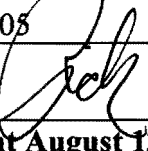


Transmittal

Date:	August 31, 2009	FD 35147
To:	Kenneth Blodgett Surface Transportation Board Section of Environmental Analysis Surface Transportation Board 395 E Street, S.W. Washington, DC 20423-0001 (202) 245-0305	
From:	Rick Starzak 	
cc:	Originals sent August 13, 2009 to: Helen M. Hart (1 copy) General Attorney Norfolk Southern Corporation Alan Summerville (1 copy) ICF International Stephen Seymour (2 copies) HDR, Inc.	
Subject:	Pan Am Railway-Section 106	
Client Name:	Norfolk Southern	
Project Title:	Pan Am Railway	
Project Number:	785.08	
Method of Transmission:	☐ Mail ☒ Overnight-Monday ☐ Courier	
Purpose of Transmission:	☐ Per your request ☐ For your review ☒ For your information or use ☐ Other:	
Items Being Transmitted:	Quantity	Description
	1	Letter to NY SHPO with attachments dated 8/13/2009

Ken,

Attached is your hard copy of the NY SHPO letter, revised APE Map, and the Literature Review: Delaware & Hudson Engine Terminal, Mechanicville. Based on the SHPO's response letter concurring with a finding of no effect on historic properties, that concludes Section 106. Steve Seymour was SHPO response, asked to forward 1 or 2 copies to John Connell at USACE.

Thanks, and let me know if you have questions.-Rick



New York State Office of Parks, Recreation and Historic Preservation

Historic Preservation Field Services Bureau • Peebles Island, PO Box 189, Waterford, New York 12188-0189

518-237-8643

www.nysparks.com

David A. Paterson
Governor

Carol Ash
Commissioner

25 August 2009

Mr. Richard Starzak
IFC Jones & Stokes
811 West 7th Street, Suite 800
Los Angeles, CA 90017

Re: STB
Norfolk Southern Railway / Mechanicville Intermodal and Auto Facility
City of Mechanicville, Towns of Halfmoon and Stillwater, Saratoga County
08PR04526

Dear Mr. Starzak:

The State Historic Preservation Office (SHPO) has reviewed the information submitted for this project (*Literature Review: Delaware & Hudson Engine Terminal, Mechanicville, Proposed Mechanicville Intermodal and Automotive Facility, Town of Halfmoon, Saratoga County, New York*; August 2009; prepared by ICF Jones & Stokes). Our review has been in accordance with Section 106 of the National Historic Preservation Act and relevant implementing regulations.

Thank you for submitting this additional information. Based on this and previously submitted reports, SHPO recommends that the planned project will have **No Effect** on historic resources listed or eligible for listing on the National Register of Historic Places. This recommendation pertains only to the Area of Potential Effects (APE) examined by the various investigations undertaken for the above-reference project. Should the project design be changed, SHPO recommends further consultation with this office.

These comments are those of the Field Services Bureau and relate only to Historic/Cultural resources. They do not include potential environmental impacts to New York State Parkland that may be involved in or near your project. Such impacts must be considered as part of the environmental review of the project pursuant to the State Environmental Quality Review Act (New York Environmental Conservation Law Article 8) and its implementing regulations (6 NYCRR Part 617).

If you have any questions please don't hesitate to contact me.

Sincerely,

Philip A. Perazio, OPRHP
Phone: 518-237-8643 x3276; FAX: 518-233-9049
Email: Philip.Perazio@oprhp.state.ny.us

Cc: John Connell, U.S. Army Corps of Engineers (via email)

August 13, 2009

Mr. Philip A. Perazio
Representing State Historic Preservation Officer
New York State Office of Parks, Recreation and Historic Preservation
Historic Preservation Field Services Bureau, Peebles Island
PO Box 189
Waterford, NY 12188-0189

RE: STB; Norfolk Southern Railway Co., Pan Am Railways, Inc.
Proposed Rehabilitation of Former B&M and D&H Rail Yards
South of Rt. 67; HALFMOON, MECHANICVILLE, STILLWATER, Saratoga County;
OPRHP Project Review Number: 08PR04526

Dear Mr. Perazio:

Thank you for your comments dated March 11, 2009, regarding the above undertaking and its potential effect on historic and prehistoric cultural resources. As indicated in previous correspondence, the U.S. Surface Transportation Board is involved in the approval of this railroad transaction, and as a result, the undertaking is subject to compliance with Section 106 of the National Historic Preservation Act (NHPA). You reviewed the *Research and Historical Documentation Review* prepared in February 2009, by a railroad historian about the former Delaware & Hudson (D&H) engine terminal at Mechanicville and requested that we "review and discuss the literature regarding such facilities to provide a historic context, with references, which supports the contention that the D&H Mechanicville site is likely to provide only redundant information" with archaeological investigations of engine repair facilities in other states. The resulting *Literature Review: Delaware & Hudson Engine Terminal, Mechanicville* is submitted herewith, per your request.

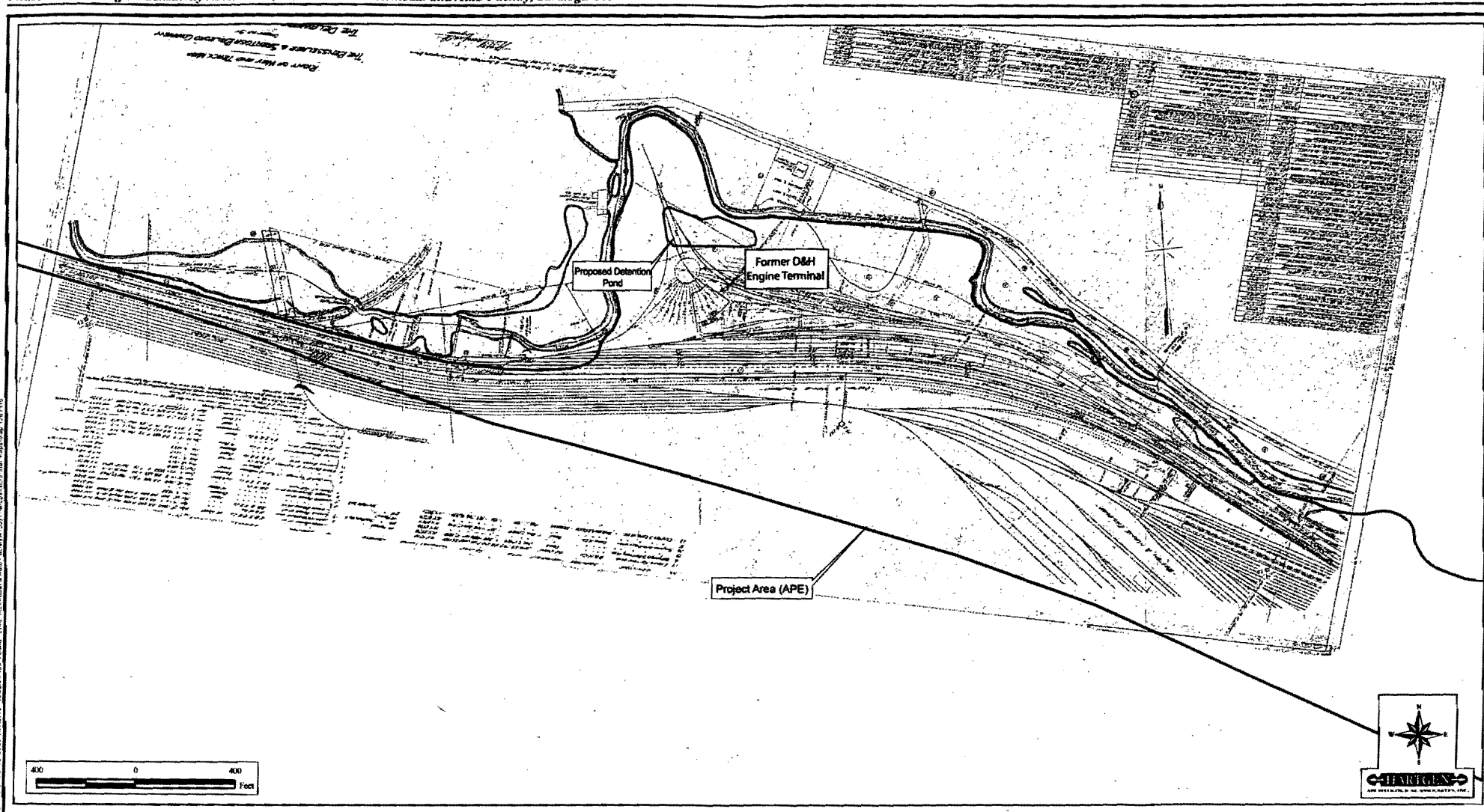
Based upon the literature review, historical research and archaeological field work, the D&H Mechanicville site does not appear to be eligible for listing on the National Register of Historic Places with regard to historical association and research potential. In addition, plans for the proposed detention pond near the former D&H engine terminal have now been confirmed, and it is clear that the proposed excavation and construction area would not disturb or otherwise affect the former D&H engine terminal. For your reference, the relevant section of the Area of Potential Effects map has been revised to show the relationship of the proposed detention pond to the former D&H engine terminal location, and is included with this transmittal.

With submittal of this report, all outstanding issues have been addressed. Your letters of March 10, 2009, and April 7, 2009, provided concurrence that the previous archaeological investigations and testing did not identify any historic properties within the APE. As stated in our letter dated February 23, 2009, and supported by the February 2009 report and the attached literature review, the former D&H engine terminal would not be eligible for the National Register under any criteria nor would any subsurface remains, should they exist, yield information important to railroad technology or to railroad history in the State of New York. The undertaking in any event would not disturb or otherwise affect the former D&H engine terminal. Therefore, we respectfully request your concurrence with the finding that no historic properties would be affected by the proposed undertaking. If you have any questions or comments, please feel free to contact me. We thank you for all your comments, responsiveness, and cooperation with the review of this undertaking.

Sincerely,

Richard Starzak
Principal/Senior Architectural Historian

Attachments: *Literature Review: Delaware & Hudson Engine Terminal, Mechanicville*
Revised Area of Potential Effects Map (Map 12B from Phase 1A Report)



Map 12b

1916 (revised 1979) Rensselaer and Saratoga Railroad Company *Right of Way and Truck Map* Showing Detail of APE Central Segment

**Literature Review:
Delaware & Hudson Engine Terminal, Mechanicville**

**Proposed Mechanicville Intermodal and Automotive
Facility
City of Mechanicville, Town of Halfmoon,
Town of Stillwater, Saratoga County, New York**

**HAA 4153-11
08PR04526**



D&H engine terminal, 1970s, before demolition. Source: RailroadForums.com

Prepared by:

**Catharine Wood, RPA
ICF Jones & Stokes
811 West 7th Street, Suite 800
Los Angeles, California 90017**

August 2009

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Management Summary

In a letter dated March 11, 2009, the New York State Historic Preservation Office (NYSHPO) made the following comment and request in response to a historical research review for the proposed Mechanicville Intermodal and Automotive Facility:

A fairly extensive literature exists on the industrial archaeology of railroads. However, there has been little investigation of this subject in New York State. Engine repair facilities in other states, such as the Rutland and Burlington facility in Burlington, Vermont, the Lakehurst Shops in Lakehurst, New Jersey, and the Erie Lackawanna facilities in Scranton, Pennsylvania have been determined eligible for listing on the National Register of Historic Places both for historical association and research potential. Please review and discuss the literature regarding such facilities to provide a historic context, with references, which supports the contention that the D&H Mechanicville site is likely to provide only redundant information.

SHPO requests that the following specific issues be addressed.

1. What particular research questions relevant to locomotive repair facilities have been identified in the literature?
2. Were there standard types of repair facilities or was each one custom built? How does the Mechanicville site compare with other, similar facilities?
3. Was size alone (i.e. number of stalls in the roundhouse) indicative of the role of a particular facility within an overall system or were other variables involved?
4. What features of such facilities are indicative of the specific capabilities of a particular facility?
5. What important innovations in railroad technology occurred during the period of existence of the D&H Mechanicville facility which might have been reflected in its physical features and which, by their presence or absence, indicates that it was either progressive or conservative in adopting new technology? What would this indicate about the evolution of the industry in New York State and the history of the company that owned this facility?

ICF Jones & Stokes staff conducted a review of the reports prepared for the Rutland & Burlington facility in Rutland, Vermont, the Raritan & Delaware Bay facility in Lakehurst, New Jersey, and the Delaware, Lackawanna and Western (DL&W) facility (now Steamtown National Historic Site) in Scranton, Pennsylvania. The research questions and results of the study of these facilities were compared to the results of previous studies at the Delaware & Hudson facility in Mechanicville.

Several sources indicate that roundhouse, turntable, and track pit design was standardized in the nineteenth century. According to the literature review, the Burlington, Lakehurst, and Scranton repair facilities were partially custom built to cater to the needs of the rail lines they served. However, these facilities were first built in the 1850s and have much older origins than the D&H in Mechanicville, which was built in 1913.

Generally, the number of stalls in a roundhouse appears to be indicative of the role of a facility within an overall system. Location of the facility in relation to the freight and destinations of the railroad also was indicative of the role of a

facility within a system. Of the four facilities studied, and among the entire D&H system, the D&H engine terminal (also referred to in the literature and in this report as an engine house) at Mechanicville, with only four stalls, was small and was used only for light running repairs, not major repairs that would have required specialized equipment.

Features found in locomotive repair facilities dating from the mid-nineteenth century and early twentieth-century generally included stalls, a turntable and track pits. With a small roundhouse and turntable arrangement such as at the D&H engine terminal at Mechanicville, NY, the work done on the locomotives was limited to light running repairs, such as lubrication, bulb replacement, and bolt tightening. Large roundhouses performed the same functions but had larger capacity in terms of the number of stalls. With the exception of a few roundhouses like the one constructed at Steamtown, major locomotive repairs would be done in the shops, not in roundhouses. Unlike roundhouses, shops were used to disassemble locomotives from their boilers and trucks/wheels and were equipped with cranes, heavy machinery, or specialized venting. In cases where roundhouses were equipped with cranes, they were typically only small ones for lifting turbo generators, air pumps, and other smaller equipment, not the large 50-100 ton capacity overhead cranes used in a shop.

The engine terminal at the D&H yard in Mechanicville was built in 1913, late in time in terms of innovations regarding steam locomotion which had matured in the 19th century. The D&H engine terminal at Mechanicville was new construction and, unlike the other facilities studied in the literature review, did not replace an earlier roundhouse or turntable in response to changed technological needs. The size of steam locomotives continued to evolve in the 20th century, and J-class articulated 4-6-4 steam locomotives were introduced to the D&H in 1944. Because the 1913-vintage 100-foot turntable at the D&H engine terminal at Mechanicville was too short for these articulated locomotives, the turntable was replaced in the late 1940s by a wye track, and two of the four roundhouse stalls were deepened to accommodate the longer locomotives. The D&H completed its conversion from steam to the more efficient diesel locomotive power by 1953.

Diesel power required less regular servicing than steam power, effectively eliminating the need for further innovation of roundhouse and turntable technology, and rendering those structures obsolete. As a result of diesel power's operational advantages, conversion of steam to diesel power in the 1950s was a common technological shift in the railroad industry in New York and the rest of the United States. The physical alteration of the D&H engine terminal at Mechanicville in the late 1940s to add a wye track and to lengthen two of the four roundhouse stalls was a direct response to the final evolution of steam locomotives, specifically to accommodate their increased length. No major physical changes or innovations were necessary for the transition to diesel power a few years later.

The information that the D&H engine terminal would become obsolete with the transition from steam to diesel power in the 1940s to the 1950s is redundant with the information gathered for the DL&W facility in Scranton, which concluded:

Major repairs to steam locomotives involved removal and replacement of worn or defective parts from below. Comparable work on the new diesels required lifting parts up and out of the locomotive. As a result, the existing roundhouse, with its low roof and limited overhead access, proved unsuitable for the requirements of diesel locomotive repair and maintenance. (Milner et al. 1989:32-33).

In sum, based upon the literature review, historical research and archaeological field work, the D&H Mechanicville site does not appear to be eligible for listing on the National Register of Historic Places with regard to historical association and research potential.

