United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations of eligibility for individual properties or districts. See instructions in *How to Complete the National Register of Historic Places Registration Form* (National Register Bulletin 16A). Complete each item by marking "x" in the appropriate box or by entering the information requested. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials and areas of significance, enter only categories and subcategories listed in the instructions. Place additional entries and narrative items on continuation sheets (NPS Form 10-900a). Use a typewriter, word processor, or computer, to complete all items.

1. Name of Property

historic name **Boonton Ironworks Historic District**

other names/site number

2. Location

street & number Plane Street, Grace Lord Park ☐ not for publication

city or town Boonton Town ☐ vicinity

state New Jersey code NJ County Morris zip code 07005

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended, I certify that this [X] nomination

☐ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property [X] meets ☐ does not meet the National Register criteria. I recommend that this property be considered significant ☐ nationally ☐ statewide ☐ locally. ☐ See continuation sheet for additional comments.

Signature of certifying official/Title Date

Deputy SHPO Assistant Commissioner for Community Investment & Economic Revitalization
State or Federal agency and bureau

In my opinion, the property ☐ meets ☐ does not meet the National Register criteria. ☐ See continuation sheet for additional comments.

Signature of certifying official/Title Date

State or Federal agency and bureau

4. National Park Service Certification

I hereby certify that this property is: Signature of the Keeper Date of Action

☐ entered in the National Register.
☐ See continuation sheet.

☐ determined eligible for the National Register.
☐ See continuation sheet.

☐ determined not eligible for the National Register.

☐ removed from the National Register.

☐ other, (explain:)

5. Classification

Ownership of Property
(Check as many boxes as apply)

- [x] private
- [x] public-local
- [ ] public-State
- [ ] public-Federal

Category of Property
(Check only one box)

- [ ] building(s)
- [x] district
- [ ] site
- [ ] structure
- [ ] object

Number of Resources within Property
(Do not include previously listed resources in the count.)

Contributing	Noncontributing	
2		buildings
13		sites
2		structures
		objects
15	2	Total

Name of related multiple property listing
(Enter "N/A" if property is not part of a multiple property listing.)

N/A

Number of contributing resources previously listed in the National Register

3

6. Function or Use

Historic Functions
(Enter categories from instructions)

DOMESTIC/single dwelling
INDUSTRY/manufacturing facility
TRANSPORTATION/rail-related
TRANSPORTATION/water-related
RECREATION AND CULTURE/outdoor recreation

Current Functions
(Enter categories from instructions)

RECREATION AND CULTURE/outdoor recreation
GOVERNMENT/public works

7. Description

Architectural Classification
(Enter categories from instructions)

No style

Materials
(Enter categories from instructions)

foundation: Concrete substructure (resource #17)
Fieldstone retaining walls (resource #17)
walls:
roof:
other: Fieldstone bridge and abutments (resource #8)
Steel girders and trusses (resource #17)

Narrative Description
(Describe the historic and current condition of the property on one or more continuation sheets.)
See continuation sheets.

8 Statement of Significance

Applicable National Register Criteria
(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing.)

- [x] **A** Property is associated with events that have made a significant contribution to the broad patterns of our history.
- [ ] **B** Property is associated with the lives of persons significant in our past.
- [x] **C** Property embodies the distinctive characteristics of a type, period or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.
- [x] **D** Property has yielded, or is likely to yield, information important in prehistory or history.

Criteria considerations
(mark "x" in all the boxes that apply.)

Property is:

- [ ] **A** owned by a religious institution or used for religious purposes.
- [ ] **B** removed from its original location.
- [ ] **C** a birthplace or grave.
- [ ] **D** a cemetery.
- [ ] **E** a reconstructed building, object or structure.
- [ ] **F** a commemorative property.
- [ ] **G** less than 50 years of age or achieved significance within the past 50 years.

Areas of Significance
(Enter categories from instructions)

Engineering
Industry
Transportation

Period of Significance
1831-1929

Significant Dates
1831, 1866, 1906, 1929

Significant Person
(Complete if Criterion B is marked above)

Cultural Affiliation

Architect/Builder
John Carson, Sr. (arch bridge)

Narrative Statement of Significance
(Explain the significance of the property on continuation sheets.)

9. Major Bibliographical References

Bibliography
(cite the books, articles, and other sources used in preparing this form on continuation sheets.)

Previous documentation on file (NPS):

- [ ] preliminary determination of individual listing (36 CFR 67) has been requested
- [x] previously listed in the National Register
- [ ] previously determined eligible by the National Register
- [ ] designated a National Historic Landmark
- [ ] recorded by Historic American Buildings Survey # _____
- [ ] recorded by Historic American Engineering Record # _____

Primary location of additional data

- [x] State Historic Preservation Office
- [ ] Other State agency
- [ ] Federal agency
- [ ] Local government
- [ ] University
- [ ] Other

Name of repository:

10. Geographical Data

Acreage of property 53.31

Latitude / Longitude Coordinates
(Note to Preparers: NJ HPO will complete this portion of the Registration Form for all Preparers, based on the coordinates derived from the Site Map or District Map that HPO produces.)

1. Lat 40.906507 Long -74.420107
2. Lat 40.907897 Long -74.417945
3. Lat 40.903373 Long -74.409121
4. Lat 40.902051 Long -74.413635

(NJ HPO will place additional coordinates, if needed, on a continuation sheet for Section 10.)

Verbal Boundary Description
(Describe the boundaries of the property on a continuation sheet for Section 10.) See continuation sheets

Boundary Justification Statement
(Explain, on the section sheet following the Verbal Boundary Description, how the chosen boundaries meet the requirements for boundary selection and are the most appropriate boundaries for the nominated property or district.) See continuation sheets

11. Form Prepared By

name/title Margaret M. Hickey, AIA, and Beth A. Bjorklund, Historic Preservation Specialists; and
Patrick Harshbarger, Principal Historian, M.A., MPA, and James S. Lee, Principal Archaeologist, MA, RPA
organization Connolly & Hickey Historical Architects, LLC and Hunter Research, Inc. date December 13, 2022
street & number c/o P.O. Box 1726 telephone 973-746-4911
city or town Cranford state NJ zip code 07016

Additional Documentation

(Submit the additional items with the completed form that are outlined in the "Standard Order of Presentation" that NJ HPO provides. Each page must contain the name of the nominated property or district, and the State and the county in which the property or district is located. Consult with NJ HPO if you have questions.)

