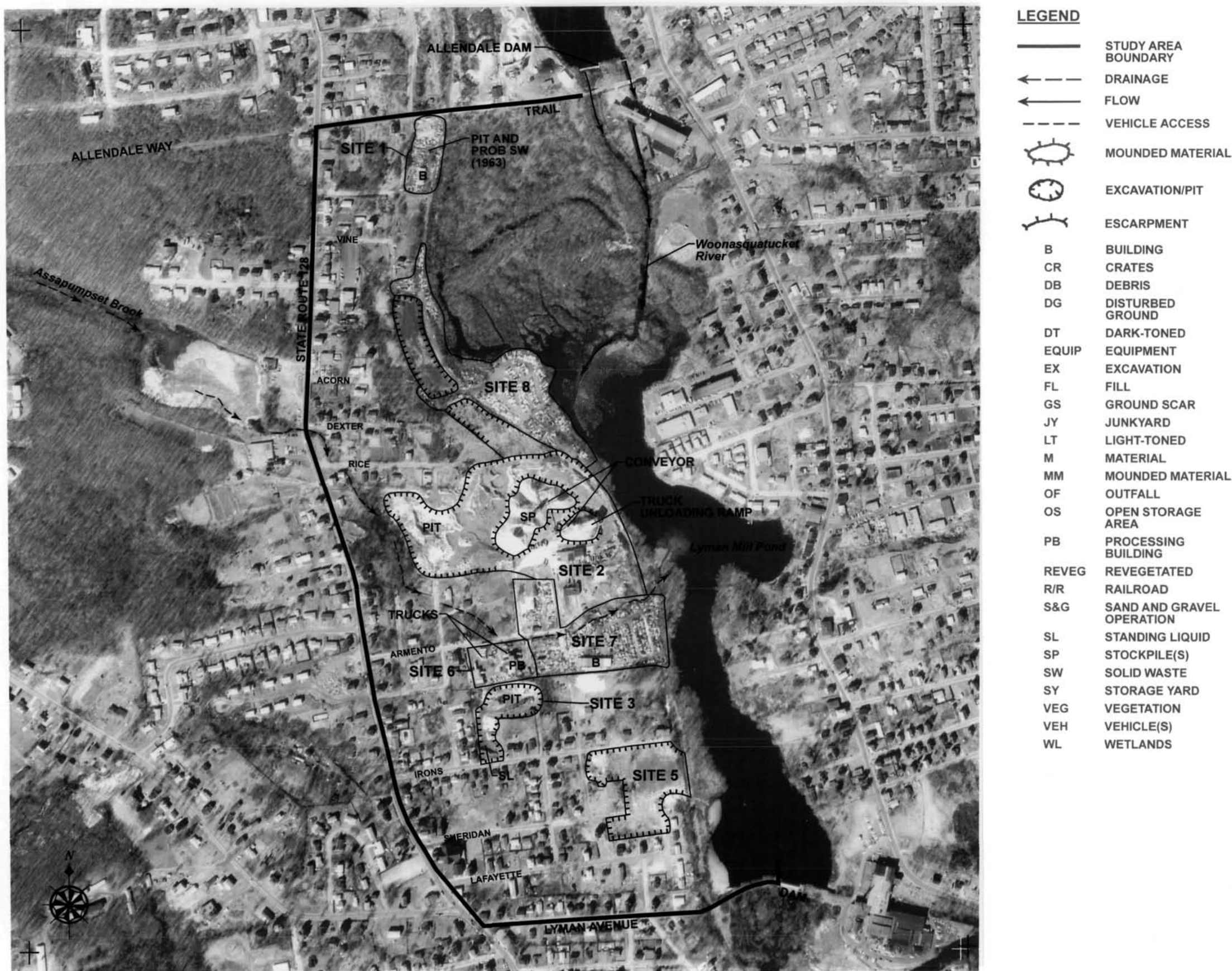


Figure 6. Centredale Manor Restoration Project study area, historical photographic analysis, March 9, 1970. Approximate scale 1:6,450.

MAY 5, 1976 (FIGURE 7)

Monoscopic photographic coverage was used to perform the 1976 analysis. Because stereoscopic coverage was not used the features and conditions visible on photographs from other years of analysis may not be discerned on the 1976 photograph and the following analysis is not as detailed.

Site 1 - The site, described as a probable open storage and salvage yard in 1970, now appears to be a commercial construction or trucking facility. Vehicles are observed next to the building. The location of the closed pit has become revegetated (REVEG).