Introduction

The proposed Mechanicville Intermodal and Automotive Facility will be constructed on portions of the former Delaware & Hudson (D&H) and Boston & Maine (B&M) yards in the towns of Halfmoon and Stillwater and the City of Mechanicville, New York (collectively herein referred to as Mechanicville). As explained in more detail in Fisher and DiVirgilio 2008, the area on which the proposed facility will be constructed includes the former location of the D&H engine terminal (roundhouse and turntable) but does not include the former location of the B&M engine terminal and associated shops.

The 2008 and 2009 archaeological investigations conducted by Hartgen Archeological Associates, Inc., related to the former D&H yard in Mechanicville, New York, did not identify any remnants of a roundhouse, turntable or any other structural facility associated with the rail yard, and noted that the map-documented structure (MDS #9, identified as the roundhouse) has been removed (Cowan 2009; Fisher and DiVirgilio 2008). In its Phase IA study, Hartgen Archeological Associates, Inc. concluded that most of the area of potential effects (APE) was substantially disturbed both by the installation of the extensive former Mechanicville rail yards of the D&H and the B&M in the late nineteenth and early twentieth centuries and by the subsequent dismantling of the former D&H and B&M Mechanicville rail yards in more recent years (Cowan 2009). Therefore, the Phase IB and Phase II archaeological investigations were conducted in two areas immediately outside of the D&H and B&M rail yards that did not show evidence of disturbance from prior site activities (Cowan 2009).

In a letter dated December 22, 2008, the New York State Historic Preservation Officer (NYSHPO) requested that "further consideration be given to the potential for the presence of remains of the late-19th and early-20th century locomotive servicing complex...Such remains, if present, may provide important information regarding the development of railroad technology." In response to this request by the NYSHPO, a report on the construction history, historic context, and lack

of potential for National Register eligibility of the former D&H engine terminal at the Mechanicville facility was submitted to the NYSHPO for review and comment on February 23, 2009.

In a letter dated March 11, 2009, the NYSHPO made the following comment and follow-up request in response to the February 23, 2009 historical research review for the proposed Mechanicville Intermodal and Automotive Facility:

A fairly extensive literature exists on the industrial archaeology of railroads. However, there has been little investigation of this subject in New York State. Engine repair facilities in other states, such as the Rutland and Burlington facility in Burlington, Vermont, the Lakehurst Shops in Lakehurst, New Jersey, and the Erie Lackawanna facilities in Scranton, Pennsylvania have been determined eligible for listing on the National Register of Historic Places both for historical association and research potential. Please review and discuss the literature regarding such facilities to provide a historic context, with references, which supports the contention that the D&H Mechanicville site is likely to provide only redundant information.

SHPO requests that the following specific issues be addressed.

1. What particular research questions relevant to locomotive repair facilities have been identified in the literature?
2. Were there standard types of repair facilities or was each one custom built? How does the Mechanicville site compare with other, similar facilities?
3. Was size alone (i.e. number of stalls in the roundhouse) indicative of the role of a particular facility within an overall system or were other variables involved?
4. What features of such facilities are indicative of the specific capabilities of a particular facility?
5. What important innovations in railroad technology occurred during the period of existence of the D&H Mechanicville facility which might have been reflected in its physical features and which, by their presence or absence, indicates that it was either progressive or conservative in adopting new technology? What would this indicate about the evolution of the industry in New York State and the history of the company that owned this facility?

ICF Jones & Stokes staff conducted a review of the reports prepared for the Rutland & Burlington facility in Rutland, Vermont, the Raritan & Delaware Bay facility in Lakehurst, New Jersey, and the DL&W facility (now Steamtown National Historic Site) in Scranton, Pennsylvania. The research questions and results of the study of these facilities were compared to the results of previous studies at the D&H facility in Mechanicville. The time period of interest for purposes of this report is the early days of steam locomotives from the mid-19th to early-20th century. The engine terminal at the Rutland & Burlington yard in Burlington, Vermont, operated between 1857 and 1919; the engine terminal at the Raritan & Delaware Bay yard in Lakehurst, New Jersey (Lakehurst Shops), operated between 1854 and 1936; and the engine terminal at the DL&W yard in Scranton, Pennsylvania (Steamtown National Historic Site), was in operation between 1855 and 1937. By contrast, the D&H did not construct the engine terminal in its yard in Mechanicville, New York until 1913, where it remained until it was demolished in the 1980s. The D&H retired its last steam locomotive in mid-1953. The D&H's steam and, later, its diesel locomotives went to the D&H's main shop, the Colonie Shops south of Watervliet, New York, for overhaul and maintenance. Because its main Colonie Shops were not

far away, the D&H used the Mechanicville yard only for light running repairs and for servicing yard-switching engines (Darbee 2009).

Prior archeological reports prepared for the locomotive repair facilities at Burlington, Vermont, the Lakehurst Shops in New Jersey and the Steamtown National Historic Site in Scranton, Pennsylvania have involved archaeological research questions focused on the design of each facility that could be gleaned from excavations and background historical research. Because the NYSHPO request and this report relate to the locomotive servicing area of the former Mechanicville D&H yard, which was comprised of a roundhouse and turntable, of primary interest for purposes of this report are the roundhouses and turntables at these other yards. These elements of a repair facility provide information about the size and importance of each facility. The design of each facility revealed the use and purpose of that facility, and whether the facility went through physical changes because of technological innovations or due to an increase or decrease in use, also provides information on the use and purpose of the facility. Further, these observations based on examination of the archaeological evidence provide insights into the working conditions of the railroad employees.

In order to address the NYSHPO's request for review of the industrial archaeology literature of the Rutland & Burlington facility in Rutland, Vermont, the Raritan & Delaware Bay facility in Lakehurst, New Jersey, and the DL&W facility (now Steamtown National Historic Site) in Scranton, Pennsylvania, it is important to understand what distinguishes the discipline from prehistoric and historic archaeology. The techniques of the industrial archaeology discipline are uniquely suited to synthesize the complex relationship between society and technology that began in the age of the Industrial Revolution, whereas the sub-discipline of prehistoric archaeology focuses on pre-contact cultures and historic archaeology focuses on early European settlement and its effect on Native American peoples, as well as the subsequent spread of the frontier and later urbanization and industrialization. Industrial archaeology strives to act as a bridge between the humanities and technology and thus recognize monuments in terms of existing and often occupied buildings that house industrial processes and other structures and relics such as company records and machinery (Kemp 1996).

The following literature review exemplifies the research methods of industrial archaeology which emphasizes the use of engineering drawings and specifications, articles in technical journals, company records and the documentation of historic manufacturing processes.

Mid-19th and Early 20th Century Locomotive Repair Facilities

The development of American locomotive repair facilities from the mid-19th to the early 20th century documents the changes in locomotive design and railroad

technology and on a broader scale reflects the evolution of commerce and industry within North America.

Steam locomotives and the first commercial railways were built in Britain during the early decades of the nineteenth century. American railway technology was inspired by the early British developments and some of the first American railways were characterized, in a large measure, by a direct transfer of British technology (Mueller et al. 1997). The British Sturbridge Lion was the first steam locomotive to be used in trial runs in America (by the D&H in 1829) (Shaughnessy 1997) and the Alleghany Portage Railroad, opened in 1834, used the stone block sleeper and iron chair rail track system developed in Great Britain (Mueller et al. 1997, citing to White 1979). After the initial period of direct technology transfer from Britain, at mid-century American railroad technology had developed its own distinctive characteristics based on innovations and adaptations to local conditions (Mueller et al. 1997, citing to White 1979).

Meeks (1956) identified three principal periods in the development of American railroad architecture during the 19th century:

- **1830–1845:** The initial period of building was characterized by experimentation and utilization of a variety of different styles.
- **1845–1860:** The mid century was characterized by standardization in railroad buildings. As railroads expanded throughout the East and the national economy grew, other railroad technologies matured during this period, including the replacement of strap rails by the T-rails of modern form and the replacement of wood-burning locomotives by coal-fired engines.
- **1860–1890:** This period was characterized by technical innovations that provided improvements in railway safety, speed and comfort. No new architectural styles or types appeared during this period; rather the period was characterized by maturation of a Victorian Gothic architectural style in public railroad buildings. At the end of the 19th century, the Victorian architectural esthetic was replaced by eclecticism and building at an unprecedented large scale (Mueller et al. 1997, citing to Meeks 1956).

The primary focus of the archaeological studies, relevant to the NYSHPO's questions, conducted at Burlington, Vermont; the Lakehurst Shops in New Jersey; and the Steamtown National Historic Site in Scranton, Pennsylvania, was on the physical remains of the roundhouse and turntable. To some extent, the roundhouse reflected the major architectural developments and economic trends of the period (19th and 20th century). However, roundhouses did not as a rule receive the architectural attention that was given to passenger terminals, since roundhouses were not public buildings, and they were generally situated away from commercial and residential centers. The primary function of the roundhouse was to provide routine maintenance for locomotives, and hence roundhouses were subject to a number of important design considerations and esthetics were of secondary or minor importance (Mueller et al. 1997).

Roundhouse Maintenance Activities

There are few surviving written records to provide details regarding locomotive maintenance procedures prior to the nineteenth century. "These activities were carried out by mechanics and shopmen with little need to commit the specifics of their trade to writing" (Mueller et al. 1997:64, citing to White 1979). However, the late nineteenth- and early twentieth-century locomotive maintenance manuals that are available often provide important references to earlier practices in addition to recommended contemporary procedures and, in conjunction with the analysis of the physical remains of roundhouses, provide direct evidence of historical steam locomotive maintenance procedures (Mueller et al. 1997).

Routine maintenance activities for steam locomotives included (1) exterior cleaning; (2) inspection, lubrication, and adjustment of the running gear—suspension, frames, trucks, drive wheels, axles, tires, brakes, rods, crosshead slides, guide bars, crank pins, connecting rods, valves and cylinders, etc.; (3) replenishment of the fuel, water, and sand; (4) disposal of ashes; (5) boiler inspection, washing and testing; and (6) replacement of worn parts, such as bearings, wheel tires, and trucks (Mueller et al. 1997, citing to Forney 1883, 1890).

By the early twentieth century, locomotive maintenance procedures had developed to the point that some of these activities were performed at specialized facilities outside the engine house but any or all of these activities could have been carried out inside the mid-nineteenth century roundhouse" (Mueller et al. 1997:64).

Fuel replenishment normally occurred outside the roundhouse at a special coaling shed.

Whether fueled by wood or coal, locomotives needed a steady supply of combustible fuel to maintain steam pressure in the boilers. Locomotives would also have needed to replenish their water supply, in order to allow continuous generation of steam. In order to increase the traction of the locomotives, a device controlled by the engineer dropped dry sand on the rails in front of the drive wheels. These devices, known as sandboxes, were used on virtually all American locomotives by 1850. (Mueller et al. 1997:64, citing to White 1979)

The principal waste product from steam locomotives was ash. The removal of hot cinders and ashes from locomotive ash pans and smoke boxes required specialized facilities for disposal. The waste material, especially coal ash, was corrosive (Mueller et al. 1997). In Hartgen Archeological Associates, Inc. 2008 Phase IA Archeological Sensitivity Assessment report for the proposed Mechanicville Intermodal and Automotive Facility, the D&H coal ash clinker area was identified through background research. According to that research, in 1994 the New York State Museum conducted a cultural resource survey and test excavation on the north side of the Mechanicville former rail yard within a bend on the south side of the Anthony Kill River, to the north of the former D&H engine terminal. The site tested in 1994 is located within the APE identified by Hartgen in its 2008 Phase IA report. The shovel test excavations identified a coal ash area that corroborated information from a 1916 railroad map that identified the area as a former ash track

and ash dump (Fisher and DiVirgilio 2008, citing to NYAC 1994). It was common practice to douse the hot ashes with water and then to drain the ash pits. (Mueller et al. 1997). A twentieth-century manual estimated that each engine would produce 2 to 2.5 cubic yards of ash (Mueller et al. 1997, citing to Howson, ed., 1929). However, it is assumed that the smaller nineteenth-century locomotive ash pans had a lower capacity (Mueller et al. 1997).

Boiler cleaning was an important locomotive maintenance activity, and a problem that led to a variety of technological innovations during the early twentieth century. The generation of steam left scale and residue deposits on the boiler lining. Iron and alumina sulphates, calcium and magnesium deposits were known to hinder the efficient transfer of heat, sometimes resulting in the overheating and weakening of the metal (Mueller et al. 1997, citing to Forney 1890 and Webb 1912). Boiler cleaning required that all steam be blown off, the water drained and the engine allowed to cool, then special tools were used to scrape the precipitates from the metal parts. This type of maintenance was required to allow the engine to cool and to bring it back to full steam after cleaning, and the entire process could require as much as twelve hours (Mueller et al. 1997). "During the twentieth century, a number of systems were developed whereby cold water was introduced to the boiler, hastening the cooling process, and hot water was introduced to facilitate firing up, all without damage to the boiler from thermal shock" (Mueller et al. 1997:65-66, citing to *Railway Master Mechanic* 1907, Orrock 1918, Paterson and Webster 1925, and Howson, ed., 1929).

Inspection Pits and Drop Pits

Roundhouses typically included inspection pits and drop pits to facilitate maintenance and repairs such as the removal of truck wheels, driving wheels and tender wheels. These pits were simply work areas recessed below the roundhouse floor that extended below the tracks and permitted easy access to the locomotive's underside (Mueller et al. 1997).

Inspection and drop pits were a standard feature in roundhouses, but their design has changed over the years. The radial arrangement of inspection pits was a standard design element that began in the mid-nineteenth century. The engine house designs that became standard by the late nineteenth century typically included long inspection pits in each locomotive stall, which would have allowed inspection and repair along the full length of the locomotive undercarriage (Mueller et al. 1997). Drop pits were necessary for removal of locomotive and tender wheels. "Drop pits were typically arranged circumferentially around the turntable to intersect two or more inspection pits. Drop pit floors typically included a set of rails that would carry the jack between stalls" (Mueller et al. 1997:77).

At the turn of the twentieth century, drop pit design had become fairly standardized, according to *Railway Master Mechanic*:

Each roundhouse has one or more sets of tracks arranged for dropping driving wheel and truck wheels. Driving wheel drop pits and truck wheel

drop pits are usually in connection with different working pits, though the same working pits are sometimes equipped for dropping both truck and driving wheels.

Truck wheel drop pits are usually at the end of the repair pits toward the outer wall and the pits are connected by a tunnel. On the bottom of this tunnel is a light, narrow gauge track on which the transfer carriage and jack travel so as to provide lateral movement when removing and replacing wheels...

Drop pits constructed on circular lines, on a radius with the center of the turntable as a center, are looked upon with greater favor than those built on straight lines (Railway Master Mechanic 1907:202).

Roundhouse Design

Meeks (1956) has observed that the 1850s was a period of standardization in railway architecture, and the earliest available manuals pertaining to roundhouse design date to this period (e.g., Dempsey 1855; Vose 1857). Twentieth century writers have repeatedly pointed out the changes in the appearance of roundhouses (Mueller et al. 1997, citing to Railway Master Mechanic 1907 and Orrock 1918), and these changes may be viewed as architectural design responses to basic requirements for careful siting, efficient entry/egress, lighting, heating, durability, sanitation and waste disposal. Satisfactory solutions to other requirements, such as ventilation, were not solved until the twentieth century (Mueller et al. 1997).

The circular or polygonal plan for the roundhouse, with stalls arranged radially about a central turntable, has been an American architectural standard since the mid-nineteenth century or possibly earlier (Mueller et al. 1997). Dempsey's 1855 manual indicated, "The most convenient form in which buildings for standing engines are constructed is polygonal" (Dempsey 1855:295), and Vose (1857) described the circular/polygonal engine house plan as a standard design.

The circular/polygonal plan persisted into the late nineteenth century but the basic plan was modified as the number of locomotive stalls increased. Some later designs retained the central turntable but with the radially arranged locomotive stalls extending only through an arc or semicircle. In this type of engine house plan, the roof covered only the locomotive stalls but not the turntable (Mueller et al. 1997:67).