Property Owner

(Either provide the name and address of the property owner here or provide the information separately to NJ HPO. Check with NJ HPO for other requirements. All owners' names and addresses must be provided, including public and non-profit owners, but their presence on the form, itself, is not required).

name _____
street & number _____ telephone _____
city or town _____ state _____ zip code _____

United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet

Boonton Ironworks Historic District
Name of Property
Morris County, NJ
County and State
Name of multiple listing (if applicable)

Section number 7 Page 1

Summary Paragraph

The Boonton Ironworks Historic District is comprised largely of Grace Lord Park, which is dotted with above-surface and potentially buried remains of the Boonton Ironworks, the Morris Canal, and the Morris & Essex Railroad, and also includes a pocket of industrial development in private ownership and a municipal recycling center within the otherwise open space of the park. The park is accessible via Main Street at its northwest end, Plane Street along its east side, and Morris Avenue at its southeast end, with trails connecting these points and crossing the Rockaway River, which the park straddles. The district includes seventeen resources, of which fifteen are contributing, and two non-contributing. Three of the contributing resources (the bed of the Morris Canal, Inclined Plane 7 East of the Morris Canal, and the Arch Bridge from the Boonton Ironworks) were previously listed on the New Jersey and National Registers of Historic Places.[1]

Narrative Description

Setting/Overview

The remains of the Boonton Ironworks, Morris Canal, and Morris & Essex Railroad primarily stand within Grace Lord Park, which is a passive recreational and scenic park located in the heart of the Town of Boonton that features the natural beauty of the Rockaway River including a dam and falls. The site is bounded to its north and northeast by Boonton's Main and Plane Streets, which are primarily composed of commercial development; to its southeast and south by Morris Avenue, which connects residential areas to Main Street; and to its west by a late-19th-/early- 20th-century residential development that boasts a mix of residential buildings on winding tree-lined streets typical of an early railroad suburb. The Rockaway River runs northwest-southeast bisecting the park with a dam and 30-foot cascading falls at the north end. A gravel trail connects the park entrance at West Main Street, following the course of the river along its south side (Photograph 0001), with a trail head on Morris Avenue. The trail also splits to cross the river via the Arch Bridge (resource #8), which was constructed as part of the Boonton Ironworks complex and now serves as a pedestrian bridge; here the trail connects to a paved access road from Plane Street. The former Railroad Trestle Bridge (resource #17) also crosses the river at the south end of the park but due to its condition is not currently safe for pedestrian use. There are playgrounds and a gazebo at the West Main Street entrance to the park. (Photograph 0002). Opposite this on the north side of the river, and paralleling Main Street, is a small area called Canal Side Park, which features a paved walking path connecting flat grassy areas and a playground. This abuts a large public parking lot to the southeast, which is accessible via Plane Street. Together, the parking lot and Canal Side Park follow the former path of the bed of the Morris Canal (resource #12). The industrial and transportation-related archeological ruins are scattered throughout the park with the heaviest concentration at the center and southeast end. The remaining above-ground archeological ruins are primarily left to the elements and therefore have been overgrown by vegetation yet remain an integral part of the landscape. All of the architectural resources are also located toward the center and southeast in two locations that are

[1] The bed of the Morris Canal and Inclined Plane 7 East of the Morris Canal were previously listed on the New Jersey Register on 11/26/1973 and the National Register on 10/1/1974 (NR Reference #74002228). The Arch Bridge from the Boonton Ironworks (NR Reference #SG100008042) was listed on the New Jersey Register on 7/8/2022 and the National Register on 9/1/2022.

encapsulated within the open space of the park. A paved road off Plane Street provides access to these areas with a section of private property (not currently developed) on the northwest side and the Town of Boonton's recycling center on the southeast side.

Inventory

The inventory includes seventeen resources of which fifteen are contributing and two are non-contributing. Of the fifteen contributing resources, four of them have been identified as contributing (key) as these resources individually meet the criteria. The resources fall within three main categories based on their location and association with the Boonton Ironworks, the Morris Canal, or the Morris & Essex Railroad/Delaware, Lackawanna & Western Railroad, and these can be further grouped as either archeological resources and built resources and based on their contributing or non-contributing status; the resources are numbered to reflect this.

Boonton Ironworks Resources

1. Potential Buried Remains from the Boonton Ironworks and Later Industries
2. Remains of Retaining Wall and Engine House/Blacksmith Shop
3. Remains of Furnace Stacks and Engine House
4. Remains of Stone Foundation with Arches
5. Remains of Water Control Structures
6. Remains of First Nail Factory
7. Remains of Boonton Electric Company
8. Arch Bridge from the Boonton Ironworks
9. Remains of George W. Esten House
10. Boonton Department of Public Works Building
11. Boonton Department of Public Works Salt Shed

Morris Canal Resources

12. Bed of the Morris Canal
13. Inclined Plane 7 East of the Morris Canal

Railroad Resources

14. Former Morris & Essex Railroad Siding
15. Remains of Morris & Essex Turntable
16. Remains of Delaware, Lackawanna & Western Engine House
17. Boonton Ironworks Railroad Trestle Bridge

United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

Boonton Ironworks Historic District
Name of Property
Morris County, NJ
County and State

Name of multiple listing (if applicable)

#1: Potential Buried Remains from the Boonton Ironworks and Later Industries *(Block 34, Lots 1, 24, 25, and 26)*

Contributing Site

(Figures 9, 13, 23, and 24)

Although not visible above-ground, the archeological remains of an estimated 26 buildings and structures associated with the Boonton Ironworks are considered likely to exist below ground. The main buildings within this resource type include: the filling and casting houses associated with the furnace stacks; the first nail factory and nail store house; annealing house, the iron foundry, the pattern house (later paint works and bronze powder works); the rolling mill, the sawmill, the header mill, plumbers shop, carpentry shops, blacksmith shops, offices and a large number of storage sheds for charcoal, coal, coke, clay, scrap iron, tools and patterns. In addition, several headrace and tailrace flumes (both timber and iron pipe), headgate structures, associated bridges, and, after 1866, a sitewide fire suppression system linked these buildings into an integrated industrial site.

After the closing of the company in 1876 and attempts to restart the furnaces in the early 1880s, the properties that made up the ironworks began to be leased out to other corporations who at first adapted the buildings for their own use. By the end of the 19th century, with the slow decline of the ironworks buildings, many were replaced with new buildings, some incorporating elements of the older structures and some completely removing them. These new corporations included the New York Agricultural Works, Boonton Electric Light Station, Wrought Iron Paint Company, Boonton Iron & Steel Company, Lincoln Iron works, Loando Hard Rubber Company, George Benda bronze powder works, General Foundry Company, General Storage Battery Company and General Forging Company. Most of these companies were attracted to the site for the same reasons as the ironworks; the consistent source of water provided by the Morris Canal and access to transportation, but in this case provided by the railroad.

While the evolution in the use and changes to the ironworks buildings and waterpower system over the course of the 50-year history of the company has great archeological potential to yield information about a period during which the iron industry went through revolutionary changes, including the use of charcoal, coal and coke as fuels sources; the subsequent adaption of these buildings to new manufacturing processes in the late-19th century also has great potential to reveal information about significant changes in American industries during this period.

#2: Remains of Retaining Wall and Engine House/Blacksmith Shop *(Block 34, Lot 1.01)*

Contributing Site

A large masonry retaining wall runs along the southern side of Plane Street as it crosses through the ironworks site. The mortared, cut stone wall runs for roughly 190 feet, although a central portion of the wall has collapsed and been replaced with steel sheeting (Photograph 0003). It was likely constructed to create the mill pond impoundment that was once situated just to the north of it but filled in between 1930 and 1957. At least two large, riveted-iron headrace pipes are visible within this wall, one opening at street level and the other roughly eight feet above street level. These fed into the rolling mill that was

formerly located in this area. The 1886 Sanborn Map Company map suggests two additional headrace flumes ran over the top of this wall to large water wheels located within the center of the rolling mill.