Site 2 - The enlarged sand and gravel quarry remains active and additional excavations have been dug. Standing liquid (SL) has accumulated in one of these excavations. Large light-toned sand and gravel stockpiles and the conveyor systems remain visible.

Site 3 - The sand and gravel pit remains open and no environmentally significant changes are noted since 1970.

Site 5 - Earthmoving has expanded the size of a construction company now located at the east end of Irons Avenue. Since 1970 fill material has been deposited along on the abandoned railroad and along the western shore of Lyman Mill Pond. A large support building has been constructed on the recently filled area.

Site 6 - The site remains active and parked trucks are observed near the processing building.

Site 7 - The junkyard remains operational. The northern section of the junkyard has been cleared of derelict vehicles and now appears to be associated with the sand and gravel operations of Site 2. The conditions at this storage yard will be discussed under Site 2.

Site 8 - The junkyard remains operational. Fewer vehicles are observed in the southern portion of the junkyard compared to those observed in 1970. Derelict vehicles are predominately observed in the northern portion of the site. Due to the lack of stereo viewing the depressions observed in 1970 are not discerned. A large accumulation of dark-toned mounded material (DTMM), probable derelict tires, is visible along the shoreline of Lyman Mill Pond.



LEGEND

	STUDY AREA BOUNDARY
	DRAINAGE
	FLOW
	VEHICLE ACCESS
	MOUNDED MATERIAL
	EXCAVATION/PIT
	ESCARPMENT
B	BUILDING
CR	CRATES
DB	DEBRIS
DG	DISTURBED GROUND
DT	DARK-TONED
EQUIP	EQUIPMENT
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
JY	JUNKYARD
LT	LIGHT-TONED
M	MATERIAL
MM	MOUNDED MATERIAL
OF	OUTFALL
OS	OPEN STORAGE AREA
PB	PROCESSING BUILDING
REVEG	REVEGETATED
R/R	RAILROAD
S&G	SAND AND GRAVEL OPERATION
SL	STANDING LIQUID
SP	STOCKPILE(S)
SW	SOLID WASTE
SY	STORAGE YARD
VEG	VEGETATION
VEH	VEHICLE(S)
WL	WETLANDS

Figure 7. Centredale Manor Restoration Project study area, historical photographic analysis, May 5, 1976. Approximate scale 1:6,450.

MARCH 18, 1981 (FIGURE 8)

Site 1 - More vehicles are present at the commercial facility compared to those observed in 1976. Probable debris and fill material have been dumped along the eastern edge of the site.

Fill material is observed along the southern side of Allendale Way, east of Site 1. This filling encroaches on the wetlands along the northern portion of Lyman Mill Pond.

Site 2 - The sand and gravel quarry remains active. Large light-toned sand and gravel stockpiles and large excavations containing bodies of standing liquid are noted. The light-toned sand and gravel stockpiles on the eastern side of the site reach the west shore of Lyman Mill Pond. The storage yard, formerly operated as part of Site 7, contains vehicles (VEH) and equipment (EQUIP) likely associated with the sand and gravel operations.

Site 3 - The pit has been partially filled. Debris is noted near the western rim of the smaller pit. Drainage would flow into the pit and remain.

Site 5 - Earthmoving has continued at this construction company. A large open storage yard (OS) for supplies and equipment has been filled and leveled in the center of the site where liquid was noted in 1976. Fill material has been deposited along the west shore of Lyman Mill Pond.

Site 6 - The site remains active and parked trucks are observed near the processing building.

Site 7 - The junkyard remains operational and contains numerous derelict automobiles. A pile of possible scrap metal is observed near the eastern end of the site.

Site 8 - The junkyard remains operational and has been expanded northeast into the wetlands along the northwestern shore of Lyman Mill Pond. There are fewer derelict vehicles observed compared to those observed in 1976. A crane, piles of probable scrap metal, and containers are noted in the northern portion of the site. Numerous truck trailers are observed in a storage yard in the southern portion of the site. Dark-toned mounded material remains visible at the eastern side of the site and along the shoreline of Lyman Mill Pond. These deposits appear to consist of probable solid waste and derelict tires.