Berg's (1893) discussion of roundhouse designs differentiates the two designs, applying the terms "closed" or "full circle" roundhouse to structures with a completely circular or polygonal plan, and "open" or "segmental" to the semi-circular plans. "Full-circle roundhouses could be built with the roof covering only the locomotive stalls, and the term 'engine-house rotunda' was applied to designs in which the roof extended over the locomotive stalls and the turntable" (Mueller et al. 1997:67-68).

By the early twentieth century, some railroads had adopted standard building plans for roundhouses (Mueller et al. 1997, citing to Railway Master Mechanic 1907). "The adoption of standard roundhouse blueprints would have been preceded by the emergence of basic design criteria during the mid- to late nineteenth century. Nearly all of the late nineteenth-century engine house designs are of the segmental design, although a few examples of the full-circle rotunda and square plan exist" (Mueller et al. 1997:68). The segmental plan consisted of a series of identical stalls that extended through an arc of semi-circle, and this plan could be adapted readily to smaller sites or expanded to meet requirements for increased maintenance capacity. The full-circle rotunda, characterized by great height and interior space, was viewed as uneconomical in comparison to the segmental designs, in which only the locomotive stalls were enclosed. The full-circle design was also considered to be more dangerous than the segmental plan because of the ever-present fire hazard in engine houses:

As a rule, roundhouses, especially closed or full-circle ones, can be considered as traps which will at times possibly cause a serious blockade to a large number of engines, and in case of a fire a large amount of valuable equipment will probably be destroyed and the road seriously crippled for want of motive power for months afterwards (Berg 1893:175).

Roundhouses were built at a larger scale as locomotive sizes increased and as the number of engines in service on particular railways increased. White's (1979) study of American locomotives indicates that the length of a typical locomotive and tender did not exceed fifty feet until after 1875 (Mueller et al. 1997):

Turntables

Turntables have been essential to rail yard operations since the beginning of the railroad era, and their development since the mid-nineteenth century has not been marked by any significant design innovations (Mueller et al. 1997). "Turntables were initially made of wood, then cast iron or structural steel. By the late nineteenth century, turntable bridges were being fabricated by structural steel shops" (Mueller et al. 1997:69, citing to Dempsey 1855 and Vose 1878).

A late nineteenth-century description of a rail yard turntable is given as follows:

Turntables are platforms by means of which the engine or cars may be turned around. This is effected by excavating a pit under a portion of the track, and laying in the bottom of this pit a circular track, upon which a platform, supported by friction wheels, is made to revolve. A great many plans have been devised to effect this object.

In the center of the pit is placed a conical centre-post, with a broad base resting on a firm foundation of stone. This post extends nearly to the top of the centre-box. The top of the post is made hemispherical, and on it rests a cast-iron cap, carrying a set of steel plates grooved and filled with conical steel rollers. The whole weight of the table and engine rests on these steel

rolls in turning. A cap of cast iron rests on the top steel plate, and to this cap the centre-box is suspended on a circle of bolts, with a layer of wood between the box and cap...upon the arms crossties are laid, and to these ties rails similar to those on the road are secured. The pit is usually built with a curbing stone, and in the centre is built a strong foundation of a size suitable to carry a top stone. The pit is deepest in the centre, and grows shallower toward the circumference, ending in a level plateau for the reception of the circular track. This track, carefully leveled, rests on well-laid sills — stone or iron preferable to wooden sills. One man, with a lever of such a length as will extend over the curbing of the pit, can with ease turn the heaviest engine on this table. If steel is used for the centre-plates and rollers, the table turns more easily and is more durable. The rolls ought to be oiled, and if cleaned at least every three months they are very durable. In regard to diameter of table to suit any particular case, the larger diameters are best, as the engine, either with empty or with full tender, can be most readily balanced; and it is necessary that the centre of gravity of the load be in all cases over the centre of the table, so as to have no appreciable weight on the circular track (Benjamin, ed. 1884:643).

The late nineteenth century roundhouse designs have turntables in the 50- to 60.5-foot range. Early to mid-twentieth century manuals recommend lengths ranging from 75 to 115 feet (Mueller et al. 1997, citing to American Railway Engineering Association 1905, Railway Master Mechanic 1907, Orrock 1918, and Howson, ed., 1929).

Before electric, diesel or compressed air power was available, workmen used devices to effect the rotation of turntables. Turntable rotation was originally effected exclusively by hand, and for that purpose a suitable lever was installed at one or both ends of the table. With engines of moderate weight, accurately balanced on the table, manual turntable operation could be made to answer the ordinary terminal requirements (Howson, ed., 1929:563).

One of the most crucial relationships between a roundhouse and turntable was the distance between the center of the turntable and the front wall of the roundhouse. This relationship was based on several factors, including locomotive size and standard railroad operating practice. Because of the constant danger of fire and explosion inherent in the operation of the coal-fired boilers used by steam locomotives, an open area was maintained between the edge of a turntable and the front wall of a roundhouse. This distance approximated the combined length of the largest locomotive and tender capable of being serviced in the building (Milner et al. 1989).

Similarly, the minimum clear width of a roundhouse bay was related to the width of the locomotive intended to be serviced. This dimension did not appear to change as frequently as length, possibly because side clearance within much of the existing railroad infrastructure such as trackage, tunnels, bridges, and stations did not adapt readily to alteration. As a result, minimum roundhouse bay width remained fairly constant despite frequent increases in bay depth. Additionally, the number of bays in newer roundhouses tended to increase as the front wall of these buildings necessarily moved farther back from the center point of turntables as they were aligned to accommodate longer and heavier locomotives (Milner et al. 1989).

Roundhouse and Turntable Construction Materials

Brick and wood were the preferred structural materials for roundhouses until the twentieth century when concrete and steel were favored. Manuals published at the turn of the century (Railway Master Mechanic 1907; Webb 1901) recommended brick for the outer structural walls and wood truss framing.

Aside from the strength and resistance to fire, the most critical factor in the selection of material was the corrosive effect of the steam and gas generated by the locomotive engines. Although the noxious character of locomotive fumes was appreciated from the beginning of the railway era, their corrosive effect apparently was not fully appreciated at the outset. Although virtually all of the twentieth century manuals recommended against the use of any exposed iron or steel within roundhouses, citing the harmful effect of locomotive fumes, numerous late nineteenth-century designs utilized iron truss roof frames (Mueller et al. 1997:71).

Flooring

Various materials were employed for roundhouse floors, apparently with little consensus as to the best surface. Webb (1901) simply observed that various materials (cinders, wood, brick and concrete) were in use, while other writers cited the relative merits of different materials and pointed out the importance of proper grading to facilitate drainage.

Floors of wooden planks have long been used with success and are still looked upon favorably. Concrete floors have been installed in many roundhouses within recent years and flooring of vitrified brick set on edge in tar has given very satisfactory results. To insure good drainage floors are elevated to a height of two inches above the rail midway between the pits and slope gradually toward the pits (Railway Master Mechanic 1907:202).

Either cement, asphalt, or concrete are excellent materials for running shed floors. Hot water ruins all those made of composite material, and the pressure of screw or hydraulic jacks when lifting engines, etc. invariably cracks and breaks up any protective covering with which such floors may be provided, whilst wood blocks are liable to fire, and after a time become rotten and decay (Paterson and Webster 1925:35-36).

Roofing and Ventilation

Roofing was an important consideration, particularly with regard to the need to provide ample natural lighting, good ventilation, and economical heating. Webb's manual provides one of the infrequent discussions of the preferred roofing material.

Many roofs have been built of slate with iron truss framing with the idea of maximum durability. The slate is good, but iron framing deteriorates

rapidly from the action of the gases of combustion of the engines which must be "fired" in the houses before starting. Roof frames are therefore generally made of wood (Webb 1901:xii-13).

Roofing designs reflected the need to provide ventilation and natural lighting balanced against the need to conserve heat. Early rotunda style roundhouse designs provided extensive lighting through the walls and roof; however, the extensive use of sky-lighting seen in the mid-nineteenth century designs fell out of favor as electric lighting became available (Mueller et al. 1997). Orrock (1918) indicated that skylights were wasteful of heat and that they were quickly blackened by the locomotive fumes. As the full-circle rotunda plan was replaced by the open and segmental buildings with outdoor turntables, roof profiles changed significantly.

The early roundhouse designs showed only minimal attention to the provision of roof vents for the escape of steam engine fumes. Later designs included large smoke jacks or smoke shoots which were hoods that could be lowered over the locomotive smokestack to allow the fumes to rise directly through the roof (Mueller et al. 1997). Webb (1901) indicates that that smoke jacks were in use at the turn of the century. Many different designs for smoke jacks were put forth in the early twentieth century, utilizing various materials and mechanisms to raise and lower them over the locomotives' smokestacks (Mueller et al. 1997). The principal constraints were that they needed to be made of a non-corrosive material but light enough in weight so that they could be raised easily. No standard solution was forthcoming, as Orrock (1918) discussed the problem of engine house ventilation:

Smoke Jacks. The only desirable opening in an engine-house roof is that required for a smoke jack. Skylights rob the house of a great deal of heat, and very soon get blackened up. Ventilators, also, unless operated by mechanical suction or fan, are of little use. The smoke emitted from engines, when mixed with steam, forms sulphuric acid that destroys all exposed metal. All material, therefore, for openings of any kind should be such as will not readily be affected by smoke fumes, and while there has been a steady improvement in the design of engine houses, the smoke jack problem has not yet been satisfactorily solved (Orrock 1918:509).

Previous Archaeological Investigations

Review of the archaeological work conducted at the rail yard facilities at Burlington, Vermont, Lakehurst, New Jersey, and Scranton, Pennsylvania, provided a history of American railroads, the towns that built up around these facilities, the varying degrees of which the facilities had been maintained through time, and how the researching archeologists assessed and recorded information about each of the sites. The methods used in recording these sites and the research questions asked by the archaeologists assist in determining how these sites are identified in relation to the communities they are in and to the historic record overall. Structural remains were identified at those three rail yards, and

archival literature such as valuation maps, engineer drawings and purchase orders were available for review and aided in the archaeological excavations and documentation at these sites. As was evidenced in the document review, each of the three facilities with structural remains was at different levels of decay and therefore the research questions and methods used in those analyses were particular to each site. Zitzler (1989) offered a keen observation that is relevant to this current literature review and analysis and is important to keep in mind regarding the archaeological investigations conducted at the rail yard facilities at Lakehurst, Scranton, Burlington and Mechanicville:

...historical and archaeological research indicates that few of the comparable facilities that remain extant contain archaeological remains of early design features that are as well preserved or as extensive as those found at Steamtown... (Zitzler 1989).

Rutland & Burlington Railroad, Burlington, VT, 1851-1919

Archaeological Phase II Testing was conducted at the former Rutland & Burlington Railroad engine roundhouse and turntable in 1996 through 1997. The site is located within Burlington, Chittenden County, Vermont (Corey et al. 1999).

The site of the former Rutland and Burlington Railroad engine roundhouse has been named the "Rail" site (VT-CH-736). During the initial archaeological investigation conducted in 1996, a circular portion of the foundation remnant of the railroad facility turntable was uncovered. Subsequent Phase II testing undertaken in 1997 further investigated the turntable remnants at the Rail site and also led to the identification of the foundation remains of the engine roundhouse (Corey et al. 1999).

Historic Background

The Rutland and Burlington Railroad constructed an engine roundhouse and turntable by 1851 or early 1852 near the waterfront area of Lake Champlain. Foundation remnants of this railroad facility were identified during archaeological Phase IB survey and further investigated during the Phase II testing. Remains of this railroad facility are remarkably preserved beneath the current rail yard, portions of which are still active. The landform on which the rail site is situated was built during the expansion of the Burlington waterfront in the mid-nineteenth century. The Rutland and Burlington Railroad developed the rail yard near the waterfront by cribbing and filling the shoreline (Corey et al. 1999). By 1853, the Rutland and Burlington Railroad had constructed a rail depot, engine roundhouse and associated railway tracks. Later development included further infilling of the waterfront and the construction of a dock immediately to the west of the Rutland and Burlington Railroad depot. The railroad roundhouse was destroyed by fire in 1917 (Corey et al. 1999).

Research Questions

Subsurface testing and background research have demonstrated that the Rail site preserves *in situ* remnants of the historic Rutland and Burlington Railroad engine house. This railroad facility is one of the earliest known railroad facilities in Vermont and it played a significant role in transforming Burlington from a waterfront port to a railroad center. By the 1870s Burlington was a leading lumber industrial center, transporting lumber by rail to all parts of the northeast and elsewhere (Corey et al. 1999).

Findings

Historic Background Research

On July 2, 1850, the Board of Directors of the Rutland and Burlington Railroad authorized its Committee on Buildings to erect terminal facilities at the two most important towns along the railroad, Rutland and Burlington. The Directors further resolved "that a one-story passenger depot for three tracks, about two hundred feet long, be built of brick at Burlington and also an engine house at Burlington for four engines" (Corey et al. 1999:54, citing to Minute Book 1:136-137).

The Rutland and Burlington four-stall engine house was completed probably by late 1851 or early 1852. It was constructed of brick above a stone foundation and its roof was most likely supported by wood timbers.

The building possessed a quarter-round plan and occupied the northeast quadrant of the area surrounding the turntable. The latter incorporated a stone perimeter wall enclosing the circular pit where the turntable itself revolved. Each end of the turntable traveled on a ring rail laid on a stone shelf projecting from the inside of the perimeter wall (Corey et al. 1999:55).

...The most specific information about the Burlington engine house prior to the 1917 fire is available from scaled maps of the city and its railroad facilities. Numerous such maps were published between 1853 and 1915, including the series of insurance maps prepared by the Sanborn Map Company (Corey et al. 1999:55).

The Burlington City map included in Beers' 1869 *Atlas of Chittenden County, Vermont* records four buildings in the terminal complex of the renamed (in 1867) Rutland Railroad. The "Engine House" appears in the same plan as on the 1853 map with the addition of a turntable symbol at the front of the building with a single track leading onto it. An unidentified smaller rectangular building stands parallel to the east side of that track immediately south of the turntable. Northwest of the engine house, the "Freight Depot" of rectangular plan stands near the southeast corner of the "Rutland R.R. Passenger Depot," also shown on the 1863 map (Corey et al. 1999).

A crude visual image of the original engine house appears on Meilbek's *Birds Eye View of Burlington and Winooski, VT*, published in 1877 by J.J. Stoner. That

drawing depicts a four-stall, quarter-round building with a gable roof plus a rectangular one-story west ell oriented with its gable roof perpendicular to that of the main block. The gable roof of the main block contrasts with the barrel-vaulted roof shown in a ca. 1900 photograph (Corey et al. 1999).

The under scaled turntable symbol shows four short tracks radiating (erroneously) from the hub of the turntable rather than from the northeast side of the circular symbol (Corey et al. 1999:57).

The first edition of the Sanborn Fire Insurance map of Burlington was issued in January 1885. It presents a relatively detailed plan of the "Round Ho" that since 1870 was under lease along with the entire Rutland Railroad by the competing Central Vermont Railroad. The quarter-round, one-story, brick main block was entered on the curved southwest façade by four tracks leading from the closely adjacent turntable. The straight south façade of the building lacked openings while there were several windows along the curved northeast façade. Three small circles drawn next to the inside of the latter façade are labeled "water tanks"; those tanks were probably placed atop the roof. At the west corner of the roundhouse's northeast façade, a rectangular one-story, brick wing projects northward flush with the west wall of the main block. Attached to both the west side of the north wing and the west side of the main block, a larger one-story, brick wing extends southward to the edge of the turntable symbol. Lighted by several windows on its west façade, the west wing contained a blacksmith shop in its south half and a "Joiner Shop" in its north half (Corey et al. 1999:57).

Based upon the relatively accurate scale to which Sanborn maps are drawn, it is possible to estimate approximate dimensions of the buildings depicted on them.

The roundhouse extended about 50 feet in the dimension perpendicular to its curvature and about 65 feet along its curved northeast façade (outside the north wing). The north wing was about 20 feet by 20 feet, and the larger west wing was about 40 feet in the east-west dimension by 80 feet north-south. The turntable symbol slightly exceeds 50 feet in diameter, indicating that the turntable itself was 50 feet in length and therefore corresponded to the length of the locomotive stalls inside the roundhouse (Corey et al. 1999:57).