The ruins of a brick building are situated on top of the western end of the retaining wall. (Photograph 0004). This building was constructed in 1863 and is identified on the 1886 Sanborn maps as an engine house, likely for a stationary steam engine, and on the 1892 Sanborn map as a blacksmith's shop. The building was one story with a front-gable roof and the brick walls were detailed with simple brick corbelling.

#3: Remains of Furnace Stacks and Engine House *(Block 34, Lots 1 and 25)*

Contributing Site

(Figures 10, 11, 12, and 22)

The heart of the early ironworks were the two furnaces built at the northern end of the site in the early 1830s known as Furnace No. 1 and No. 2. These stone blast furnaces were rebuilt and modified several times over the next 50 years.

The furnace stacks would have been surrounded by supporting structures including: a filling house, where materials were stored for the loading of the furnace; a casting house into which the molten iron was drawn to cast objects or iron pigs; and an engine house from which the air blast was generated to enable the furnace to reach the temperature necessary to smelt iron. The term "engine house" likely indicates the use of steam-powered blowers. It is not clear from documentary evidence whether waterpower was ever used prior to the installation of the engines.

Within the historic district, remains of the furnace stacks are visible. These remains, which are roughly 50-foot square, include the base of both stacks up to the bosh section. The tuyere, tapping hole, crucible and hearth of the furnace are likely to survive below this level[2]. At both furnaces, sections of iron and slag cemented to the firebricks, which would have lined the furnace survive. At Furnace No. 2 this material forms a nest-shaped feature above the remaining furnace masonry supported by a series of railroad rails that appear to have been incorporated into the furnace structure in an unusual manner (Photograph 0005). Masonry foundations of the engine house also survive between the two stacks and extends 40 feet to the southwest. These remains are likely the elements of the engine mounts that held the blowing equipment in place.

While originally built to use increasingly scarce charcoal to convert iron ore into pig iron, these furnaces were converted in the late 1840s to use readily available anthracite. This technique was relatively new to the United States and first developed in Pennsylvania. Samuel Thomas, the son of a Welsh ironmaster, David Thomas, who had pioneered the use of anthracite coal in the United States at the Lehigh Crane

[2] The bosh is the lower section of a blast furnace shaft where the walls taper inward to the crucible. The tuyere is the nozzle that injects air into a furnace. The hearth is the space within a furnace where metallurgical processes are carried out. The crucible is the area at the bottom of the furnace shaft where liquid iron accumulated. Gordon, Robert B. 2019. *American Iron, 1607-1900* (Johns Hopkins University Press, Baltimore, Maryland).

Iron Company, helped the Boonton ironworks modify the existing furnace.

#4: Remains of Stone Foundation with Arches *(Block 34, Lot 1)*

Contributing Site

(Figure 18)

Directly north of the Furnace No. 2 is a partial stone masonry foundation (Photograph 0006). This foundation is roughly 60 feet long, 12 feet high and partially built into the bank behind it. Four, 10-foot-wide, round-arches with projecting keystones open to the south/southwest and extend under the bank roughly 25 feet. A retaining wall holding the berm of the Morris Canal parallels this foundation roughly 50 feet behind its southwest face. The full extent of the foundation is buried under soil. Because of its location, this is interpreted as part of the trestle system that carried rail cars up to the filling house and beyond to the first nail factory.

#5: Remains of Water Control Structures *(Block 34, Lot 1)*

Contributing Site

To the east of the furnace stacks are a series of masonry and concrete remains related to a gatehouse and associated water control features that drew water from the canal and directed it into the Boonton ironworks waterpower system. A gatehouse, originally part of the first nail factory building, was located on top of these walls from the 1830s until at least 1924, and the walls, buttresses, gates and pipes in this area represent several episodes of change and reconstruction over the same period (Photograph 0007). These structures provided water that up until *circa* 1876 was used in the first nail factory, before emptying into the mill pond, which supplied water to the second nail factory, rolling mill, sawmill and header mill. By the beginning of the 20th century the water was being supplied to new industries that had sprung up in the late-19th century and early-20th century including the Boonton Electric Company, the New York Agricultural Works, the George Benda bronze powder works, and the Lincoln Iron Works.

#6: Remains of First Nail Factory *(Block 34, Lots 25 and 26)*

Contributing Site

South of the furnace stacks is an area recently cleared of two 20th-century buildings. A retaining wall along the northeastern edge of this area is likely the remains of the first nail factory built within the historic district by 1840. This retaining wall is approximately 190 feet in length and is roughly 40 feet in height (Photograph 0008). While it was incorporated into later buildings that replaced the nail factory ruins between 1896 and 1902, the rough coursed masonry incorporates large stone blocks that suggest an earlier date of construction. A large, infilled headrace entrance is also visible on the second level of this retaining wall in line with the location of the waterwheels identified within the Sanborn Map Company plans of the site from the late 19th century. Elements of an arched, underground tailrace were also observed to the southwest of this wall. No other elements of the first nail factory were observed.

#7: Remains of Boonton Electric Company *(Block 34, Lots 1.01, 25 and 26)*

Contributing Site

A series of remains related to the Boonton Electric Company's (New Jersey Light & Power Company) generating facility, built between 1909 and 1916 are present just south of the water control structures. These consist of concrete machinery mounts and foundations that incorporate elements of previous buildings and the waterpower system (Photograph 0009).

#8: ***Arch Bridge from the Boonton Ironworks*** *(Block 34, Lot 1)*

Contributing (key) Structure

(Figures 17 and 25)

The 1866 Arch Bridge, located within Grace Lord Park, crosses the Rockaway River at a naturally narrow point approximately a quarter of a mile downstream from the Boonton Falls. A curving gravel and dirt trail extends northwest-southeast through the park on the south side of the river and approximately one-quarter of a mile southeast of the Main Street entrance, an extension of the trail crosses the river via the Arch Bridge.

The Arch Bridge is a single-span, arched, coursed rubble fieldstone bridge with curved wing walls that are built into the wooded and rocky slopes of the Rockaway River (Photograph 0010). The wing walls are dry-laid rubble fieldstone of fairly regularly-sized rubble stones with larger stones at the base. The bridge itself is of mortared coursed rubble fieldstone. The voussoirs are coursed ashlar, and at the keystone there is a cast iron plate inscribed with "FL-18-66" (Fuller & Lord 1866). The bases of the arch rest on large boulder-like stones at the river edge. There are five iron tie rods through the masonry with the anchor plates visible at the faces of the bridge. The bridge slopes down toward the northeast, with an approximate drop of four feet over the span of the bridge. There is a concrete cap on the walkway surface of the bridge and metal chain link fences enclose the walkway; this fence continues for several feet on the north side of the bridge and even farther along the south side of the bridge. The concrete cap and metal chain link fence are the only modifications that have been made to the bridge.