LEGEND

	STUDY AREA BOUNDARY
	DRAINAGE
	FLOW
	VEHICLE ACCESS
	MOUNDED MATERIAL
	EXCAVATION/PIT
	ESCARPMENT
B	BUILDING
CR	CRATES
DB	DEBRIS
DG	DISTURBED GROUND
DT	DARK-TONED
EQUIP	EQUIPMENT
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
JY	JUNKYARD
LT	LIGHT-TONED
M	MATERIAL
MM	MOUNDED MATERIAL
OF	OUTFALL
OS	OPEN STORAGE AREA
PB	PROCESSING BUILDING
REVEG	REVEGETATED
R/R	RAILROAD
S&G	SAND AND GRAVEL OPERATION
SL	STANDING LIQUID
SP	STOCKPILE(S)
SW	SOLID WASTE
SY	STORAGE YARD
VEG	VEGETATION
VEH	VEHICLE(S)
WL	WETLANDS

Figure 8. Centredale Manor Restoration Project study area, historical photographic analysis, March 18, 1981. Approximate scale 1:6,450.

APRIL 17, 1995 (FIGURE 9)

Site 1 - Filling to raise the ground level is evident in the northwestern portion of the site. Debris noted in 1981 is not evident. The fill material may have included debris and construction rubble. A small automobile junkyard occupies the northwestern portion of the site. A trail/dirt road into the fill area on the eastern side of the site connects to Allendale Way. The two buildings in the southern portion of the site appear to be associated with a construction contractor.

The deposit of fill material observed in 1981, east of Site 1 along the southern side of Allendale Way, now appears to be covered by vegetation.

Site 2 - The sand and gravel quarry remains active. Large light-toned sand and gravel stockpiles remain visible. A large excavation containing standing liquid is observed at the northern end of the site. The excavation appears larger than what was observed in 1981. A large building has been constructed in the area formerly used as a storage yard and a part of the junkyard at Site 7.

Site 3 - The excavation, noted in 1981 between Armento Street and Irons Avenue, has been filled, leveled, graded, and new homes have been constructed on the site. The conditions at this location will not be discussed on subsequent dates of photography.

Site 5 - No significant earthmoving is noted at the construction company at the eastern end of Irons Avenue. The facility maintains an open storage yard for supplies, equipment, and vehicles (not annotated). Light-toned (LT) stockpiles of probable sand or gravel are also maintained at the site in its northeast and southwestern corners.

Site 6 - There are fewer trucks observed at the processing building compared to 1981. The processing building appears to be operational.

Site 7 - The junkyard remains operational. Numerous automobiles are tightly parked in the central portion of the site. Since 1981 the material noted in

the eastern portion of the site, including a large pile of possible scrap metal, has been removed or is not discerned. Contaminants associated with operations at this junkyard, including potential spills, could threaten Assapumpset Brook and Lyman Mill Pond.

Site 8 - The several open storage yards on the eastern portion of the site have been reorganized and cleared. The numerous truck trailers noted in 1981 have been removed. The crane and containers, noted in 1981 at the northern portion of the site, are no longer on the site. Scattered piles of debris are present. Large mounds of derelict tires have been concentrated at the eastern edge of the site, along the west shore of Lyman Mill Pond.

A road maintenance facility with stockpiles of gravel, trucks, earthmoving equipment (not annotated), and a vehicle shed has been established on the western portion of the site.

Site 9 - A junkyard has been established at the eastern end of Dexter Street on filled and graded land that was undeveloped woodland in 1981. The derelict vehicles at this location may have been relocated from the southern portion of Site 8.