The same Sanborn Fire Insurance map shows two related railroad buildings sited south of the roundhouse. A small one-story, wood-framed shed stood near the southeast side of the turntable. Somewhat farther south of the turntable, an elongated one-story, wood-framed "Car Ho," was entered at its north end by two tracks from the turntable; presumably this was a shop for repairing cars (Corey et al. 1999:57).

The next edition of the Sanborn Fire Insurance map of Burlington was issued a decade later in November 1894. The symbols for the roundhouse and turntable appear unchanged from the 1885 edition. The small shed southeast of the turntable also remains in place. The car repair shop, however, is not shown, indicating that it had been removed (Corey et al. 1999:57).

Significant changes occurred to the roundhouse in the late 1890s, relating possibly to the abrogation in 1896 of the Rutland Railroad lease held by the Central Vermont Railroad (Corey et al. 1999:57, citing to Shaughnessy 1964).

The Sanborn map of January 1900 records the alteration of the roundhouse by the addition of three small rectangular one-story wings to the curved northeast façade. Each 15 foot wide wing corresponds to a locomotive stall and projected about 12 feet in length, presumably to accommodate the larger and longer locomotives then being acquired by the railroad. The turntable symbol, however, remained in the same 50-foot diameter area shown on earlier maps (Corey et al. 1999: 57).

...The length of the turntable limited the length of locomotives that could enter the roundhouse, although techniques existed for turning locomotives that were a few feet longer than the turntable itself (Corey et al. 1999:57-58).

...The next edition of the Sanborn map, issued in March 1906, records more significant changes in the roundhouse. By this time, another one-story rectangular wing had been added to the northeast façade, this one adjoining the east side of the north wing labeled "Oil Storage" on the 1900 map. This new wing projected about 25 feet, which is more than double the length of the other three earlier stall wings. The 1906 map also documents that fire struck the building during the early 1900s; the entire west wing is labeled "No Roof" and "Ruins of Fire" (Corey et al. 1999:58).

In 1911, railroad staff created a "Plan Showing a Proposed Revision of Yards..." that records the roundhouse in somewhat greater detail than the Sanborn Fire Insurance maps. Corey et al. reported as follows in 1999:

The roundhouse symbol, unlike those on the earlier maps, depicts the four stall tracks inside the building extending about 60 feet into the four added wings. The fire-damaged west wing had been rebuilt or replaced by two smaller rectangular wings at the north and south ends of the roundhouse's west side. The turntable symbol extends a scale diameter of about 55 feet, about 5 feet longer than the symbols on previous maps (Corey et al. 1999:58).

Also differing from earlier maps, the 1911 plan shows four short stub tracks radiating in the open from the southeast quadrant of the turntable. These additional tracks probably reflect the increasing number of locomotives then being serviced here, and the need for a larger roundhouse. Also, for the first time, this plan shows a rectangular ash pit near the end of another stub track about 100 feet south of the turntable (Corey et al. 1999:58).

The last edition of the Sanborn Fire Insurance map to show this roundhouse was issued in October 1912. It essentially replicates the yard plan of the previous year, excepting a turntable symbol with a 50-foot diameter. Inside the roundhouse symbol, this Sanborn map shows an elongated "Heating Blr." in the northwest corner next to the brick north wing (Corey et al. 1999:58).

The 1912 Sanborn map identifies the roundhouse building as "N.Y.C. Lines Rutland R.R. Round Ho." The New York Central System had acquired in 1904 a controlling financial interest in the Rutland Railroad (Corey et al. 1999:58, citing to Shaughnessy 1964).

...The last known plan to record the roundhouse was prepared by the Rutland Railroad staff in November and December 1915, showing the "Track & Sewer Crossing" for a large grocery warehouse building just to the north. This plan records the "Engine House" in the same footprint as the 1911 and 1912 counterparts; the turntable symbol, however, has a scale diameter of 60 feet (Corey et al. 1999:58).

...The valuation form for the Burlington roundhouse, dated November 8, 1917, documents that the building itself did not exist by that time. The form bears the title, "Old Engine House Pits," and states simply that "Old engine house burned down to ground." The locomotive maintenance pits appear as elongated depressions between the rails of the tracks inside the locomotive stalls. The form describes four such pits, each 50 feet long and 3 feet deep. The pits were lined with brick walls 16 inches thick that supported longitudinal 12 inch by 12-inch timbers carrying the rails. Between adjacent pits, a brick conduit drain extended 50 feet in length by 30 inches in width to provide drainage into a manhole in the turntable pit (Corey et al. 1999: 58 and 61).

Two other valuation forms dated September 11, 1917, indicate "Boiler House" and an "Eng. Ho. Foreman's Office & Storeroom." The sketch plans of both of these buildings show that they were apparently attached to opposite sides of an "Old Eng. Ho. Wall" (Corey et al. 1999:61).

...The boiler house had a four-sided but tapered plan extending 53 feet in overall length by about 7 feet at the narrow end and 19 feet at the opposite end. Both the old engine house wall and the 19-foot end wall of the boiler house were constructed of brick. In contrast, the angled wall opposite the old engine house wall and the 7 foot end wall of the boiler house were wood-framed and sheathed with boards-and-battens (Corey et al. 1999:61).

The wider end of the boiler house contained a "Sand House" 20 feet in length with a "dirt floor" for storing locomotive sand; a "sand screen" and a "sand dryer with stove" were also present. The narrower end contained an "old locomotive boiler" for making steam for heating. This boiler also supplied steam to the adjacent freight house (Corey et al. 1999:61).

...One other valuation form, dated September 11, 1917, exists for the "Ash Pit" south of the old engine house. The pit for dumping ashes from locomotive fireboxes consisted of a rectangular pit 26 feet in depth with stone and brick sidewalls carrying the rails. A depressed parallel track passed along one side of the ash pit next to a timber retaining wall about 54 feet in length and 3 feet in height; this set up was apparently used for loading the ash onto a car for removal (Corey et al. 1999:61).

A 1917 valuation form for the turntable has not been discovered. Nevertheless, a contemporary 1918 "Record of Property Changes" exists for the Burlington turntable(s). This form provides some information about the materials incorporated in the turntable and pit, although it does not give the length of the turntable itself. The stonewall encircling the pit consisted of 213 cubic yards of "2nd Class Masonry," and a granite center stone of six cubic yards supported the turntable at its midpoint. A quantity of chestnut piling existed within the structure, whose site lies barely 5 feet above the water level

of adjacent Lake Champlain. The turntable itself was constructed of structural steel. A manually operated "Armstrong" type of turntable with oak levers, it traveled on a steel circle rail laid on wood ties around the perimeter of the pit. According to this form, this turntable was retired on April 14, 1918, indicating that it continued in service at least several months after the fire destroyed the roundhouse (Corey et al. 1999:61).

The Rutland and Burlington Railroad developed a new engine terminal at the Burlington yard, one designed to accommodate the longer and heavier locomotives.

A new brick roundhouse with seven locomotive stalls, each 95 feet in length, was constructed directly across the freight yard at the shore of Lake Champlain. A new steel turntable 90 feet in length and driven by an electric tractor was installed at the south front of the roundhouse. According to the same "Record of Property Changes," both the new engine house and turntable were placed in service on April 14, 1918. The next Sanborn Fire Insurance map, issued a year later in May 1919, documents the removal and/or burial of the remnants of the original roundhouse and turntable (Corey et al. 1999:61 and 63).

Archaeological Data Recovery

During Phase IB archaeological investigations, backhoe trenching conducted within the area of the turntable pit identified subsurface remains of the pit wall. Subsequent Phase II archaeological excavations identified intact remains of the engine's house foundation, floor, and maintenance pits approximately one foot below surface fill material.

Corey et al. reported as follows in 1999:

The perimeter foundation constructed of mortared cut stone encloses an interior brick floor whose existence was not previously known. The maintenance pits extend the length of each locomotive stall, and are also lined with brick. The circular perimeter wall of the turntable pit is also constructed of mortared cut stone. The subsurface evidence appears to conform to the information contained in the 1917 valuation forms prepared by the Rutland Railroad (Corey et al. 1999:63).

Conclusions

Archaeological investigations have confirmed that a substantial amount of the 1851 foundation remnants of the original Rutland and Burlington Railroad engine house are preserved beneath the current railyard. Thus, the Rail site preserves the structural remnants of one of the earliest railroad terminal facilities in Vermont. The Rutland and Burlington Railroad facility possesses outstanding historic significance for representing the initial development of Vermont's

railroad industry in general and more specifically, the early development of Burlington (Corey et al. 1999).

Raritan & Delaware Bay Railroad, Lakehurst Borough, NJ 1854 – 1936

Archaeological investigations were conducted at the Lakehurst Shops and Torrey-Cox-Cunningham House, Block 70, Lot 13 and Block 62, Lot 19 of the former Raritan & Delaware Bay Railroad yard in 1987 through 1988 (Perazio) and completed in 2006 and 2007 (Tomaso). The site is located within the Borough of Lakehurst in Ocean County, New Jersey.

On Block 70, documentary research and subsurface testing identified remains of the Lakehurst Shops, originally constructed in the 1860s as the central repair facility for the Raritan & Delaware Bay Railroad. On Block 62, testing uncovered archaeological deposits reflecting the occupation of the Torrey-Cox-Cunningham house, part of the worker housing built by William Torrey to house railroad employees (Perazio et al. 2007).

Because the questions posed for this review relate only to the relevance of roundhouses or engine terminals, for the purposes of this current review, only the Lakehurst Shops complex has been summarized to answer the historic context questions.

Historic Background

The Lakehurst Shops and Torrey-Cox-Cunningham house were built in the 1860s by William Torrey. By the mid-nineteenth century, Torrey had been harvesting wood from the extensive woodlands around the area in order to make charcoal on his expansive forested land holdings, and had proposed to develop a railroad line that would allow for the export of forest products from Southern New Jersey (Perazio et al. 2007:19).

Eventually, his plans came to fruition, and the Lakehurst Shops and its associated facilities made Lakehurst an important component of the early southern New Jersey over-land transportation network.

Additionally, Torrey established a brick factory in Lakehurst that took advantage of local clay deposits for the construction of local buildings, including portions of the Lakehurst Shops. Torrey's improvised rail line, which for a time used mules to pull the charcoal-laden cars to Toms River, became the basis of his later creation, the Raritan and Delaware Bay Railroad (Perazio et al. 2007:19 and 26).

The Torrey family never realized their ultimate goal of creating a major rail hub at Manchester/Lakehurst. Torrey had established the car shop complex at Lakehurst – using a large international bank loan – as part of his overall effort to spur development of northern Ocean County. Though unsuccessful

in establishing a major rail link between the region's two metropolises, Torrey did manage to create a rail line linking the Pinelands region to the markets for its forest products (Perazio et al. 2007:29, citing to Lane 1939).

The Lakehurst facility construction appears to have begun in 1862.

The machine shop, blacksmith shop, boiler and tin shop, two-stall engine house and turntable were reportedly finished in 1863. Expansion of the facility is supposed to have begun in October 1870. It does not appear to have achieved its mature form until sometime in 1872 (Perazio et al. 2007:58).

The first graphic representation of the shops is provided by an 1868 Barber and Howe woodcut. The striking difference between the woodcut and the historical record is the absence of the roundhouse. In its place, adjacent to the shop buildings, is what appears to be a single-stall engine house. Also absent from the woodcut is the turntable (Perazio et al. 2007). However,

by 1872, the full complex of buildings, including the eight-stall roundhouse, had been erected and remained essentially unchanged until sometime between 1911 and 1931. The roundhouse and turntable were demolished between 1929 and 1931 but the shop buildings remained standing and in use for sometime after. The date of final demolition is uncertain (Perazio et al. 2007:60).

Research Questions

The research design for the archaeological data recovery effort was developed by Perazio in 1988 and focused on interpretation of the technical evolution of the shops complex. The goal of the research was to identify the capabilities of the Lakehurst Shops during the earlier stage of their existence and this included the worker house in the overall evaluation of the day-to-day lives of the occupants. Documentary evidence appeared to indicate that relatively little modernization at the facility had taken place during its operating life. This may be due to the marginality of the route and its relatively low economic importance. However, the lack of modernization provided the opportunity to examine the facility much as it originally existed. As the main repair facility for a line that was largely marginalized from the main railroad systems of the time, self-sufficiency would have been important. On the other hand, a high level of independence would have required a great investment in technology that may have been beyond the financial capability of the company. Therefore, it was of prime importance to determine as thoroughly as possible what the facility could and could not do with regard to the servicing of steam locomotives (Perazio et al. 2007).

The 1988 research design posed the following questions:

1. "What alterations were made to the Lakehurst Shops facilities over their approximately 67-year existence?"

2. "To what extent does archaeological evidence suggest functional specialization among the roundhouse stalls? Can the nature of the specialized functions be discerned?"
3. "Could the shops fabricate boilers, wheels or other large items requiring large bars of metal?"
4. "Did the shops have an air blast for the forge?"
5. "Did the shops repair both locomotives and cars? Did this change over the years?"
6. "Where did iron and steel stock come from?" (Perazio et al. 2007).

Findings

Background Historical Research

The insurance maps provide only the external outlines of the buildings and turntable along with notations about construction material, fire fighting facilities, and a few other items. The details of the internal organization of these facilities are not indicated and this information is not available from other comparable facilities in the region. Therefore, an important goal of the investigation was to record the internal structural characteristics of each of the three main components of the complex and to interpret them functionally (Perazio et al. 2007).

The Lakehurst complex contained a total of eight stalls by 1872 (Perazio et al. 2007, citing to Flagg and Schopp 1989).

...Once inside a repair stall, engines could be inspected from underneath by railroad repair workers. Minor repairs could be made in the stall immediately; for more extensive work, shop personnel could fabricate new parts in nearby shop buildings, which included a machine shop, blacksmith shop, and tin shop. Power to drive shop machinery was generated by a centrally located stationary steam engine (Perazio et al. 2007, citing to Flagg and Schopp 1989).

This single steam engine was in turn powered by a set of boilers that had an approximate lifespan of 20–30 years of active service. With power supplied by boilers, the stationary engine powered a set of overhead shafts running throughout various shops and among the buildings. Individual machines and tools could be started, stopped, and otherwise regulated by the application of power via leather belts that were attached to this system of overhead shafts (Perazio et al. 2007:34, citing to Flagg and Schopp 1989).

The boilers in use at the Lakehurst shop complex might have resembled the machinery available from an Atlas Engine Works catalog of the 1870s. However, in the shop complex's later years, the boilers in use had been taken from out-of-service locomotives and converted for use powering shop machinery. One boiler was removed from the 1903 wreck of a 4-4-0

engine; this refitted boiler provided power at Lakehurst until 1922 (Flagg and Schopp 1989; Perazio et al. 2007).

This engine was in turn replaced by a similarly converted locomotive boiler, which was used from 1922 until 1935. The use of such converted boilers at Lakehurst indicates fairly ancillary operation – most active shop complexes on busy rail lines would have invested in regular stationary steam boilers (Perazio et al. 2007:34 and 36, citing to Flagg and Schopp 1989).

The main stationary steam engine at the Lakehurst Shop complex was a 50-horsepower horizontal slide valve engine built by New York Steam Engine in 1864 (Perazio et al. 2007:36, citing to ICC 1916).

This was most likely the original engine installed when the shops were constructed. The 1870 National Industrial Census, however, lists a 40-horsepower engine at the shop complex. It is possible that the engine was modified to give more power between 1870 and 1916. This engine turned a large flywheel, most likely with a pulley, that ran in a trench next to the engine. The Lakehurst engine was located in a wedge-shaped room between the roundhouse and the machine shop. The 1874 property list refers to one large and one small stationary engine, each with its own boiler. The smaller of these engines was most likely used to power the car shop or a water pump (Perazio et al. 2007:36).

The foundations of such steam engines needed not only to support the mass of the engine but to preserve its alignment while absorbing the vibrations of its moving parts. They were consequently constructed in large single masses, when possible, with small tunnels left through the foundation to allow access to the bolts with which the machines were attached to the masonry (Perazio et al. 2007:36, citing to Swingle 1910).