#9: Remains of the George W. Esten House *(Block 34, Lot 1.01)*

Contributing Site

The remains of the George W. Esten House are located adjacent to the former Inclined Plane near the access road from Plane Street. Constructed circa 1835, the house was a three-story, five-bay vernacular wood-frame house with simple Italianate detailing. It had a rubblestone foundation, clapboard wood siding, and a side-gable roof, and featured a full-width front porch and a one-story rear addition. Only the foundation remains today. The house was likely originally constructed as a boarding house for single workers and then was the home of George W. Esten, a carpenter in charge of the pattern shop and all carpentry who rose to superintendent of the ironworks.

***#10: Boonton Department of Public Works** Building (Block 34, Lot 1)*

Non-Contributing Building

The Boonton Recycling Center is located off the paved road from Plane Street opposite the Remains of Retaining Wall and Engine House/Blacksmith Shop (resource #2. This paved area features a one-story recycling center building, which was constructed circa 1960 and expanded in the 1980s. The building consists of a small administrative office/space at the west end and a series of attached one-story garages. The building backs up to the road along the north side of the property and the front elevation faces south/southeast. It is constructed of painted concrete masonry units and has flat roofs clad with membrane roofing. The recycling center is largely paved with some areas of grass and dirt.

Historically this area was the site of the rolling mill and various support buildings. Successive fires slowly reduced the number of buildings in this area until the area was flattened sometime between 1930 and 1956.

***#11: Boonton Department of Public Works Salt Shed** (Block 34, Lot 1)*

Non-Contributing Building

There is a round salt/sand storage building at the northeast end of the Boonton recycling center/Public Works area that was constructed circa 2000.

***#12: Bed of the Morris Canal** (Block 34, Lot 1)*

Contributing (key) Site

(Figure 19)

The Morris Canal passed alongside the Ironworks essentially parallel to Plane and Main Streets running in a general northwest-to-southeast direction and included Inclined Plane 7 East. The canal is no longer extant aboveground, but its path can be traced in the landscape. At the northwest end of Grace Lord Park, the canal prism passed under a bridge at West Main Street and was set close to the Rockaway River. As it continued east it diverged from the river to maintain elevation and closely paralleled Main Street for approximately 1,200 feet in what is today Canal Side Park and a public parking lot. A sewer line was placed within the bed of the canal from West Main Street running east in the 1920s. This included the filling of the canal around the sewer line and making a long linear level area now used as a park (Photograph 0011). This work has obscured the towpath on the eastern side of the canal as well as the berm on the opposite side.

***#13: Inclined Plane 7 East of the Morris Canal** (Block 34, Lot 1)*

Contributing (key) Site

(Figures 20 and 21)

The top of Inclined Plane 7 East is located at the east end of the parking lot where Plane Street starts. (See Figure 20 for diagram of an inclined plane.) This plane lifted 90-foot-long, two-section boats weighing up to 70-tons 80 feet in elevation over a 1,440-foot incline (measured between cable wheels at top and bottom of inclined plane). A waste gate at the top of the plane would have both provided water

to the adjacent ironworks and later industrial enterprises and would have carried excess water when the plane's turbine was not in operation to a bypass flume that would also fill the ironworks mill pond. This water would eventually reenter the canal after running through the ironworks' waterpower system. A headgate was located at the top of the inclined plane that would allow water to pass over a stone abutment into an elevated timber headrace flume that paralleled the plane before end at the penstock. Water would be allowed into the penstock via a plug valve operated from the second floor of a stone powerhouse, also located next to the plane. This water would drop into the "J"-shaped penstock pipe and come up under a "Scotch reaction"-type turbine, developed for the Morris Canal, within a turbine chamber at the base of the powerhouse. The water jetting out of the turbine's nozzles would cause it to spin. The water exited the turbine chamber through an underground tailrace that emptied into the ironworks mill pond. This water would reenter the canal at the base of the inclined plane after it passed through the rolling mill.

The turbine would turn a power shaft that operated a cable-winding drum within the first floor of the powerhouse. The cable ran in a circuit to the top and bottom of the inclined plane held off the ground by vertical sheave wheel pulleys. One large horizontal "bull wheel" embedded in masonry underwater at the bottom of the canal and two at the top carried the cable around to the center of the inclined plane where they were attached to a two-section, timber cradle car. This car was set on rails spaced 12 feet, 4 inches apart affixed to parallel lines of sleeper stones.[3] The car would enter the canal at the top or bottom of the inclined plane, a boat would be pulled over the car, tied to it, and then pulled out of the water and up or down the incline. The bed of the inclined plane is visible in the landscape as a steep bank covered in vegetation between Plane Street and the Esten House. A sewer line was placed within this bed of the inclined plane in the 1920s. A tall stone retaining wall, now partially collapsed and buried, was located between the plane bed and Plane Street and a king-post bridge (non-extant) crossed over the plane bed, providing access to the ironworks from Main Street. At the base of the plane the canal prism continued, curving to the east beyond the boundary of the historic district. A waste gate within the towpath of the canal released excess water into Rockaway River. An arm of the canal also merged with the prism at the base of the plane. This arm carried water from the various tailraces within the ironworks back to the canal. Water also ran from this arm into the headrace of a sawmill and header mill, located just east of the rolling mill, before emptying into the Rockaway River.

In 2022 only some stone elements of the inclined plane and canal towpath retaining walls, the inclined plane bed and some stone sleepers are visible on the ground surface (Photograph 0012). Although this site has not been archeologically investigated, it is considered likely that several significant elements of the canal and inclined plane remains. These include elements of the waste gate, headgate, and stone headrace abutment at the top of the plane; the foundation, turbine chamber and tailrace of the powerhouse and the bull wheel and masonry setting within the prism at the base of the plane. In addition, the inclined mechanism described above dates from *circa* 1850. From 1831 to 1850 the inclined plane operated as a "lock" plane, which wound smaller boats up the incline using a large timber water wheel into a lock situated at the top of the plane. No elements of a lock plane have been identified

[3] All stone used is believed to have been locally sourced and would have been predominantly schist.

anywhere on the entirety of the canal. There is potential that archeological investigations at Plane 7 East may yield information on these earlier features.

#14: Former Morris & Essex Railroad Siding *(Block 34, Lots 1, 25 and Block 112, Lots 3 and 5)*

Contributing Site

(Figure 14)

Evidence of the railroad siding from the Morris & Essex Railroad is still present within the district. This spur of the Morris & Essex line was built to serve the ironworks in *circa* 1867 and is included on the 1868 Beers Atlas. Today, portions of the siding are still present at the crossing of the Rockaway River where a berm is present on the north side of the river. Rails are embedded in the pavement crossing and parallel to Plane Street in the center of the district. At the northwestern end of the district, the rail bed is now used as a trail that runs along the right bank of the Rockaway River to just below Boonton Falls where cars could switch to rails that partially paralleled the siding before rising on an embankment and trestle to supply material to the furnace filling houses.