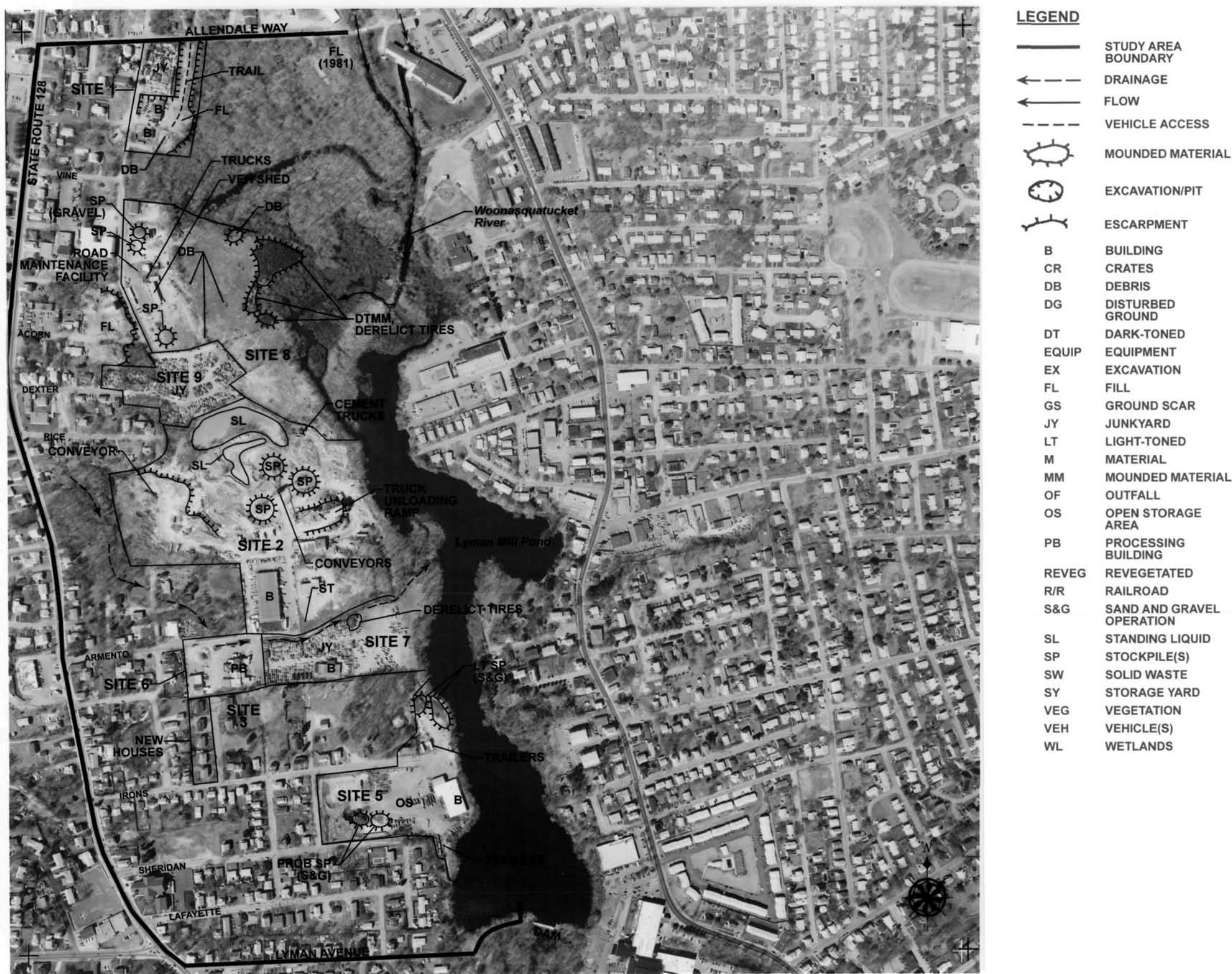


Figure 9. Centredale Manor Restoration Project study area, historical photographic analysis, April 17, 1995. Approximate scale 1:5,640.

2003 (FIGURE 10)

Site 1 - The automobile junkyard observed in the northwestern portion of the site in 1995 appears to be closed. All of the automobiles have been removed. No vehicles are present at the two buildings in the southern portion of the site.

Site 2 - The sand and gravel quarry along Armento Street remains active. Large light-toned sand and gravel stockpiles remain visible. The excavation containing standing liquid remains visible at the north end of the site.

Site 5 - Brush and trees have been cleared from the northern portion of the construction company resulting in a larger open storage area for supplies, equipment, and vehicles (not annotated). No significant earthmoving is noted. A light-colored stockpile, debris, and probable derelict equipment are visible in the northeastern corner on the site.

Site 6 - There are fewer trucks observed at the processing building compared to 1995. The processing building appears to be operational.

Site 7 - The junkyard remains operational and more derelict vehicles are present compared to those observed in 1995.

Site 8 - The road maintenance facility on the western portion of the site remains operational. The eastern portion of the site appears vacant. The large mound of derelict tires observed on the eastern edge of the site and along the western shore of Lyman Mill Pond in 1995 is not discerned. This location is vacant and appears to have been graded. Portions of the vacant storage yard in the southern portion of the site appear to be revegetated.

Site 9 - The junkyard at the eastern end of Dexter Street remains operational.

A small construction company established off Acorn Street, near the western perimeter of Site 8, contains one building and several vehicles.