In addition to the steam engine, the Lakehurst engine (or boiler) room contained a water pump to maintain pressure in the water lines throughout the shop. Sanborn maps from 1931 indicate that water for the Lakehurst complex was secured via pump from both a well and via main from the nearby lake (Perazio et al. 2007:36).

Larger shop complexes on busier railway lines included foundry facilities for melting iron. Smaller shops, like Lakehurst, however, were more often equipped only to manufacture brass castings. The ICC records for 1916 do not record foundry equipment for Lakehurst; these shops most likely were able to manufacture brass in furnaces set into the floor and fueled by charcoal or anthracite. Once brass was melted in the crucibles of such furnaces, the crucibles were raised from the floor pit and molten metal poured into iron molds (Perazio et al. 2007:36, citing to Flagg and Schopp 1989).

The shop complex also included a blacksmithing facility, responsible for forging heat-softened metal parts into needed shapes. For example, boiler flues were renewed by the shops' blacksmiths, who were capable of operating Lakehurst's trip hammers, clamps, forges, heating plates, and series of small smithing tools (Perazio et al. 2007:36, citing to Flagg and Schopp 1989).

Typical railroad smith shops of the era included one-man hand forges arranged in rows along one shop wall, at least fifteen feet apart. These forges were erected a small distance from the walls themselves, with space in front reserved for working hot metal on anvils or under a steam-powered hammer. The tops of such blacksmith forges were typically two feet above the floor, and each was equipped with a nearby anvil (Perazio et al. 2007:36 and 41).

After 1880, the Lakehurst blacksmiths were equipped with four such brick forges, which were furnished with a supply of compressed air ("the blast") used to regulate temperatures. The blast was usually supplied via delivery pipes from a central blower, sometimes located in the power house. At Lakehurst, air appears to have been supplied by a buffalo forge blower located in the nearby tin shop and connected by ceramic tubing to the blacksmith shop (Perazio et al. 2007:41).

Railroad blacksmith shops were typically vented via cupolas built into shop roofs, with all smoke and gas passing through them. Fuel at mid-century had been coal or coke; after the turn of the twentieth century, oil, which produced an even, controllable heat, was more commonly in use. Railroad blacksmith shops of the nineteenth century would have been equipped with steam hammers as well (Perazio et al. 2007:41).

The tin shop, which housed the complex's forge blower, produced thin sheets of metal for use in construction and repair of railroad facilities.

By 1916, the Lakehurst tin shop included a machinist's brake (used to bend metal), punching machines, anvils, a shearing machine, a grindstone, an 18-inch circular saw, and a circular forge. The largest of these tin shop machines was the double punch and shear, which punches holes in sheet metal. Such machines were substantial in size, weighing typically between 6 and 10 tons, and required substantial foundations (Perazio et al. 2007:41).

In 1916, the Lakehurst roundhouse was 57.5 feet deep at its end walls. Each panel (side) of the back wall was 30 feet in length, with the exception of the first stall...which was used for a through track to the rear of the roundhouse...According to the ICC valuation of 1916, these walls were constructed of brick, on rubble foundation, with common bond in lime mortar. The roof was supported by these walls and by 8-by-8-inch posts on 14-foot centers longitudinally and 25 feet transversely. Bracing consisted of two 6-by-6-inch pieces at each post. Rafters were 3 inches by 14 inches on 2-foot centers. Flooring consisted of 2-inch planks (Perazio et al. 2007:44).

...Engine doors were double swing doors of tongue-and-groove boards, each hinged to a 5-inch by 12-inch by 16-foot-long "I" beam. Each beam had a middle panel consisting of glass, modified from semicircular top to rectangular top circa 1900. The roundhouse windows had stone lintels and sills, and were double hung. Each window was protected by four round, 1-inch iron bars mounted on the exterior. The roundhouses were ventilated by six cast iron smoke jacks; Stall 8 (the through stall) and one other stall were unventilated (Perazio et al. 2007:44).

Drainage was a key feature of roundhouse design and to a lesser extent, shop buildings. Special attention was given to drains designed to carry away

encrustations cleaned from boilers, and the pit of each roundhouse stall was connected to a drainage system. Frequently, these pits would be designed simply to collect runoff and then drain into circumferential sewers. Water for each stall was supplied by several hydrants, located at intervals between stalls. Water pipes at Lakehurst seem to have been cast iron, and ranged in size from 1 ½ inches to 4 inches in diameter. These were buried an average of 3.5 feet, according to ICC valuation (Perazio et al. 2007:44 and 45, citing to ICC 1916).

Steam was also supplied directly to roundhouse stalls, and was used in cleaning to fire up boilers in completed or repaired engines, and to heat the stall itself. Steam pipes were generally installed around the walls of the stalls' service pits, enabling them to be used to hasten thawing of frozen or snow-encrusted engines. In the first decades of the twentieth century, most roundhouse stalls had lines installed for electricity and compressed air; such an air pump was installed at Lakehurst in 1909 (Perazio et al. 2007:45).

The sunken service pits between the rails of each roundhouse stall provided repair crews access to the underside of locomotive engines. At Lakehurst, these pits were comparatively shallow: they were approximately 2 to 2.5 feet deep from the top of the running rail to the floor of the pit. Though relatively shallow, this depth was not uncommon; typical late nineteenth century locomotives of the 4-4-0 type would have been easy to service from pits of these dimensions. However, later freight engines of the 2-8-0 type would have been difficult to service from Lakehurst's pits (Perazio et al. 2007:45).

In 1916, the Lakehurst turntable used to direct engines for service in a given stall was steel. It was a girder type, 50 inches in height at the center, tapering to 20 inches at the ends. It was 50 feet in length, as was the original turntable, but the 1916 version was likely a replacement, since most 1860s-vintage turntables were constructed of either wood, cast iron, or wrought iron. Lakehurst's 1916 turntable was described as 'third hand,' indicating that it had probably been moved to the site from another location, possibly the railroad's main shops at Elizabethport (Perazio et al. 2007:45, citing to Baer et al. 1994).

The turntable bridge included a 7.5-foot walkway; the turntable itself rotated on a cast iron center pivot, and rested on a stone foundation slab 6 by 6 by 5 feet. The turntable pit wall was constructed of masonry capped by an 8-by-12-inch timber, and the pit floor was of brick near the pit wall and dirt. This floor contained both a 24-inch brick drain and a wooden box drain (Perazio et al. 2007:45).

The front wall of the Lakehurst roundhouse was built relatively close to the pit wall of this 50-foot turntable, making it impossible to significantly lengthen the table to accommodate larger, more modern locomotives. Given the rail line's relatively sparse traffic, larger locomotives were not needed for many years and the Lakehurst shop complex remained useful as a regional repair center despite its relative obsolescence until the late 1920s. The roundhouse was eventually abandoned in 1929, and demolished by 1931. The Central Railroad closed the entire Lakehurst shop complex in 1935 (Perazio et al. 2007:45, citing to Baer et al. 1994).

Archaeological Data Recovery

Questions 3 – 6 from the 1988 research design could not be adequately addressed with information from the archaeological data recovery. No evidence of a steam hammer was found, and only one item potentially indicative of the raw material used in the blacksmith shop was located. No conclusive evidence of an air blast mechanism was located. Although there is no reason to believe that the shops complex could not repair cars in addition to locomotives, no clear data relating to these functions were recovered. Finally, neither the documentary evidence nor any of the metallic waste or the single block of possible raw material indicated their place of origin (Perazio et al. 2007:200).

Conclusions

The Lakehurst shops complex, built 1863-1872, experienced a brief flurry of expansion, increased specialization and attendant architectural alterations early in its history. New buildings were added, older buildings were altered, and, presumably, newer and better machines and drainage systems were deployed. However, after this late nineteenth century expansion, the shops appear to have remained more-or-less unchanged throughout the remainder of their ca. 70 year history. The period exhibiting the greatest amount of change corresponds with the latter portion of William Torrey's administration of the shops complex. Later proprietors did not apparently share in his vision of unlimited economic expansion for the area of Lakehurst, and, indeed their more pessimistic outlook, whether tautologically or prophetically, played out more accurately than his own. Whether or not later owners and operators wished to expand the shops operations, the economic incentive does not appear to have been adequate to the task (Perazio et al. 2007).

Delaware, Lackawanna & Western Railroad, Scranton, PA 1855 – 1967

Archaeological investigations were conducted at the former DL&W Railroad yard in 1988 through 1989 (Zitzler) and in 1989 through 1995 (LBA 1997).

In 1986, a significant portion of the former DL&W Scranton railyard was designated the Steamtown National Historic Site (Steamtown) and Steamtown was listed on the National Register of Historic Places. In 1988, an archaeological evaluation and testing program was conducted at the Steamtown roundhouse complex (Zitzler 1989). In 1990, an archaeological data recovery program was conducted on portions of the 1865-1967 roundhouse complex in advance of the construction of two exhibit buildings within the site (LeeDecker 1991).

Historic Background

The Scranton railyard was founded initially to haul iron products manufactured at local ironworks. As the railroad grew and the local economy changed, anthracite coal replaced iron products as the principal freight and in 1853, the DL&W Railroad was born. The DL&W operated on approximately 1,000 miles of track between Hoboken, New Jersey and Buffalo, New York. The Scranton railyard gradually evolved into the principal repair facility of the line. Throughout the late nineteenth and early twentieth centuries, tracks, shops, and several roundhouses were built and rebuilt to meet the increasing repair needs of the railroad (Zitzler 1989).

Research Questions

The primary goal of the 1988 archaeological investigation was the collection of data about the evolution of the Scranton yard's roundhouse. Specific research questions focused on the nature and extent of the foundations of the roundhouse, turntable, and transfer table. Other research concerns included collection of information relating to features of the roundhouse and turntable such as drains, inspection pits, and work areas (Zitzler 1989).

The primary goal of the 1991 Louis Berger & Associates (LBA) archaeological investigations was the exposure, excavation, and recordation of structural remains and deposits associated with the 1865-1937 roundhouse complex. Work was focused primarily on the locomotive stalls within the roundhouse structure(s), as the turntable pit had been previously tested (LeeDecker 1991).

Findings

Historic Background Research

Although not a part of the 1988 study area,

the first roundhouse constructed at the Scranton yards was erected in 1855. This brick building, located immediately northwest of the 1851 shop building, measured 225 feet in diameter and contained thirty engine stalls. A turntable probably occupied the space at the center of the roundhouse, which was covered by a domed roof approximately ninety-eight feet tall. This dome was removed because of settling in 1865 (Milner et al. 1989:24, citing to NPS n.d.:2-3;).

In 1864, the DL&W purchased a tract of land between Washington Avenue and Cliff Street with the intention of expanding the Scranton yards. This expansion included the construction, begun in April 1865, of a new roundhouse, sixty-six-foot turntable, and machine shop located on the site of the present facility. The new roundhouse measured three hundred feet in

diameter and contained forty stalls, each with sixty-seven feet under cover. The front façade, facing the turntable, was constructed of cast iron, while the rear and side walls were of brick (Milner et al. 1989:24, citing to Anonymous 1867-1868).

...The new roundhouse had a slate roof supported by iron rafters, white pine purlins, and matched pine roof boards. A circa 1883 photograph of the Scranton yards shows a steeply pitched roundhouse roof. DL&W corporate records indicate that the building had at least seventy-one windows, three round-headed doors, and forty-three double doors with sash. The discrepancy between the building's forty stalls and forty-three doors is unresolved but may refer to provisions for through-passage at certain stalls. A marble building plaque, carved with the inscription 'D.L. & W.R.R. 1865,' was placed above the roundhouse's main entry (Milner et al. 1989:24-25, citing to DL&W corporate records).

...Between 1900 and 1902, virtually the entire main line was rebuilt, including bridges, yards, and stations" (Milner et al. 1989:25, citing to Railway Age 1901 and 1902).

...The introduction of larger, heavier, and more modern locomotives necessitated the construction of a new roundhouse at the Scranton yards, and in early 1902 both the 1865 and the 1855 roundhouses, as well as the 1855 turntable, were demolished. Work began almost immediately upon a new roundhouse in the same location as the 1865 facility. By August 1902 the new roundhouse was half completed. The 348-foot-diameter brick building contained forty-five enclosed stalls, each with seventy-nine feet under cover. The building had a shallow gabled roof with a glazed and louvered roof monitor. Smoke jacks, designed to exhaust the locomotives' steam and stack gases, were suspended from the wood roof structure at the head of each stall. The rear façade of the building contained a segmentally arched, 12/12 double-hung window centered at the end of the majority of the stalls. Some stall end walls were fitted with glazed personnel doors with multiple light transoms. Historic photographs indicate two entry tracks leading into the roundhouse from the northwest, and a covered exit track located in the northeast quadrant of the building" (Milner et al. 1989:25-26).

...Locomotives entered the roundhouse complex via one of the entry tracks and were turned into the desired stall by a sixty-six-foot diameter electrically operated Lassig Company Turntable. This turntable replaced a Sellers Company unit of the same dimensions that was installed in 1899 and had replaced the original 1865 unit (Milner et al. 1989:26, citing to Railway Age 1902).

...Interior equipment within the new roundhouse included cranes mounted on wood roof support columns. A single crane served two stalls, each of which was provided with its own inspection or work pit. The cranes were used to remove steam chests, pistons, covers, heads, and other locomotive parts for servicing and repair. Coburn travelers located above each pit facilitated the movement of locomotive parts throughout the roundhouse (Milner et al. 1989:27, citing to Railway Age 1902).

...The first documented alterations to the roundhouse and turntable occurred in 1910. Thirty-six of the original wooden stall doors were replaced by new double steel doors (Milner et al. 1989:27, citing to DL&W corporate papers, Authorities for Expenditures Books, Jan. 20, 1910).

...Major alterations to both the roundhouse and turntable occurred in 1912...The work involved lengthening twelve roundhouse stalls (Nos. 35-46) by eleven feet to provide ninety feet under cover. The work pits in each stall were extended five feet at their front end and fourteen feet at their rear, making them nearly eighty feet long. The new end walls for these twelve stalls were each fitted with large, five-part windows, each part consisting of 15/12/15 light sash. These windows occupied almost the entire end wall of each stall. Dry joints were incorporated into these walls in order to reduce the potential for structural damage caused by a locomotive colliding with the wall. This construction detail was common in many roundhouses and engine houses constructed during this period (Milner et al. 1989:28, citing to Ray and Nils 1912, DL&W drawings).

The existing roof deck, roofing, and monitor were removed from the lengthened stalls and replaced with new decking, composition roofing, and a large twenty-six-foot deep monitor. Alternating panels of wood louvers and glazed sash occupied the vertical walls of the monitor. The roof was also raised slightly at this time (Milner et al. 1989:28, citing to Ray and Nils 1912, DL&W drawings).

The sixty-six foot turntable was removed in 1912 and replaced with a new ninety-foot American Bridge Company roller bearing unit with a 'Type D' center. A new, reinforced concrete turntable pit consisting of a massive perimeter wall and center base, the latter measuring thirteen feet six inches square, with a sloped floor comprised of numerous concrete slabs was also installed. The pit rail on which the turntable bridge rode was located forty-three feet nine inches from the center point and consisted of 275 linear feet of eighty-pound rail supported on seventy-eight creosoted wood ties. Construction of the pit required 415 cubic yards of concrete and 575 feet of old seventy-five-pound rail, which was used to reinforce the inner face of the perimeter wall. The pit was drained by means of an eight-inch diameter terra cotta pipe that ran from the center of the pit through the roundhouse, between stalls No. 18 and 19, to a twelve-inch diameter terra cotta pipe located beneath a transfer table located between the roundhouse and the erecting shop, and thence south to the Lackawanna River (Milner et al. 1989:28, citing to Roy and Deal 1912, DL&W drawings).

...The American Bridge Company designed the new turntable bridge. This unit consisted of two tapered main girders built up from steel plates and angles and reinforced by steel X-bracing. The rails that carried the locomotives were mounted directly atop these girders. The turntable had a design capacity of five hundred tons (Milner et al. 1989:29).