#15: Remains of Morris & Essex Turntable *(Block 112, Lot 3)*

Contributing Site

(Figure 15)

The remains of the 54-foot-diameter armstrong (hand-operated) turntable are located near the railroad trestle (Photograph 0013). This feature is accessible via a gravel and dirt trail that extends from a parking lot off Morris Avenue. This trail partly follows the former rail spur railbed before splitting and running along a short siding that heads west to the turntable. The remains of the turntable consist of a low ring of cut mortared-stone masonry with a lower or inner concentric circle of regularly spaced "teeth" stones. At the center of the circle is a large flat stone with two metal tie rods sticking up from it, which would have been the center pivot for the turntable.

#16: Remains of Delaware, Lackawanna & Western Engine House *(Block 112, Lot 3.01)*

Contributing Site

An engine house, also built circa 1867, served by the turntable was located west of the railroad siding as it entered the site, opposite the freight depot. This building was located in a wooded area south of the turntable. No historic images survive of this building, but it is visible on both the 1868 Beers Map of Boonton and the 1887 Robinson Map of Boonton and mapped as a wood-frame building. Although no evidence is visible on the ground surface, the engine house would have had substantial foundations that enabled it to support the weight of a locomotive, which would be driven into the house on rails. Engine houses often have longitudinal service pits positioned on the centerline of the tracks beneath the resting engine to provide access for maintenance. Engine house foundations have been identified and studied archeologically in New Jersey in locations where no visible evidence remained. Of particular note is an engine house and turntable identified in South Amboy, New Jersey in 2018 that was part of the Camden and Amboy Railroad. The engine house dated to the late-19th/early-20th century, while the underlying

turntable dated to the mid-19th century.[4] Another engine house for the New York, Susquehanna and Western Railroad was recently identified below a parking lot in Jersey City, New Jersey and subjected to an archeological data recovery.[5] The excavation of this site uncovered the full extent of a late-19th-century engine house and partial remains of a turntable. Significantly, timber remains within the repair bays survived, allowing for the identification and documentation of a wheel drop pit, where the wheel truck assembly for a locomotive could be lowered for repair or replacement.[6]

#17: Boonton Ironworks Railroad Trestle Bridge *(Block 34, Lot 1)*

Contributing (key) Structure

(Figures 16 and 24)

The 1906 Railroad Trestle, located within Grace Lord Park, crosses the Rockaway River approximately 250 feet from Morris Avenue. The main access is via a gravel and dirt trail that extends from a parking area off Morris Avenue a short distance into the park directly to the alignment of the former railroad and the Trestle. The Trestle crosses the river towards the northwest to the opposite side where there is no defined trail. A section of railroad tracks is visible farther northwest and extends through a parking area and along abandoned industrial buildings, some of which, based on preliminary assessments, date to the Boonton Ironworks operations. The Trestle itself is set approximately 35 feet above the river, and the embankments on both sides of the trestle leading down to the river are steep.

The trestle is a single-track, four-span steel railroad bridge set on a concrete substructure built onto masonry retaining walls at the wooded and rocky banks of the Rockaway River. (Photograph 0014). The retaining walls were constructed when the original wooden trestle was built in 1867; this wooden railroad trestle was destroyed by a flood in 1905. The two outer spans of the trestle are riveted deck girders while the two inner spans are deck trusses utilizing the double-intersection Warren truss. The double intersection Warren truss is made up of a series of overlapping equilateral triangles. The truss members are made of steel angles and plates that are riveted together. The deck of the trestle has two sets of metal rails; one set was to guide trains and one was for safety to prevent the train from turning over (into the river) if there was a derailment. The rails are set on creosote-treated wooden railroad ties. Either end of each span of the trestle is supported by a poured-in-place concrete substructure, with two abutments on the banks and two piers set within the Rockaway River. The outer concrete abutments are constructed on the 19th-century stone masonry abutments at the banks from the previous wooden trestle. These masonry abutments are composed of large, fairly regularly-sized ashlar-cut local field stones reflecting late-19th masonry construction technologies. The two center concrete piers in the river each support the end spans of the double intersection Warren Truss. They, more than likely given their age, have caisson foundations and were poured in lifts with wooden forms as seen in their existing finish.

[4] Hunter Research, Inc., Archaeological Monitoring and Testing, Environmental Remediation at the Former Conrail and Spectraserve Sites, Intermodal Ferry Transportation Center, City of South Amboy, Middlesex County, New Jersey (2018).
[5] NV5, Archaeological Data Recovery, New York Susquehanna and Western Railroad Engine Repair Site (28-Hd-48), Jersey City, Hudson County, New Jersey (2019).
[6] NV5, Archaeological Data Recovery, New York Susquehanna and Western Railroad Engine Repair Site, 137.

Integrity of the District

The Boonton Ironworks Historic District as a whole retains integrity of design, feeling, location, materials, setting, and workmanship. The built resources that remain from the period of significance, though limited, overall retain a high degree of integrity. The Arch Bridge (resource #8) retains a high degree of integrity. The concrete cap at the walkway and the metal chain link fence in place of the original wooden post fence are the only modifications, and the bridge largely reflects its original appearance today. The Railroad Trestle Bridge (resource #17) retains a high degree of integrity, remaining unaltered since its construction in 1906 when it incorporated existing nineteenth-century stone retaining walls.

Although no subsurface investigations have taken place within the historic district to date, archeological remains of the ironworks, canal, and railroad that can be directly associated with historic maps are visible on the surface, and it is certain that archeological expressions of these industrial features survive below ground. The nature of the ironworks, with its integrated system of water supply and control structures, headrace flumes, wheel and turbine pits and tailraces, would have left indelible traces below the historic grade, which could be readily relocated and identified using the extensive historic mapping available for the site, particularly the late-19th-century fire insurance maps. As summarized by Robert B. Gordon:

> In digging an ironworks site, archeologists can expect to find the arrangement and layout of buildings, furnaces, heavy machinery, and nearby, worker's communities. They will fine wastes, such as slag, that archeometallurgists can interpret with the aid of laboratory techniques to review aspects of artisans' work and skills that no one wrote down.[7]

There is the potential for the survival of foundations of the large industrial buildings that once covered the site along with the mounts that held the interior industrial machinery in place. These mounts were intentionally massive to support and stabilize such machines as steam engines, nail cutting machines, rolling mills, and puddling furnaces and would have been difficult to remove after industrial operations ceased. Their arrangement on site could reveal important information regarding the development of the site, particularly in relation to the waterpower system. It is also anticipated that a significant amount of fill within the site consists of the byproducts and waste materials from smelting and puddling iron, cutting nails and rolling rails. This type of material is valuable in the analyses of the ironworking technologies and processes.