LEGEND

	STUDY AREA BOUNDARY
	DRAINAGE
	FLOW
	VEHICLE ACCESS
	MOUNDED MATERIAL
	EXCAVATION/PIT
	ESCARPMENT
B	BUILDING
CR	CRATES
DB	DEBRIS
DG	DISTURBED GROUND
DT	DARK-TONED
EQUIP	EQUIPMENT
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
JY	JUNKYARD
LT	LIGHT-TONED
M	MATERIAL
MM	MOUNDED MATERIAL
OF	OUTFALL
OS	OPEN STORAGE AREA
PB	PROCESSING BUILDING
REVEG	REVEGETATED
R/R	RAILROAD
S&G	SAND AND GRAVEL OPERATION
SL	STANDING LIQUID
SP	STOCKPILE(S)
SW	SOLID WASTE
SY	STORAGE YARD
VEG	VEGETATION
VEH	VEHICLE(S)
WL	WETLANDS

Figure 10. Centredale Manor Restoration Project study area, historical photographic analysis, 2003. Approximate scale 1:6,450.

AUGUST 3, 2006 (FIGURE 11)

Site 1 - The site appears to be a vacant storage yard. No waste disposal activity is discerned.

Site 2 - The sand and gravel quarry remains active. Large light-toned sand and gravel stockpiles remain visible.

Site 5 - The storage yard in the northern portion of the site is not used and has become revegetated. No significant earthmoving is noted. Additional vegetation overgrowth along the shore of Lyman Mill Pond obscures the view of the area that contained debris and probable derelict equipment in 2003.

Site 6 - The processing building appears to be operational.

Site 7 - The junkyard remains operational and fewer derelict vehicles are observed compared to 2003.

Site 8 - The road maintenance facility on the western portion of the site remains operational. The eastern portion of the site appears abandoned and revegetated.

Site 9 - The junkyard at the eastern end of Dexter Street remains operational; however, fewer derelict vehicles are noted compared to what were observed in 2003.

The small probable construction company west of the perimeter of Site 7 remains active and no waste disposal activity is discerned at this location.



LEGEND

	STUDY AREA BOUNDARY
	DRAINAGE
	FLOW
	VEHICLE ACCESS
	MOUNDED MATERIAL
	EXCAVATION/PIT
	ESCARPMENT
B	BUILDING
CR	CRATES
DB	DEBRIS
DG	DISTURBED GROUND
DT	DARK-TONED
EQUIP	EQUIPMENT
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
JY	JUNKYARD
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M	MATERIAL
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OF	OUTFALL
OS	OPEN STORAGE AREA
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REVEG	REVEGETATED
R/R	RAILROAD
S&G	SAND AND GRAVEL OPERATION
SL	STANDING LIQUID
SP	STOCKPILE(S)
SW	SOLID WASTE
SY	STORAGE YARD
VEG	VEGETATION
VEH	VEHICLE(S)
WL	WETLANDS

Figure 11. Centredale Manor Restoration Project study area, historical photographic analysis, August 3, 2006. Approximate scale 1:6,450.

LAND USE/LAND COVER ANALYSIS

The land use/land cover analysis of the Centredale Manor Restoration Project study area was conducted using historical aerial photography dated 1951 and 2006 (Figures 12 and 13) and is based on the Anderson land use/land cover classification system (Anderson, 1976). The observed land use/land cover classification categories are found within the following table.

Table 1. Level II Centredale Manor Restoration Project Study Area Land Use/Land Cover Classification Scheme.

Urban

- 11 Residential
- 12 Commercial
- 15 Industrial and Commercial Complexes

Forestland

- 43 Mixed Forest

Water

- 52 Lakes and Ponds

Wetlands

- 61 Forested Wetlands

Barren Lands

- 76 Transitional
-

The land use/land cover classification findings are annotated on overlays attached to the aerial photographs. In 1951 the study area consisted of predominately residential land use and undeveloped mixed forest land. Between 1951 and 2006 the establishment of commercial junkyard operations, the expansion of quarry excavations, and the construction of additional residences accounted for the largest changes in the land use/land cover. By 2006 quarry excavations and commercial junkyard operations had replaced large sections of the undeveloped mixed forest land observed in 1951.



LEGEND

URBAN

- 11 Residential
- 12 Commercial
- 15 Industrial and Commercial Complexes

FOREST LAND

- 43 Mixed Forest

WATER

- 52 Lakes and Ponds

WETLAND

- 61 Forested Wetlands

BARREN LAND

- 76 Transitional

Figure 12. Centredale Manor Restoration Project study area, land use/land cover analysis, October 26, 1951. Approximate scale 1:6,400.