In 1915 the roundhouse underwent another series of repairs and alterations. Twenty-two stalls, probably Nos. 1-22, received new "Paroid" roofing. Damaged and deteriorated timber elements within these stalls were replaced or repaired (Milner et al. 1989:29; citing to DL&W drawings; DL&W corporate papers, Authorities for Expenditures Books, March 22, 1915). Twelve additional stalls in the roundhouse (probably Nos. 23-34) were lengthened

by eleven feet to provide ninety feet under cover. The roof above these stalls consisted of slag with copper flashings. These enlargements were completed by January 1916 (Milner et al. 1989:30).

...In September 1917, a fire destroyed twenty-one stalls, approximately Nos. 25-46, in the roundhouse. Photographs taken shortly after the blaze indicate that the fire completely destroyed the roof and sash, leaving only the charred heavy timber framing and the brick walls intact. Reconstruction of the damaged roundhouse began almost immediately. As part of this work, brick firewalls were constructed at intervals (between stalls Nos. 7 and 8, 11 and 12, 25 and 26, and 36 and 37) within the building. The reconstruction work also included new steel doors, twelve concrete and nine transite asbestos smoke jacks, and "Ruberoid" roofing (Milner et al. 1989:30, citing to DL&W corporate records, Authorities for Expenditures Books, October 23, 1917).

Available historical records do not indicate that the roundhouse and turntable complex experienced any significant changes between 1917 and 1926. A 1919 fire insurance map indicates that the roof above the northeast exit track was removed sometime prior to that date. The map also indicates the presence of a composition roof, confirming the references to proprietary roofs of this type, such as "Paroid" and "Ruberoid" contained in the corporate accounts of alterations and improvements (Milner et al. 1989:30-31, citing to Sanborn Map & Publishing Company 1919).

In late 1926 the DL&W replaced the existing turntable at the Scranton yards with a new unit designed to accommodate heavier locomotives. The American Bridge Company's Ambridge, Pennsylvania plant fabricated the new ninety-foot Standard Continuous Deck Turntable, which was fitted with a "Type H" center. The unit could accommodate a locomotive weighing up to 325 tons. Two 25-horsepower Westinghouse Type-K electric motors drove the turntable. These motors were controlled from a cab mounted at one end of the turntable bridge (Milner et al. 1989:31).

Installation of the new unit required alteration of the turntable pit. The pit rail was relocated ten inches closer to the center point and the outer wall of the pit was extensively underpinned with reinforced concrete. The base of the turntable center bearing was raised approximately 2 feet 4 inches by means of a concrete-filled steel casing (Milner et al. 1989:31, citing to DL&W drawings).

In 1937, the DL&W announced a major \$106,000 enlargement of the roundhouse (Milner et al. 1989:31, citing to *Scranton Times*, March 10, 1937).

These alterations:

entailed the lengthening of Stalls No. 13-42. Stall Nos. 13 and 14 were lengthened approximately forty-eight feet, providing 138 feet under cover. Stalls No. 28-31, in the vicinity of the driver drop pit, were lengthened twenty-nine feet, providing 119 feet under cover. The existing drop pit was filled and a new pit constructed to the rear of the former location. Stalls No. 15-27 and 32-42 were lengthened nineteen feet, providing 109 feet under cover. A toilet room was constructed at the rear of Stalls No. 24 and 25" (Milner et al. 1989:31-32, citing to Phillips and Mack 1937, DL&W drawings).

These alterations required the demolition of a portion of the 1902 Paint Shop and necessitated removal of the transfer table located between the roundhouse and the erecting shop. Architectural plans also suggest that Stalls No. 1-7 were demolished (Milner et al. 1989:32, citing to Phillips and Mack 1937, DL&W drawings).

The demolition of Stalls No. 1-7 appears to be closely related to the introduction of diesel locomotives at the Scranton railyards in the early 1930s (Milner et al. 1989:32, citing to *Scranton Times*, March 12, 1937). Although use of diesel equipment was initially limited to yard switching work, the new locomotives required a substantially different approach to maintenance and repair (Milner et al. 1989:32).

Major repairs to steam locomotives involved removal and replacement of worn or defective parts from below. Comparable work on the new diesels required lifting parts up and out of the locomotive. As a result, the existing roundhouse, with its low roof and limited overhead access, proved unsuitable for the requirements of diesel locomotive repair and maintenance. The demolition of Stalls No. 1-7 may have represented an acknowledgement of the inevitability of the new motive technology's affect on existing steam locomotive repair facilities. The need for a new diesel shop was apparently recognized even before the introduction of diesel locomotives to freight and passenger service in 1945, since by the end of 1944, the DL&W had begun to phase out use of the roundhouse and had started construction on a new diesel repair facility attached to and incorporating the adjacent Locomotive Erecting Shop (Milner et al. 1989:33, citing to *Railway Age* 1946:868-871).

The roundhouse and turntable complex continued to serve the needs of the DL&W's shrinking steam locomotive fleet throughout the 1950s and 1960s. Shop drawings indicate that the turntable underwent minor repairs, principally related to strengthening the bridge, in 1948, 1950, and 1967 (Milner et al. 1989:33, citing to DL&W drawings). Alterations to the roundhouse included the removal, prior to circa 1950, of most of the roof in the vicinity of Stalls No. 41 and 42, and the introduction of large openings into the side wall of Stall No. 46. Additional undocumented minor alterations to the building continued until its abandonment ca. 1967 (Milner et al. 1989:33).

Archaeological Data Recovery

The 1988 archaeological testing program at the roundhouse complex demonstrated that portions of the roundhouse structure at Steamtown remained and many architectural features were preserved in subsurface contexts. Architectural features associated with the roundhouse that were identified during this testing program included the 1912/1926 turntable pit, the 1937 driving wheel drop pit, five inspection pits associated with the 1902-37 structure, and various brick features believed to have been associated with the 1865 roundhouse (Zitzler 1989).

The results of the 1990 archaeological data recovery program identified many features of the earlier 1865 roundhouse over which the later 1902 roundhouse

was built. The overall dimensions and shape of the 1865 roundhouse have been revealed by these investigations. In addition, many architectural features such as the outer foundation wall, an interior footing, and drainage features were discovered as well as a virtually intact 1865 inspection pit. Inspection pits, drop pits, foundation elements, drainage features and machinery associated with the 1902/1937 roundhouse were also excavated and recorded (LeeDecker 1991).

Conclusions

From Zitzler's 1989 final report:

In spite of the effects of alteration and extensive deterioration, the material remains of the site, including those uncovered archaeologically and left *in situ*, provide information important to the understanding of several aspects of late nineteenth and early twentieth century industrial life, and are crucial to the interpretation of the Steamtown National Historic Site (Zitzler 1989).

The remains of the Roundhouse and Turntable and its associated features convey a vivid sense of working conditions typical to late nineteenth and early twentieth century industrial America. One aspect of these conditions as suggested by the remains is that worker safety and comfort were significantly less of a consideration than at present. Additionally, the scale of the remains and the machinery they were intended to service reflect the nature of the industrial landscape of the period (Zitzler 1989).

The archaeological remains are also significant in terms of the history and development of late nineteenth and early twentieth century transportation, commerce, industry, engineering, and architecture. Much of the story of the evolution of railroad technology, from the development of early steam locomotives to the introduction of diesels, is represented by archaeological remains associated with the Roundhouse and Turntable. The remains reveal the periodic replacement and expansion of the Roundhouse and Turntable as well as the relocation and redesign of associated facilities. Such changes were made during several different periods in response to the adoption and use of increasingly larger and more sophisticated equipment (Zitzler 1989).

Archaeological findings correspond closely to historic architectural and engineering drawings of similar facilities built for mid-sized railroads. Railroads of similar size were more common during the late nineteenth and early twentieth century than either the large trans-regional railroads or the "captive" lines associated with certain industries. Although many roundhouses and turntables of similar design were built, most have been demolished because they were obsolete or were located in commercially strategic areas. Moreover, historical and archaeological research indicates that few of the comparable facilities that remain extant contain archaeological remains of early design features that are as well preserved or as extensive as those found at Steamtown National Historic site (Zitzler 1989).

Delaware & Hudson Railroad, Mechanicville, NY 1913 -1980

Archaeological research and field investigations (Cowan 2009; Fisher and DiVirgilio 2008) and historic research (Darbee 2009) were conducted at the former D&H Railroad yard in the City of Mechanicville and Towns of Halfmoon and Stillwater, Saratoga County, New York. The site of the D&H roundhouse and turntable is located within the APE, while the B&M roundhouse, turntable, and shops were located in the same yard but outside the APE.

Historic Background

A predecessor of the D&H, the Rensselaer and Saratoga Railroad (R&S) dated from 1832 and operated in 1835 between Waterford (near Albany) and Ballston Spa, New York, passing through Mechanicville. The main line of the D&H, which ran from the Canadian border at Rouses Point, NY, through Schenectady, NY, to Binghamton, NY, and on to Wilkes-Barre, PA, passed through Ballston Spa. The D&H was known primarily as a 'bridge carrier,' generating relatively little freight traffic on its own line but receiving and dispatching significant freight volumes from connecting railroads. The line through Mechanicville eventually reached Albany and also continued westward from Albany to connect again with the main line at Delanson, NY, southwest of Schenectady (Darbee 2009:3 and 4).

D&H leased the R&S in 1871. The railroad's main passenger route went through Mechanicville to Albany, with through service to New York City and, on the north, to Montreal, Quebec. The location of the D&H station in Mechanicville was on the railroad's primary passenger route. Freight traffic was primarily along the main line via Ballston Spa, but there also was traffic that interchanged with the B&M in Mechanicville to serve points in southern New England (Darbee 2009:4).

That interchange traffic would not develop, however, until the B&M line was completed from Boston. A long delay in completing the Hoosac Tunnel in Massachusetts held back this western extension, the long route that would become the B&M's West End. The tunnel was finally completed in 1876 by the Boston, Hoosac Tunnel & Western Railroad (BHT&W). The line through Mechanicville to Rotterdam Junction and its connection to the New

York Central system opened in 1877. What would become the B&M opened shortly after completion of the Hoosac Tunnel in the late 1870s. At this time, the BHT&W still owned this line. It was absorbed in 1887 by the Fitchburg Railroad, which constituted most of the route to Boston, and the B&M acquired the Fitchburg in 1900 (Darbee 2009:4).

Local topography and the D&H alignment through Mechanicville were such that the B&M was forced to make a sharp westward curve and then cross the D&H at grade in order to continue westward toward Rotterdam Junction. "XO" Tower controlled this crossing and associated connecting tracks. The D&H and the B&M established interchange trackage and facilities in the late 19th century. The ca.1880 bird's-eye view of the area of the area of the Former Mechanicville Yards contained in Hartgen's Phase IA (Map 9) shows trains running on through tracks, but few yard facilities and no evidence of engine servicing facilities. When these did develop, the B&M's yard tracks dominated the area, while the D&H's yard was much smaller, consisting of several tracks along the north side of and parallel to the B&M. The D&H engine terminal was located on the north side of the D&H tracks, and the B&M engine terminal was located on the south side of its tracks (Darbee 2009:4).

...The B&M track chart shows land parcel acquisition between 1906 and 1908 in the area where the B&M engine terminal was built, and the ICC valuation records show numerous structures being built in the area on the east end of the Former Mechanicville Yards over the period between approximately 1900 and 1915. A *Railway Age Gazette* article, dated October 24, 1913, describes in detail the construction of the B&M Engine Terminal at Mechanicville and refers to the D&H's engine terminal at Mechanicville as "new," thereby indicating that both the D&H and B&M engine terminals were constructed in or just before 1913 (Darbee 2009:4 and 5).

The engine terminal at the D&H yard in Mechanicville was built in 1913, late in time in terms of innovations regarding steam locomotion which had matured in the 19th century. This engine terminal was new construction, unlike the other facilities studied in this literature review, and did not replace an earlier roundhouse or turntable in response to changed technological needs. The size of steam locomotives continued to evolve in the 20th century, and J-class articulated 4-6-4 steam locomotives were introduced to the D&H in 1944. Because the 1913-vintage 100 foot turntable at the D&H engine terminal at Mechanicville was too short for these articulated locomotives, the turntable was replaced in the late 1940s by a wye track, and two of the four roundhouse stalls were deepened to accommodate the longer locomotives. The D&H completed its conversion from steam to the more efficient diesel locomotive power by 1953 (Shaughnessy 2009).

During its peak period of activity, from the end of World War II into the late 1960s, the [D&H and B&M yards in Mechanicville] were at their greatest level of development. The roughly half-dozen tracks on the north side were the D&H's, including several additional tracks at the east end called the 'Old Yard.' Toward the west end of the D&H's yard tracks, at the northwestern edge of the [yard], was the D&H engine terminal. The D&H's yard was a 'flat' yard, lacking a hump, so all switching of cars was done with locomotives (Darbee 2009:5).

The D&H engine terminal included a turntable, a roundhouse with two to four stalls, a water tower, and four additional structures, likely a sand house (for drying sand to be loaded onto engines to drop on the track for traction), an office, storage buildings. All of the structures that comprised the D&H engine terminal were demolished by the end of the 1980s. As explained in more detail below, the D&H engine terminal was considerably smaller than the B&M engine terminal at the Former Mechanicville Yards (Darbee 2009:5).

The B&M yard was more complex than that of the D&H, reflecting its far more important role as the principal facility on the B&M's West End. At the west end of the B&M yard was the B&M receiving yard, where freight trains coming from east, west, north, or south dropped cars for classification. East of the receiving yard was the B&M hump and east of the hump were the B&M classification tracks, where cars were sorted by gravity into groups of cars headed to the same destination. South of the B&M hump was a car shop, where damaged cars could be switched out for repairs. Near the east end of the B&M yard was the B&M engine terminal (Darbee 2009:5).

The B&M engine terminal included:

a power house that provided power for the engine terminal and the rest of the yard; coal and water facilities for steam locomotives, including a 100,000 gallon water tank and a 50 ton "coal pocket" for loading coal into locomotives tenders; a 110 foot turntable; a 24-stall roundhouse; a machine shop or backshop where heavy locomotive repairs could be made; a car repair shop; an icing facility for refrigerator cars; two oil pump houses and an oil sump for used oil; a steel storage tank for fuel oil; and various buildings for personnel or storage...Immediately east of the B&M yard, at the grade crossing of the B&M and the D&H, a connecting track enabled D&H trains to enter or leave the B&M yard with interchange traffic; B&M crews could also use this connection to deliver or pick up cars in the D&H yard (Darbee 2009:5).

Neither the D&H nor the B&M yards and engine terminals were static. Change was a constant as railroad locomotive power changed from steam to diesel; as older buildings wore out or became obsolete and were replaced by new ones; as traffic mix and quantities changed; and as the northeastern rail map was remade during a period of railroad bankruptcies and reorganizations. As late as the mid-1970s, the D&H and the B&M handled more than a dozen trains each at [their respective yards in] Mechanicville on a daily basis, but further changes in traffic and changes in operating procedures that minimized the need for intermediate classification at both [the D&H and B&M yards] led to the retirement and demolition of the yards (Darbee 2009:5 and 6).

Research Questions

During the 2008 Phase IA archaeological investigations conducted at the D&H Mechanicville site, no surficial archaeological evidence of the repair facility was identified. No subsurface archaeological investigations were conducted because Hartgen Archeological Associates, Inc. concluded that most of the APE was substantially disturbed both by the installation of the extensive former

Mechanicville rail yards of the D&H and the B&M in the late nineteenth and early twentieth centuries and by the subsequent dismantling of the former rail yards at Mechanicville in more recent years (Cowan and Glazer 2009). Due to the obvious and intensive disturbance to the rail yards and to the shallow nature of soils within the APE, the Phase IA report concluded that there was little chance that potential archaeological deposits would be preserved within the rail yards. Therefore, the report recommended no Phase IB field reconnaissance within that area (Cowan 2009).

The Rensselaer and Saratoga Railroad Company right-of-way and track map (1916, revised 1979) depicted a four-stall roundhouse on the north side of the D&H tracks (Fisher and DiVirgilio 2008, Valuation Map 12b). The 1929 15-minute USGS Cohoes topographic map depicts the rail line with four associated buildings dating from the 20th century (Fisher and DiVirgilio 2008, Map 10). Those 20th century structures have since been removed and the area is highly disturbed. In 1994, the NY State Museum conducted a cultural resource survey and test excavation on the north side of the D&H portion of the former rail yards at Mechanicville within a bend on the south side of the Anthony Kill River. The shovel test excavations identified an area that corroborated information from a 1916 railroad map identifying the area as a former ash track and ash dump (Fisher and DiVirgilio 2008, citing to NYAC 1994).