A review of late-19th- and early-20th-century Sanborn fire insurance maps (1886, 1892, 1896, 1901, 1909, 1916, and 1924) and historic aerial photography (1931, 1957, 1963, 1970, and 1979) has provided some insight into post-ironworks activity within the Boonton Ironworks Historic District. The 1886 map, which post-dates the ironworks closing by only two or three years, shows the full buildout, but

[7] Robert B. Gordon, "Industrial Archeology of American Iron and Steel," The *Journal of the Society for Industrial Archeology* ed. David R. Starbuck, Vol. 118, Nos. 1 and 2 (1992):15.

notes that the furnaces were being taken down. By the end of the 19th century, the nail factory is labeled as "In Ruins."[8] By 1902 and 1909 the nail factory is gone, replaced by an electric generating plant, but most of the other buildings remain standing, even though the 1909 map post-dates several fires that destroyed significant portions of the rolling mill. In 1916 the rolling mill is labeled as "Vacant & Open in Poor Repair"[9] and just "Old and Vacant" in 1924.[10] None of the plans show the furnace stack remnants, even though they are still there today. The 1931 historic aerial photograph shows the ruins of many of these buildings surrounded by an overgrown lot. Only the mill pond appears to survive, suggesting much of the waterpower system was filled in when the Morris Canal was dewatered and dismantled in 1929. The 1957 aerial photograph appears to show that many parts of the district continued to be overgrown but the rolling mill site, and the lower nail mill, saw and header mill area has been leveled to create an open area, probably through a combination of bulldozing and filling. The maps and aerials do not show evidence of the removal of material from the site except for some quarrying into the slag heap along the Rockaway River west of the railroad spur.

After the ironworks ceased operations in the 1880s and 1890s, new construction was limited to the construction of an electric generating plant, four new industrial buildings and several municipal buildings on concrete slab foundations. While this new construction may have caused some disturbance to potential ironworks archeological deposits, this would be limited in its extent and depth. The continued municipal use of the site has mainly been as a large, paved lot for material and equipment storage, suggesting little recent subsurface ground disturbance within the eastern portion of the site. A section of the railroad spur continued in use until the early 1970s, several sidings are identifiable as archeological features, and the masonry foundation of a largely intact railroad turntable is located at the southern end of the district. While the section of the Morris Canal within the district was deliberately dismantled in the late 1920s, many elements of it are likely to remain buried, including the large masonry turbine shaft, along with detailed documentation (more so than at any other inclined plane) that locates every element of its earthworks and illustrates all of its mechanical features. As with the fire insurance maps of the ironworks, these dismantling plans provide a roadmap for its future archeological investigation.

Overall, evidence suggests that many standing elements of the Boonton Ironworks Historic District survived into the early-20th century when a series of fires and the closure of the Morris Canal made the location less and less desirable as an industrial site. Other than the construction of a few new buildings in a limited area in the center of the district and the creation of the municipal yard in the eastern part of the district, very little large-scale disturbance is evident, and the majority of the district has been left fallow since the end of the period of significance in 1929.

[8] Sanborn Map Company, *Insurance Maps of Boonton, Morris Co., New Jersey* (1896). Firestone Library, Princeton, New Jersey
[9] Sanborn Map Company, *Insurance Maps of Boonton, Morris Co., New Jersey* (1916). Firestone Library, Princeton, New Jersey
[10] Sanborn Map Company, *Insurance Maps of Boonton, Morris Co., New Jersey* (1924). Firestone Library, Princeton, New Jersey

Industrial sites in similar conditions have yielded important archeological discoveries. Excavations in Paterson, New Jersey, for instance, have demonstrated the potential of a site where little was visible on the ground surface. In the mid-1970s archeologist Edward Rutsch conducted excavations in connection with the proposed extension of Route 20 into downtown Paterson. In two parking lots on either side of Market Street, Rutch's team identified the several shops of the Roger's Locomotive Company, the erecting shop of the Grant Locomotive Company, the waterpower system of the Rosen Mill and elements of the Middle and Lower Raceways of the Societies for Establishing Useful Manufactures' raceway system in Paterson,[11] now, all within a National Historic Landmark District. At the Roger's Locomotive Company site, excavation of the blacksmith shop, foundry, and annexes to the erecting shop were excavated, revealing foundations, pier supports and a drainage system, along with iron manufacturing byproducts, engine mounts, machines and tools, apparently discarded before the shops were closed around 1902 and covered with a new building.[12] This data provided significant previously unknown details of work processes and a surprising reliance on hand tools and skilled craftsmen well into an industrial era better known for its labor-saving machines. Excavations within the Grant Locomotive Company erecting shop were similarly productive with the survival of several bays where engines would have been assembled on tracks set on heavy foundations with long, narrow pits between them for accessing the underside of the engines. This site also yielded hand tools, apparently left behind by the workers. The silk mill that took over the building afterwards simply filled the bays with ashes to a new level and built a wooden floor on top.[13] This type of treatment was likely the most cost-effective way to adapt the building for a new use, and could very well be predictive of the treatment of the buildings within the Boonton Ironworks Historic District after they were taken over by new companies after the 1890s. In addition to the railroad shops, Rutsch was able to document the extent and fabric of partially buried raceways and document changes made to the Rosen Mill, including the possible conversion of its power system from a waterwheel to a turbine.[14]

Another example of the survival of industrial and waterpower features below grade is the Petty's Run Archaeological Site in Trenton, New Jersey. This site was first identified in the 1980s and then excavated between 2008 and 2013. The site features, within a very tight footprint of less than 3,000 square feet, the remains of an 18th-century plating mill for making hammered iron tools, one of the few 18th-century steel furnaces in the American colonies, a 19th-century cotton mill that was converted into a paper mill, along with their associated waterpower system.[15] This site was identified within a grassy park situated between the New Jersey Statehouse and the Old Barracks Museum. This park was created in the 1920s when a series of rowhomes overlying the site were demolished. The foundations of the buildings, a headrace, a waterwheel pit later converted to use water-powered turbines, a tailrace, the base of a steel cementation furnace, and many associated historic artifacts were all identified and had been protected by the fill used to level and prepare the site for the construction of the rowhouses, some

[11] Edward S. Rutch. *Salvage Archeology Project, Paterson, New Jersey 1973-1976* (1978):14.
[12] Rutch, 329.
[13] Rutch, 611.
[14] Rutch, 653.
[15] Hunter Research, Inc. *Petty's Run Archaeological Site: Iron, Steel, Cotton and Paper in Historic Trenton* (2014):8-1-8-24.

of which utilized the earlier remains within their own foundations. This report not only emphasizes the potential survival of waterpower and industrial features being capped by fill, but also demonstrates that a large number of significant artifacts, including many associated with 18th-century steel, were recovered from this fill.[16]

Excavations at the site of the Balbach Smelting Works in Newark, New Jersey demonstrate the potential to identify technological changes within industrial archeological sites. Excavations conducted in open lots in advance of the construction of Newark's Riverfront Park in 2013 identified 43 subsurface features associated with the former Desilverizing Department of the Balbach Smelting and Refining Works.[17] Features such as the base of a roasting furnace, machinery mounts, furnace fire boxes, smelting trough, smelting kettle base, and slag drain trough revealed significant information about historic industrial processes. The comparison of some features identified also enabled the authors of the report to determine that while Balbach had patented certain processes for smelting metals, they also adapted processes developed by others. The archeology also suggested that several older processes were kept in use despite the development of more efficient methods, potentially an indicator of frugality.[18]

These three examples from Paterson, Trenton and Newark demonstrate the potential for significant archeological information to survive below ground within the Boonton Ironworks Historic District, even after the standing historic buildings have been demolished and replaced by new buildings. Characteristic elements of such industrial sites contribute to their survival, including the subsurface nature of waterpower features, the massive size of foundations and engine mounts, and the large amount of waste byproducts and scrap material produced by the processes occurring on sites. The sometimes chaotic and sudden shutdown of the sites, sometimes with intent to reopen when economic conditions improve, also contributes to the survival of archeological data as workers and managers often abandon in place their machines, tools and work processes. In the case of Boonton, the relative lack of activity after the final closure of the site makes the likelihood for the survival of significant archeology even greater.