LEGEND

URBAN

- 11 Residential
- 12 Commercial
- 15 Industrial and Commercial Complexes

FOREST LAND

- 43 Mixed Forest

WATER

- 52 Lakes and Ponds

WETLAND

- 61 Forested Wetlands

BARREN LAND

- 76 Transitional

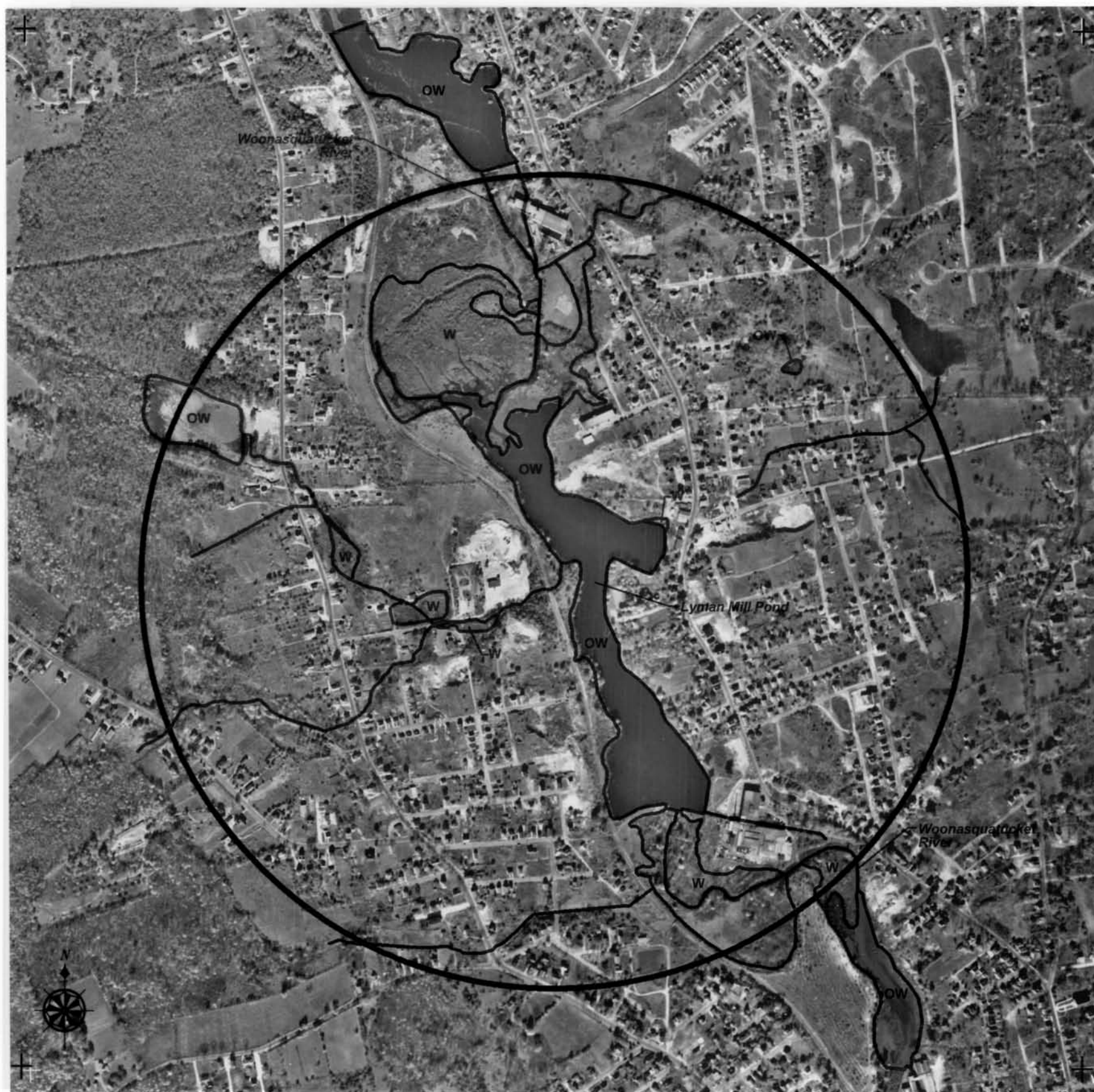
Figure 13. Centredale Manor Restoration Project study area, land use/land cover analysis, August 3, 2006. Approximate scale 1:6,450.