Subsequent historic research conducted by Darbee (2009) focused on the history of the D&H locomotive servicing facility, i.e., the engine terminal, at Mechanicville and its context within the general development of railroad technology.

Findings

Historic Background Research

According to a *Railway Age Gazette* article dated October 24, 1913, construction of the D&H engine terminal was completed in 1913. The D&H engine terminal was located near the northwestern end of the railyards in Mechanicville, approximately 1.5 miles northwest of the B&M engine terminal (Fisher and DiVirgilio 2008, Valuation Map 12b). The D&H engine terminal was significantly smaller than the B&M engine terminal.

A large northward loop in the Anthony Kill at the northwestern point created a peninsula large enough to accommodate the D&H engine terminal and a wye track, which was used for turning locomotives too large to fit on the turntable adjacent to the D&H roundhouse. The D&H engine terminal included a turntable, a roundhouse with two to four stalls (versus the 24 stalls in the B&M's much larger engine terminal roundhouse), and four additional structures, likely a sandhouse (for drying sand to be loaded onto engines to drop on the track for traction), an office, and storage buildings. At one time there was also a water tower, which supplied water to the steam engines, but it appears from historical maps

and track charts that the water tower had been removed prior to 1954, possibly coincident with D&H's retirement of its last steam engine in mid-1953 (Darbee 2009:7).

Facilities such as offices, storage sheds, and sand houses were built without foundations; the ICC valuation records for the B&M engine terminal, for example, noted many buildings that were supported simply by old railroad ties resting on the ground (Darbee 2009:8).

...A review of other D&H facilities within relatively close proximity of the Former Mechanicville Yards provides additional context for evaluating the relative significance of the D&H engine terminal at the Former Mechanicville Yards. The most important D&H facility was the Colonie Shops south of Watervliet, New York, which was the railroad's primary steam and diesel locomotive shop where all of the D&H locomotives went for overhaul and heavy maintenance. The D&H's main shops at Colonie were not far away from Mechanicville, so the D&H engine terminal at the Former Mechanicville Yards was used only for light running repairs and for servicing yard-switching engines and engines that only spent a brief time in Mechanicville while dropping or picking up cars going to and from the B&M. The D&H yard at Colonie Shops and all related buildings have been removed. D&H also had major engine terminals at Oneonta, New York, and Carbondale, Pennsylvania. Oneonta was midway on D&H's west end line to Binghamton and Owego, New York, while Carbondale was midway on the line from Nineveh, New York (junction with the Binghamton/Owego line) to Wilkes-Barre, Pennsylvania. Both of these D&H engine terminals had large, full-circle roundhouses (as opposed to the small two to four stalls at the D&H roundhouse in the D&H yard in the Former Mechanicville Yards), as well as other servicing facilities of a size and scale to maintain a large number of locomotives (Darbee 2009:9 and 10).

In addition to the major engine terminals at Colonie, Oneonta and Carbondale, the D&H had several other smaller engine terminals similar to its engine terminal at the Former Mechanicville Yards. These included Binghamton and Wilkes-Barre, which were close to the major terminals at Oneonta and Carbondale, and as such only had small engine terminals similar to the D&H engine terminal at the Former Mechanicville Yards. Similarly, Plattsburgh, New York, midway on D&H's line between Albany and Rouses Point, New York, on Lake Champlain, had a small engine terminal with a roundhouse having approximately six stalls. Rouses Point, New York, at the north end of the D&H at the Canadian border, had a medium-sized engine terminal since traffic was given to and received from Canadian railroads at this point. As of 2006, the Rouses Point roundhouse and turntable were the last extant from the D&H system (Darbee 2009:10).

Archaeological Data Recovery

The 2008 and 2009 archaeological studies at the former D&H Mechanicville rail yard did not identify any surficial remains of the early 20th century roundhouse and turntable. In the report, it was noted that the map-documented structure (MDS) #9, identified as the roundhouse, had been removed (Cowan 2009; Fisher and DiVirgilio 2008). In 1994, the New York State Museum conducted a cultural

resource survey and test excavation on the north side of the Mechanicville former rail yard within a bend on the south side of the Anthony Kill River, to the north of the former D&H engine terminal. The site tested in 1994 is located within the APE identified by Hartgen in its 2008 Phase IA report (Fisher and DiVirgilio 2008, Map 13b). The shovel test excavations identified the area that corroborated information from a 1916 railroad map identifying an area as a former ash track and ash dump (Fisher and DiVirgilio 2008, citing to NYAC 1994). In the Phase IB report, Cowan summarized the Phase IA findings, concluding that, "Due to the obvious and intensive disturbance to the rail yards and to the shallow nature of soils within the APE (area of potential affect), the Phase IA report concluded that there was little chance that potential archaeological deposits would be preserved within the rail yards" (Cowan 2009:2).

Conclusions

The former D&H engine terminal at the Mechanicville facility was of less importance to the D&H's operations generally, as evidenced by the existence of the larger, more complex engine servicing facilities in nearby Colonie, NY, Oneonta, NY and Carbondale, PA. Likewise, the D&H engine terminal was far smaller in size and scope than the former B&M engine terminal at Mechanicville, just south of the D&H facility. Based on written record, the D&H engine terminal was a very typical small engine terminal. The turntable, turntable pit, roundhouse, and support for the buildings and structures were of standard early 20th century construction. The contextual information regarding the D&H facilities further supports the conclusion that the D&H engine terminal at the former Mechanicville yards was a minor facility on this railroad and did not play a major role in the development, operation or maintenance of the D&H locomotive fleet (Darbee 2009).

New York State Historic Preservation Office

Research Questions

The discussion above details the research questions investigated in the archeological reviews previously conducted for each of the facilities specified by the NYSHPO in order to support the contention that the D&H Mechanicville engine terminal is likely to provide only redundant information, if any (Perazio 2009). The research questions posed in these studies focused primarily on the development of locomotive repair facilities during the mid-19th to the early 20th century, and successive changes, if any, that occurred during that time span.

1. What particular research questions relevant to locomotive repair facilities have been identified in the literature?

The Rutland & Burlington repair facility in Burlington, Vermont had available Sanborn Fire Insurance Company maps and valuation maps that detailed the repair facility complex. The archaeological research questions sought to confirm the written records in comparison to the structural remains of the roundhouse and turntable.

The research questions concerning the Raritan & Delaware Bay repair facility in Lakehurst, New Jersey were not specifically focused on the remains of the roundhouse and turntable. Instead, the questions sought to correlate the historic written record with the remains of the repair shop complex. In particular, the research questions included whether they were able to fabricate boilers, wheels, and other large items; whether they repaired both locomotives and cars; whether there were alterations to the shop complex and whether special use functions of the roundhouse stalls could be determined through the archaeological evidence.

The DL&W repair facility in Scranton, Pennsylvania had available detailed written records and engineering drawings concerning the roundhouse and turntable and associated shops and all the alterations to these structures that occurred during its time of operation. The research questions posed during the archaeological investigations were focused on data collection and confirming the written record with the structural remains of the roundhouse and turntable.

Research questions pertaining to the D&H yard in Mechanicville were identified in Darbee's historic review (2009). These questions focused on the history of the D&H locomotive servicing facility at Mechanicville and its context within the general development of railroad technology. In addition, the research identified whether other buildings within the complex may have had deep subsurface components, and whether there may remain any subsurface components of the locomotive servicing complex within the portion of the D&H yard to be developed into the Mechanicville Intermodal and Automotive Facility.

Darbee concluded

....the only potential for any subsurface remains of the D&H locomotive servicing complex are from the turntable and the roundhouse, which are structures that commonly had below-grade foundations. The turntable and the roundhouse at the D&H engine terminal shared common characteristics with many other similar railroad facilities and do not represent either early railroad technological developments or innovative or unusual railroad operating or maintenance technology. Subsurface remains, if any, would not reveal any information that could not be found in existing written, photographic, and archival records, which present a much more complete set of data than could be obtained at the site. Other structures in the D&H engine terminal -- sand house, office building, and storage buildings -- did not have conventional foundations and simply sat on the ground or on old crossties laid beneath their sills and thus would not have subsurface remains (Darbee 2009:11).

The research questions relevant to the Rutland & Burlington, Raritan & Delaware Bay, and the DL&W locomotive repair facilities that have been identified in the literature elicited information regarding the locomotive repair facilities at those yards, and in particular provided information on the roundhouses or engine terminals and development of those facilities. As such, the research questions related to the D&H engine terminal provide similar and redundant information related to the development of railroad technology generally as to such facilities.

2. Were there standard types of repair facilities or was each one custom built? How does the Mechanicville site compare with other, similar facilities?

According to the literature review, the Burlington, Lakehurst and Scranton repair facilities were built in the early 19th century before standardization of repair facilities. These three facilities were custom built to cater to the needs of the rail lines they served. Standardization seems to have been achieved by the late-19th to early-20th centuries. Meeks (1956) identified the period of 1845-1860 as characterized by standardization in railroad buildings, including roundhouses or engine terminals. Mueller et al. (1997:77) stated: "The engine house designs that *became standard* by the late nineteenth century typically included long inspection pits in each locomotive stall" [emphasis added]. By the early twentieth century, some railroads had adopted standard building plans for roundhouses (Mueller et al. 1997, citing to *Railway Master Mechanic* 1907). "The adoption of standard roundhouse blueprints would have been preceded by the emergence of basic design criteria during the mid- to late nineteenth century" (Mueller et al. 1997:68). According to *Railway Master Mechanic* (1907:202), "At the turn of the twentieth century, drop pit design had become fairly standardized."

The D&H engine terminal at Mechanicville was built in 1913 when facilities were standardized. "The turntable and the roundhouse at the D&H engine terminal shared common characteristics with many other similar railroad facilities and do not represent either early railroad technological developments or innovative or unusual railroad operating or maintenance technology" (Darbee 2009:11). The D&H engine terminal at

Mechanicville was new construction and, unlike the engine terminals at Burlington, Lakehurst, and Scranton, did not replace an earlier roundhouse or turntable in response to changed technological needs.

According to Darbee's literature review, the Mechanicville engine terminal was small in comparison to the other rail yard facilities along or near the D&H line, such as the B&M yard at Mechanicville, located just south of the D&H yard, and the D&H Colonie Shops south of Watervliet, NY. The D&H engine terminal at the Mechanicville yard was used for only light running repairs and for servicing yard-switching engines and engines that only spent a brief time in Mechanicville while dropping or picking up cars going to and from the B&M (Darbee 2009).

The D&H engine terminal [with 4 stalls] was significantly smaller than the B&M engine terminal [24 stalls]...at the southeastern end of the Former Mechanicville Yards... A large northward loop in the Anthony Kill at the northwestern point created a peninsula large enough to accommodate the D&H engine terminal and a wye track, which was used for turning locomotives too large to fit on the turntable adjacent to the D&H roundhouse (Darbee 2009).

The following table indicates the age of development and sizes of the engine terminals in the literature search.

Rail Yard	Year	# of Roundhouse Stalls	Rail Yard Shops
Rutland & Burlington Burlington, Vermont	1851- 1919	4 (1851) 7 (1918)	Blacksmith shop, joiner shop, boiler house, sand house and car house
Raritan & Delaware Bay Lakehurst New Jersey	1854- 1936	2 (1862) 8 (1872)	Machine shop, blacksmith, boiler and tin shop
Delaware, Lackawanna & Western Scranton, Pennsylvania	1855- 1967	40 (1865) 45 (1902)	Machine shop, paint shop, blacksmith & pattern shop, engine room, boiler room, foundry, locomotive erecting shop, power plant and diesel shop
Delaware & Hudson Mechanicville, New York	1913- 1980	4	No shops

Even within the D&H system, the engine terminal at Mechanicville was among the smallest.

A review of other D&H facilities within relatively close proximity of the Former Mechanicville Yards provides additional context for evaluating the relative significance of the D&H engine terminal at the Former Mechanicville Yards. The most important D&H facility was the Colonie Shops south of Watervliet, New York, which was the railroad's primary steam and diesel locomotive shop where all of the D&H locomotives went for overhaul and heavy maintenance...D&H also had major engine terminals at Oneonta, New York, and Carbondale, Pennsylvania. Oneonta was midway on D&H's west end line to Binghamton and Owego, New York, while Carbondale was midway on the line from Nineveh, New York (junction with the Binghamton/Owego line) to Wilkes-Barre, Pennsylvania. Both of these D&H engine terminals had large, full-circle roundhouses (as opposed to the small two to four stalls at the D&H roundhouse in the Former Mechanicville Yards), as well as other servicing facilities of a size and scale to maintain a large number of locomotives (Darbee 2009:9 and 10).

In addition to the major engine terminals at Colonie, Oneonta and Carbondale, the D&H had several other smaller engine terminals similar to its engine terminal at the Former Mechanicville Yards. These included Binghamton and Wilkes-Barre, which were close to the major terminals at Oneonta and Carbondale, and as such only had small engine terminals similar to the D&H engine terminal at the Former Mechanicville Yards. Similarly, Plattsburgh, New York, midway on D&H's line between Albany and Rouses Point, New York, on Lake Champlain, had a small engine terminal with a roundhouse having approximately six stalls. Rouses Point, New York, at the north end of the D&H at the Canadian border, had a medium sized engine terminal since traffic was given to and received from Canadian railroads at this point. As of 2006, the Rouses Point [6-bay medium size] roundhouse and turntable were the last extant from the D&H system. Given these larger engine terminals and other similar facilities in close proximity to the Former Mechanicville Yards, the D&H engine terminal at Mechanicville was not of primary importance to D&H's operations (Darbee 2009:10).

In conclusion, by the time the D&H engine terminal was constructed, such facilities were relatively standard in design, and differed in size according to the needs of the particular railroad system. It appears that the construction of the D&H engine terminal in Mechanicville was similar to other engine terminals, and was smaller in comparison to others on its own railroad system or other railroad systems.

3. Was size alone (i.e. number of stalls in the roundhouse) indicative of the role of a particular facility within an overall system or were other variables involved?

Generally, the number of stalls in a roundhouse does appear to be indicative of the role of a facility within an overall system. The more complex roundhouses had greater capacity and carried out the widest variety and the most complex repairs. The length of a turntable was a function of the longest locomotives in the fleet at the time of construction and was not indicative of the role of an engine terminal.

An important variable in the role that a repair facility played within a rail line system was the location of the facility. Location dictated the amount of traffic the repair facility saw and was a factor in the size of the roundhouse and the associated structures at the repair yard, such as shops that catered to more specific and elaborate repair needs.

The Rutland & Burlington railroad provided a link in the transportation of lumber from Canada to U.S. markets (Corey et al. 1999). Although the Burlington roundhouse only had four stalls, the location of the facility was within the town's developing lumber industry and received a high volume of traffic. The roundhouse and turntable were renovated to meet the increase in trains being serviced at that yard and also to accommodate the larger size of the locomotives.

By 1872, the New Jersey Raritan & Delaware Bay Lakehurst repair facility roundhouse had eight stalls. However, the front wall of the roundhouse had been built relatively close to the pit wall of the 50-foot turntable, therefore making it impossible to significantly lengthen the table to accommodate larger, more modern locomotives (Perazio et al. 2007). According to the archaeological report, the Raritan & Delaware Bay Lakehurst repair facility was not successful in becoming a "major rail hub" due to the "marginality of the route and its relatively low economic importance", and therefore the need to renovate to accommodate the larger locomotives was not an imperative (Perazio et al. 2007).

In 1865, the DL&W rail line was freighting anthracite between New Jersey and New York. At the time, its roundhouse in Scranton, PA had 40 stalls. Between 1900 and 1902 virtually the entire main line was rebuilt. The introduction of larger, heavier and modern locomotives necessitated the construction of a new roundhouse at Scranton. The 1902 roundhouse had 45 stalls and had become the principal repair facility for the line (Milner et al. 1989).