[16] Hunter Research, Inc. *Petty's Run Archaeological Site: Iron, Steel, Cotton and Paper in Historic Trenton*, 8-1-8-24.
[17] Richard Grubb & Associates, Inc. Phase III Archaeological Data Recovery, Newark Waterfront Park, Balbach & Sons Smelting and Refining Work (29-Ex-129), and the Morris Canal (28-Ex-133), City of Newark, Essex County, New Jersey (2013):6-1.
[18] Richard Grubb & Associates; 6-21.

United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet

Boonton Ironworks Historic District
Name of Property
Morris County, NJ
County and State
Name of multiple listing (if applicable)

Statement of Significance

The Boonton Ironworks Historic District, although largely composed of ruins, is regarded as the most complete example of an integrated anthracite-fueled ironworks site in the State of New Jersey, closely linked with transformative improvements in canal and railroad transportation systems. Established in 1829 to take advantage of raw materials and waterpower delivered directly to the site by the contemporaneously constructed Morris Canal, the Boonton Ironworks initially produced rolled wrought-iron products on machinery imported from England, added a charcoal iron furnace in 1833, modified the furnaces for using anthracite coal as a fuel in 1848, and also added facilities that same year to roll and cut wrought-iron nails and spikes. This was exceptional to have by this time what amounted to a fully integrated ironworks. Boonton Ironworks was capable of receiving iron ore from its own mines, and coal and limestone from eastern Pennsylvania, and stepping through the production of pig iron in blast furnaces to wrought iron in puddling furnaces, iron bars in rolling mills, and forges for forming and cutting nails, spikes and other finished products. Boonton thus represents one of the most significant transitions in the scaling up of the iron economy and technology in the Northeastern United States prior to the Civil War, i.e., a completely integrated ironworks no longer dependent on geographically separated and independently operated furnaces, forges and mills.

The Boonton Ironworks continually improved and enlarged its operations from the 1850s to the mid-1870s, including gaining direct access to the region's rail networks via a Morris & Essex Railroad branch line in 1867. After 1876, a combination of factors including boom and bust economic cycles, competition from new ironworks in western Pennsylvania, new steelmaking technology, and a series of fires and decisions made by owners to disinvest limited the Boonton Ironwork's ability to make the changes necessary to remain economically viable as an integrated ironworks. The next 50 years from 1877 to 1929 witnessed numerous attempts to revitalize iron production and adapt to new industrial uses, most of which failed or only resulted in short-term gains. Industrial activity ceased in 1929 when the Morris Canal was dismantled depriving the site of waterpower, which was still being used to generate electricity. As such, Boonton Ironworks also represents an early example of a full narrative arc in American industrialization and deindustrialization lasting almost 100 years.

The Boonton Ironworks Historic District is significant under Criterion A in the areas of Industry and Transportation, under Criterion C for in the area of Engineering for the 1866 Arch Bridge (resource #8) and the 1906 Railroad Trestle Bridge (resource #17), and under Criterion D for the site's potential to yield important information from the extant above-ground and buried remains of the industrial and transportation-related features through investigations using the methods of industrial archeology. Due to the infant nature of America's iron industry, limited scientific understanding of metallurgy and the rapid technological changes that took place, scholars of iron manufacturing often lack detailed data needed to understand the exact processes of iron foundries in the 19th century. The period of significance is from 1831, when the Boonton Ironworks and the Morris Canal both began operation, to 1929 when the last industrial occupant of the site ceased using the waterpower and portions of the Boonton Ironworks site were given to the Town of Boonton as a public park by descendants of James Couper Lord, one of the proprietors of the ironworks.

Narrative Statement of Significance[19]

1. Significance in the Area of Industry (Criterion A)

Summary – The development of the Boonton Ironworks represents a significant pattern of events and trends emblematic of the rise and decline of northern New Jersey's iron industry (Criterion A). These events, which begin with the founding of the ironworks in 1829, occurred at a time when the rich iron veins of northern New Jersey were being actively mined and iron manufacturing operations were developing and holding the promise of becoming largescale operations. Small colonial iron villages that had developed around individual furnaces and forges in Morris, Sussex, and Warren Counties suddenly became the scenes of increased investment and often overexuberant economic expectations. The operation of the Boonton Ironworks, in conjunction with the Morris Canal and later the Morris & Essex Railroad, was directly responsible for the development of the present-day Town of Boonton. Even more importantly within a historic context framed by the development of America's legendary iron industry, the Boonton Ironworks represented an early, and for a short time, successful attempt at forming a fully integrated ironworks with mines, blast furnaces, puddling furnaces, roll mills and a nail factory located in close geographic proximity. Boonton Ironworks was not the earliest integrated ironworks in the United States, but it was one of a small handful from the late 1830s to the 1850s that presaged the massive iron and steel works of the later 19th century. For numerous economic, geographic and technological reasons, Boonton Ironworks fell into a long half-century decline after 1876 paralleling the almost total collapse of the industry in northern New Jersey. This too presaged an all-too-common significant pattern of events in America's iron and steel industry, some that are still with us today, where competition and technological change could lead to rapid collapses and abandonments. Since integrated ironworks relied on massive workforces – Boonton employed over 600 workers at its height – missteps could leave entire communities in dire financial straits.[20]

Early Development of Boonton and the First Ironworks (pre-1829 prior to the period of significance)

The original center of the Town of Boonton was located along the Rockaway River approximately one and-one-half miles from the Boonton Ironworks Historic District and old Boonton is now covered by the Boonton Reservoir (also called the Jersey City Reservoir). This old section of Boonton served as the place of at least forges operating in the 18th century due to the proximity to the waterpower of the Rockaway River, to the River's falls that resulted from the glacial deposits, and to Morris, Sussex and Warren Counties' significant iron ore deposits, vast forests and limestone outcroppings that were the impetus for Morris County's iron mining industries.

[19] Portions of the history of Boonton and the ironworks is adapted from "Conditions Assessment and Recommendations Plan for the Arch Bridge Over the Rockaway River from the Boonton Ironworks," prepared by Connolly & Hickey Historical Architects, February 22, 2019; and "Conditions Assessment and Recommendations Plan for Train Trestle from the Boonton Ironworks," prepared by Connolly & Hickey Historical Architects, February 26, 2020.