WETLANDS/DRAINAGE ANALYSIS

The wetlands/drainage analysis was conducted for a study area that encompasses the Centredale Manor Restoration Project study area and the surrounding area within a one-half mile radius, with somewhat more coverage to the north and south along the Woonasquatucket River. The wetlands/drainage analysis was performed using aerial photographs, soil surveys, hydric soils data, and National Wetland Inventory maps to identify wetland boundaries and drainageways within the wetlands study area. The analysis was performed using the 1951, 1963, and 2006 photographs, and is displayed on Figures 14, 15, and 16.

OCTOBER 26, 1951 (FIGURE 14)

Three lakes, or bodies of open water (OW), are located within the Woonasquatucket River in this vicinity. Wetland areas (W) are located both north and south of Lyman Mill Pond, the centrally located lake. Two additional areas of open water are visible in the northern portion of the wetlands/drainage analysis study area. The area of open water located west of the Woonasquatucket River has a surface drainage connection to the river. Three wetland areas are located along this drainage. The area of open water located east of the Woonasquatucket River is not associated with a visible surface drainage. Additional drainage pathways into the Woonasquatucket River are noted within the study area.



LEGEND

OW OPEN WATER
W WETLAND

Figure 14. Centredale Manor Restoration Project study area, wetlands/drainage analysis, October 26, 1951. Approximate scale 1:9,400.

SEPTEMBER 2, 1963 (FIGURE 15)

The three lakes located within the Woonasquatucket River appear much as they did in 1951. The two additional areas of open water in the northern portion of the wetlands/drainage analysis study area also remain visible. Some of the drainage pathways into the Woonasquatucket River are no longer present due to development in these areas. Portions of the wetland area north of Lyman Mill Pond have been filled. Portions of the wetland areas in the central and southern portions of the study area were also filled. The time period in which the fill activity took place is noted for each of the fill areas on the overlay attached to this figure.



45

AUGUST 3, 2006 (FIGURE 16)

Other than a somewhat lower water level in the centrally located lake (Lyman Mill Pond), the three lakes located within the Woonasquatucket River appear much as they did in 1951 and 1963. The additional area of open water in the western portion of the wetlands/drainage analysis study area remains visible. The area of open water in the eastern portion of the study area and some of the drainage pathways into the Woonasquatucket River are no longer present due to development in these areas. Additional portions of the wetland area north of Lyman Mill Pond have been filled. The larger fill area northwest of Lyman Mill Pond had ongoing fill activity first noted in 1963 until sometime between 1995 and 2004. See the other figures in this report during that time period for the progression of this fill area over time. Additional portions of the wetland areas in the central and southern portions of the study area were also filled. The time period in which the fill activity took place is noted for each of the fill areas on the overlay attached to this figure.



LEGEND

OW OPEN WATER
W WETLAND

Figure 16. Centredale Manor Restoration Project study area, wetlands/drainage analysis, August 3, 2006. Approximate scale 1:9,400.

GLOSSARY

Access Road - A paved or unpaved route of vehicular access.

Auto Junkyard (JY) - A yard for the collection, storage, and resale of junked vehicles and parts of vehicles.

Building (B) - A relatively permanent, essentially boxlike construction having a roof.

Dark- (DT), Medium- (MT), or Light-Toned (LT) - Tones of features in question are compared with the darkest and lightest tones of gray (if using B&W photography) on the print.

Debris (DB) - The remains of anything that can be identified as being broken down, destroyed, demolished, or dismantled.

Disturbed Ground (DG) - A rough area where the ground surface has been dug up or overturned.

Excavation Area (EX) - An area where earth or other material is being removed in order to alter the ground level (e.g., building construction).

Fill (FL) - Earth, stones, or other material that is used to build up the level of an area of ground.

Ground Scar (GS) - An area of bare soil, apparently the result of human activity.

Liquid - Used when discussing impoundments, lagoons, catchment basins, or features that contain a liquid or when discussing discharge from outfalls, at storm drains, or tank trucks.

Material (M) - Raw or waste materials on or in the vicinity of the site.

Mounded Material (MM) - Piles of raw or waste materials on or in the vicinity of the site.

Open Storage Area (OS) - An area of open-air (outdoor) storage of containerized, raw or waste materials, within industrial or manufacturing sites.