Based upon Darbee's review (2009), it appears that the size of the roundhouse at the D&H yard at Mechanicville was indicative of the level of repair work conducted at the facility. It was a small repair yard with only a four-stall roundhouse and therefore took on only light duty work. More complex work was conducted at the engine terminal at the neighboring B&M yard in Mechanicville, which had a 24-stall roundhouse, or at other D&H facilities along its rail line, such as the nearby D&H main shops at Colonie, south of Watervliet, New York. Within the D&H system, the four-stall engine terminal at Mechanicville was small in scale, indicating its minor role. The D&H system had: major, full circle engine terminals at Colonie and Oneonta, New York; medium engine terminals at Binghamton, New York, and Wilkes-Barre, Pennsylvania; and small engine terminals similar in scale to Mechanicville at Plattsburgh and Rouses Point, New York (Darbee 2009).

Accordingly, size, as measured by the number of stalls in the roundhouse, was not the sole factor indicative of the role of the Mechanicville D&H engine terminal within the D&H system. Both its relatively small size and location in proximity to other larger and more important repair facilities, on the D&H system as well as on other railroad systems, indicated the relative unimportance of the D&H engine terminal in Mechanicville.

4. What features of such facilities are indicative of the specific capabilities of a particular facility?

Locomotive repair facilities had a great variation in purpose, capacity, size, equipment and complexity. For example, with a small roundhouse and turntable arrangement such as at the Rutland & Burlington facility in Burlington, Vermont or the D&H facility at Mechanicville, New York, the work done on the locomotives was limited to light running repairs, such as lubrication, bulb replacement, and bolt tightening. Roundhouses were also used for storing locomotives. Large roundhouses performed the same functions but had larger capacity in terms of the number of stalls. With the exception of a few roundhouses like the one constructed at Steamtown, major locomotive repairs would be done in the shops, not in roundhouses. Unlike roundhouses, shops were used to disassemble locomotives from their boilers and trucks/wheels and were equipped with cranes, heavy machinery, or specialized venting. In cases where roundhouses were equipped with cranes, they were typically only small ones for lifting turbo generators, air pumps, and other smaller equipment, not the 50-100 ton capacity overhead cranes used in a shop.

Below is a summary description of the features identified from the literature review.

Rutland & Burlington, Burlington, Vermont

Roundhouse

1851-52: four stalls; service pits 50 feet long and 3 feet deep; a brick conduit drain that was connected to a manhole in the turntable pit; windows.

1900: alteration to stalls to accommodate the larger and heavier locomotives (no measurement is given in text).

1918: seven stalls.

Turntable

Manually operated Armstrong-type with oak levers, constructed of structural steel and traveled on a steel circle rail laid on wood ties around the perimeter of the pit (Corey et al. 1999).

1885: 50 feet long

1911: 55 feet long

1915: 60 feet long

Shops, Buildings and Other Features

Blacksmith shop, joiner shop, car house and boiler house. Within the boiler house was a sand house with a sand screen and sand dryer with a stove and an old locomotive boiler for steam heating (Corey et al. 1999).

1911: four short stub tracks radiating in the open from the southeast quadrant of the turntable.

1917: ash pit, rectangular, 26 feet deep, stone and brick side walls.

A depressed parallel track passed along one side of the ash pit next to a timber retaining wall about 54 feet in length and 3 feet in height; this set up was apparently used for loading the ash onto a car for removal (Corey et al. 1999).

Raritan & Delaware Bay, Lakehurst, New Jersey

Roundhouse

1862: two stalls.

1870: eight stalls; six of the eight stalls were ventilated by means of cast iron smoke jacks; service pits 30 feet long and 2 to 2.5 feet deep; drainage pits; steam pipes for firing up boilers.

1909: air pump installed. In the early 20th century, most roundhouse stalls had lines installed for electricity and compressed air. (Perazio et al. 2007).

Turntable

1916: steel, 50 feet in length, described as "third hand," rotated on a cast iron pivot, stone foundation slab, pit wall masonry capped by timber, pit floor was brick and dirt with a brick drain and wooden box drain (Perazio et al. 2007).

Shops and Buildings

Machine shop, blacksmith shop, boiler and tin shop.

Power to drive shop machinery was generated by a centrally located stationary steam engine that was powered by a set of boilers.

The boilers in use at the Lakehurst shop complex might have resembled the machinery available from an Atlas Engine Works catalog of the 1870s. In the shop complex's later years, however, the boilers in use had been taken from out-of-service locomotives and converted for use powering shop machinery. One boiler was removed from the 1903 wreck of a 4-4-0 engine; this refitted boiler provided power at Lakehurst until 1922. This engine was in turn replaced by a similarly converted locomotive boiler, which was used from 1922 until 1935. The use of such converted boilers at Lakehurst indicates fairly ancillary operation – most active shop complexes on busy rail lines would have invested in regular stationary steam boilers (Perazio et al. 2007:34 and 36, citing to Flagg and Schopp 1989).

Delaware, Lackawanna & Western, Scranton, Pennsylvania

Roundhouse

1855: 40 stalls; "at least 71 windows" (Milner et al. 1989).

1902: 45 stalls; ventilated by smoke jacks suspended over each stall.

Turntable

1855: 66 feet

Shops and Buildings

Machine shop, paint shop, blacksmith and pattern shop, engine room, boiler room, foundry, locomotive erecting shop, power plant and diesel shop.

D&H Engine Terminal, Mechanicville, NY

Roundhouse

1913: 4 stalls (Fisher and DiVirgilio 2008, Valuation Map 12b). The depth of 2 stalls was extended in the late-1940s to accommodate J-class steam locomotives (Shaughnessy 2009).

Turntable

1913: 100 feet; electrically powered. Still in service in 1947, it was removed to accommodate the J-class articulated 4-6-4 steam locomotives that were first introduced in 1944. The turntable was replaced by wye track for turning locomotives and was removed by 1953 when complete dieselization had occurred (Shaughnessy 2009).

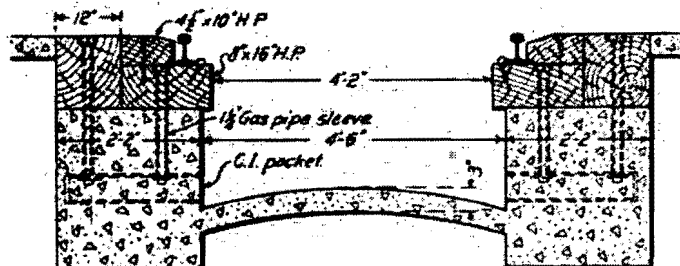
Shops and Buildings

No shops. Sand house, office and two storage buildings.

Track Pit

A common feature of a roundhouse was the track pit to access and service the underside of the locomotive, often featuring a sloped floor for the draining of lubricants or the boiler. Track pit designs and construction information is well documented in the literature. For example, at the B&M engine terminal constructed in 1913 at Mechanicville, shortly after construction of the D&H engine terminal in the nearby D&H yard, the Railway Age Gazette described and illustrated the features of the track pits as follows:

the stalls were 100 ft. long and the track pits 75 ft. The walls of the pits are of concrete with 8 in. by 16 in. timbers under the rails and 12 in. by 12 1/2 in. jacking timbers outside of the rail supports, all of which are anchored into the concrete wall by 3/4 in. bolts at 6 ft. intervals attached to cast iron pockets set in the concrete just above the floor of the pit. The bolts are inserted in 1 1/4 in. gas pipe sleeves as shown in the accompanying cross section. The cast iron pockets are 4 in. square inside and open on the inner end to allow adjustments of these anchor bolts to be made. The jacking timbers are treated with two coats of preservative by a dipping process. The floor of the house is of concrete, 4 in. thick laid on a cinder fill. The building is heated by hot air brought in through a duct along the inside wall and 24 in. laterals between each pair of stalls, having three inlets to each pit. The pits are given a pitch of 6 in. toward both ends for drainage. A drop pit is provided under two stalls for light repairs, heavy repairs being made on the jacking pits in the locomotive shop.



As stated in this article, light repairs were done in roundhouses while heavy repairs would be made in the locomotive shops. The same 1913 Railway Age Gazette article

discusses the relationship between the "new" D&H engine terminal and the B&H engine terminal, but it does not provide any information on the pits or other equipment at the D&H. This may suggest that it was standard and not notable for its design or technological advancement.

5. What important innovations in railroad technology occurred during the period of existence of the D&H Mechanicville facility which might have been reflected in its physical features and which, by their presence or absence, indicates that it was either progressive or conservative in adopting new technology? What would this indicate about the evolution of the industry in New York State and the history of the company that owned the facility?

Innovations in railroad technology during the mid-19th century to the early 20th century were primarily related to the safety and efficiency of the repair facility and therefore created a standardization of these repair facilities. The D&H Mechanicville engine terminal was developed in the aftermath of this period of standardization. According to Darbee's report (2009), "based on the written record, the D&H engine terminal was a very typical small engine terminal. The turntable, turntable pit, roundhouse, and support for the buildings and structures were of standard early 20th century construction."

Examples of important 19th century innovations that lead to early-20th century standardization of light repair locomotive facilities include the following:

1. Design of the roundhouse.
2. Design of the inspection pits and drop pits to accommodate the upgrade of roundhouses.
3. Use of electricity.
4. Smoke jacks for ventilation.
5. Use of cold and hot water to hasten process of boiler cleaning without damaging the boiler from thermal shock.
6. Fire brick and heat resistant materials to line ash pits.
7. Construction material. The change from wood and cast iron to structural steel and concrete.

By the end of the 19th century, the railroad industry had evolved and matured in New York as a result of an early start and rapid and sustained growth of major carriers. The State of New York granted the first charter for a railroad in the United States to Stephen

Van Rensselaer and others on April 17, 1826, to construct a railroad connecting the Hudson and the Mohawk rivers. The railroad opened in September 1831 (Whitemore 1909). In 1853, the New York Central Railroad Company consolidated many of the railroads already in operation in New York between Albany and Buffalo. Under the direction of the Vanderbilt family after 1867, beginning with Cornelius Vanderbilt and his son William Henry Vanderbilt, it became one of the country's most lucrative and important carriers. Other important 19th-century carriers included the New York and New Haven, the New York and Albany, and the Hudson River Railroad. The 1895 map below illustrates the vast extent and network of railroads and their yards constructed in New York by the end of the 19th century.

As the 1895 map demonstrates, railroads and steam power were well established in New York during the 19th century. By the time the D&H engine terminal in Mechanicville was constructed in 1913, the technology for turntables and roundhouses for performing running repairs on steam locomotives was fully developed and standardized. As shown in the literature review, the other three roundhouses that were identified dated to the 1850s and 1860s, more than 50 years earlier than the D&H engine terminal constructed at Mechanicville.

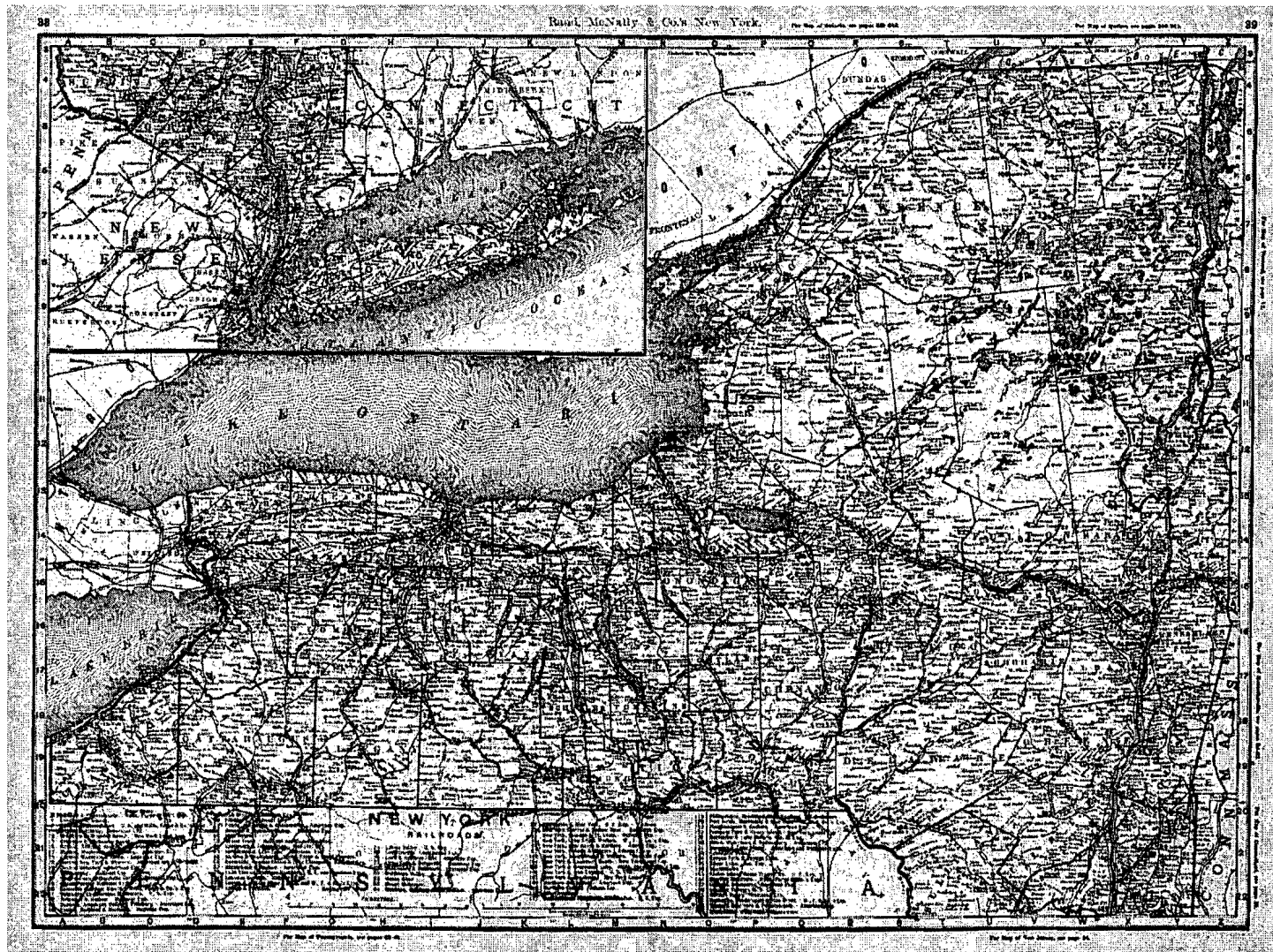
The D&H Mechanicville engine terminal was built in 1913, late in time in terms of innovations regarding steam locomotion which had matured in the 19th century. However, the size of steam locomotives continued to evolve in the 20th century. The J-class articulated 4-6-4 steam locomotives were introduced to the D&H in 1944. Because the 1913-vintage 100 foot turntable at the D&H engine terminal at Mechanicville was too short for these articulated locomotives, the turntable was replaced in the late 1940s by a wye track, and two of the four roundhouse stalls were deepened to accommodate the longer locomotives. The D&H completed its conversion from steam to the more efficient diesel locomotive power by 1953 (Shaughnessey 2009).

Diesel power required less regular servicing than steam power, effectively eliminated the need for further innovation of roundhouse and turntable technology, and rendering those structures obsolete. As a result of diesel power's operational advantages, conversion of steam to diesel power in the 1950s was a common technological shift in the railroad industry in New York and the rest of the United States. The physical alteration of the D&H engine terminal at Mechanicville in the late 1940s to add a wye track and to lengthen two of the four roundhouse stalls was a direct response to the final evolution of steam locomotives, specifically to accommodate their increased length. No major physical changes or innovations were necessary for the transition to diesel power a few years later.

The information that the D&H engine terminal would become obsolete with the transition from steam to diesel power in the 1940s to the 1950s is redundant with the information gathered for the DL&W in Scranton, which concluded:

Major repairs to steam locomotives involved removal and replacement of worn or defective parts from below. Comparable work on the new diesels required lifting parts up and out of the locomotive. As a result, the existing roundhouse, with its low roof and limited overhead access, proved unsuitable for the requirements of diesel locomotive repair and maintenance." (Milner et al. 1989:32-33).

In sum, based upon the literature review, historical research and archaeological field work, the D&H Mechanicville site does not appear to be eligible for listing on the National Register of Historic Places with regard to historical association and research potential.



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