Outfall (OF) - The place where an effluent is discharged into the environment.

Quarry - An open pit mine from which consolidated rock is removed by cutting, blasting, etc.

Sand/Gravel Pit - A surface mine from which sand and/or gravel are extracted.

Solid Waste - Any discarded material other than fluids, including solid or semi-solid material resulting from industrial, commercial, mining, and agricultural operations, and from community activities.

Standing Liquid (SL) - A small, shallow, temporary collection of liquid, not necessarily waste.

Wetlands (WL) - Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

REFERENCES

MAPS

Source ^a	Figure	Name	Scale	Date
USGS	1	United States	1:2,500,000	1972
USGS	2	North Scituate, RI	1:24,000	1996
USGS	2	Providence, RI	1:24,000	1996

COLLATERAL INFORMATION

EPA. 2009. Collateral data and site map supplied by EPA Region 1 as attachment to Remote Sensing Services Request Form.

LMS (Lockheed Martin Services). 2006. Master Quality Assurance Project Plan. Prepared for EPA Environmental Sciences Division. Contract EP-D-05-088. Las Vegas, Nevada.

Anderson. 1976. A Land Use and Land Cover Classification System for Use with Remote Sensor Data. U.S. Geological Survey Professional Paper 964. U.S. Government Printing Office, Washington, D. C. 28 p.

Cowardin, L. M. 1979. Classification of Wetlands and Deep Water Habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Washington, D.C. 193 p.

AERIAL PHOTOGRAPHS

Photo source ^a	Figure ^b	Date of acquisition	Original scale	Film type ^c	Mission I.D.	Source frame #	EPIC ID #
NAS	3,12,14	10-26-51	1:20,000	B&W	DPJ-3H	98,99 100	60217,60218, 147875
USGS	4	05-19-55	1:24,000	B&W	GS-VJU	03,04	60219,60220
NOS	-	05-01-56	1:30,000	B&W		131,132	60222,60223
AVPT	-	02-07-62	1:20,000	B&W	1188	483,484	60224,60225
ASCS	5,15	09-02-63	1:20,000	B&W	DPJ-2DD	157,158	60227,60228
ASC	-	04-05-65	1: 6,000	B&W	1342	1073	60230
USGS	6	03-09-70	1:24,000	B&W	GS-VCLG	225,226	60233,60234
KEY	7	05-03-76	1:38,000	B&W	44007	96	143307
NOS	-	09-20-79	1:30,000	B&W		130,131	60235,60236
USGS	8	03-18-81	1:24,000	B&W	GS-VESC	48,49	60237,60238
USGS	-	03-16-85	1:60,000	CIR	417004	31,94	33766,33929
NOS	-	08-23-85	1:30,000	B&W		1938	1938
CEI	9	04-17-95	1:6,000	B&W	15383	99,101 102-104 100	147498,147499 147125-147127 147128
COE ^d	-	03-04-00	1:5,120	B&W	GOED	5,6	DI0000213
URI	10	00-00-03	1:30,000	CC	330280	2	
USDA/FSA ^d	-	07-03-04	1:40,000	CC	NAIP04	119,120	DI0000198
USDA/FSA ^d	11,13,16	08-03-06	1:40,000	CC	NAIP06	DOQQ	DI0000181

^aASC Air Survey Corporation, Sterling, Virginia
ASCS U.S. Department of Agriculture, Agricultural Stabilization and
Conservation Service, Salt Lake City, Utah
AVPT Aerial Viewpoint, Inc., Spring, Texas
CEI Col-East Aerial Photography and Mapping, Inc., North Adams, Massachusetts
COE U.S. Army Corp of Engineers, Washington, D.C.
EPA U.S. Environmental Protection Agency, Environmental Sciences
Division, Las Vegas, Nevada
KEY Keystone Aerial Surveys, Inc., Philadelphia, Pennsylvania
NOS National Ocean Service, Coast and Geodetic Survey, Washington, D.C.
URI University of Rhode Island, Kingston, Rhode Island
USDA/FSA U.S. Department of Agriculture/Farm Service Agency, Salt Lake City, Utah
USGS U.S. Department of Interior, U.S. Geological Survey, Washington, D.C.

^bPhotographs listed with no figure number were analyzed but not placed
in this report.

^cB&W Black-and-white
CIR Color infrared
CC Conventional Color

^dDigital diapositive (see Methodology section)