[20] Peter C. Wendt, Jr., *Boonton Was an Iron Town* (Boonton, NJ: Boonton Historical Society, 1976), , 1-2.

After the route of the Morris Canal bypassed old Boonton in the late 1820s, there remained some industrial operations at old Boonton in the 19th century, though the majority of the new industrial activity, including the Boonton Ironworks, was developed close to the Morris Canal. By 1890, the Jersey City Water Supply Company had purchased much of the property referred to as old Boonton for the purpose of constructing a reservoir, which was built between 1902 and 1903, subsequently flooding the area.[21]

The majority of Morris County, including Boonton, is located within the Highlands physiographic region of New Jersey where the land is generally inadequate for farming but rich with iron ore. The area's extensive iron ore deposits were known to the Lenni Lenape, who used it to make powdered pigments and small tools, and were extracted by European settlers beginning in the late-17th century. Colonial ironmakers organized their furnaces and forges around specific natural resources. A combination of iron ore, charcoal from forests, limestone for flux and waterpower to drive bellows and triphammers was needed to be successful. Furnaces converted ore into pig iron, and forges mostly converted pig iron to wrought iron, although it was possible with a good grade of ore to convert it into small quantities of what was referred to as bar iron. Most locations had barely enough resources to support one furnace or forge, resulting in the colonial iron industry being dispersed within isolated communities. By later standards, the deposits of ore and resources of northern New Jersey were modest, but they were rich from the colonial standpoint and placed northern New Jersey among a handful of colonial iron-producing regions including eastern Massachusetts, western Connecticut, the Hudson Valley of New York, eastern Pennsylvania, and southern New Jersey. Ironmasters, as the skilled men who operated the furnaces and forges were known, had mostly learned their craft in Great Britain. They participated in a trans-Atlantic mercantile economy with trade based on carting the pig or wrought iron to port cities such as New York and Philadelphia for shipment overseas. By the beginning of the American Revolution, the future United States was the third largest iron-producing region in the world (behind Sweden and Great Britain) but was highly constrained by the British mercantile system that required American ironmakers to send pig iron and wrought iron to England for finishing into products like cookware, and also made illegal direct trade with the British empire's European rivals including France. Jobs created by these early forges and furnaces including quarrying, woodcutting, mining, and charcoal burning,[22] but the work force tended to be at a small scale. For instance, bloomeries, where wrought iron was made, were the earliest method used for iron making and consisted of a shallow masonry hearth that was fired by charcoal and was fitted with bellows to supply a forced draft. The craftsperson would take the bloom from the hearth and hammer the slag, which is what made the metal tough. These sites were usually fitted with water-powered hammers, were small in size, and were easy to use therefore not requiring a lot of labor.

[21] Maudie Fischer, Editor, *The Boonton Years: 1867 to 1967: Compiled for the Boonton Centennial Committee by the Citizen* (Boonton, NJ: Boonton Public Library, 1967), 6-7.
[22] Joseph J. Macasek, *Guide to the Morris Canal in Morris County* (West Orange, New Jersey: Midland Press, Inc., 1996), 6; Robert B. Gordon, *American Iron, 1607-1900* (Baltimore, Maryland: Johns Hopkins University Press, 1996), 59-78.

Tradition holds that the first recorded iron refinery in Morris County was the Troy forge on the Whippany River, established circa 1710.[23] It was followed by forges constructed at Dover in 1722 and Rockaway in 1730.[24] Circa 1714, a tract of land containing the Dickerson mine was purchased by John Reading from the proprietors of West Jersey, and he sold the land to Joseph Kirkbridge in 1716.[25] Located in what is now Mine Hill Township, the Dickerson mine is one of the oldest mines in not only Morris County but possibly the United States. (Refer to Figure 1 for a map showing abandoned mines in northern New Jersey, with a noted concentration of iron mines in Morris County and the Highlands region.)

The first record of iron operations in the region of Old Boonton was somewhat later circa 1747-48. At that time, it was noted that Obadiah Baldwin was operating an ironworks, but the extent and exact age of the operations is unknown.[26] David Ogden, a lawyer from Newark, purchased property in Old Boonton in 1759 and may have operated a forge either concurrent with Baldwin's operations or at the same location. Ogden may have been the first to name the area circa 1760 after Thomas Boone, the Royal Governor of the province at the time; the first time the name was written appears to be when Samuel Ogden, David's son, called it "Boon-Town" in 1771.[27]

Samuel Ogden became resident-manager of the ironworks at old Boonton in 1765, the year he graduated from King's College (Columbia University). Within five years, Ogden purchased the ironworks from his father, bought additional land on the opposite bank of the Rockaway River, and began to expand operations by constructing a rolling and slitting mill, likely to complement a forge. The whole expansion included purchasing the machinery from England; hiring two experts to erect and operate it; maintaining forge fires to reheat the iron prior to rolling and slitting; and constructing a dam, flume and water wheel to harness the waterpower. Samuel's brother, Isaac, and brother-in-law, Nicholas Hoffman, apparently provided some of the capital for this expansion.[28] A 1772 advertisement in the *New York Gazette and the Weekly Mercury* stated:

> SAMUEL OGDEN MANUFACTURES in the best manner, at his works in Booneton; bar iron for rudders, grist-mills, and saw-mills; share moulds, large and small, square and flat iron of all sizes; and also cart, wagon and chair tire. Which he will deliver at New York on the most reasonable terms, drawn agreeable to any given directions, immediately after application made therefore, to him at said works, or to Mr. Nicholas Hoffman merchant, in New-York."[29]

[23] James A. Kaser, "Iron Industry," in Maxine N. Lurie and Marc Mappen, *Encyclopedia of New Jersey* (New Brunswick, NJ: Rutgers University Press, 2004), 413.
[24] John T. Cunningham, *This is New Jersey* (New Brunswick, New Jersey: Rutgers University Press, 1968), 55.
[25] Edmund D. Halsey, "History of Morris County, Chapter VII: The Iron Industry of Morris County – Earliest Enterprises – Forges and Bloomaries," in *History of Morris County: 1739-1882* (New York: W. W. Munsell & Co., 1882), 39-48.
[26] Wendt, Jr., 3.
[27] Fischer, 4.
[28] Fischer, 4.
[29] Charles Shimer Boyer, *Early Forges & Furnaces in New Jersey* (Philadelphia: University of Pennsylvania Press, 1963) 43.

This ad is a good case in point of just how important iron was to a variety of users from shipbuilders to wagonmakers and wheelwrights, but Ogden may also have been flying close to what was legal per the provisions of the Iron Act of 1750. One of the trade and navigation acts passed by the British Parliament the Iron Act of 1750 made it illegal for American ironmakers to produce nails, iron plate or any edged tools such as knives, scythes or sickles. These limitations were sometimes ignored and also one of the many sources of frustration with Parliament that fueled the drive for American independence.[30]

After the American Revolution, Samuel Ogden leased the ironworks to John Jacob Faesch who managed the property until his death in 1799. After his death, Faesch's sons attempted to operate the facility but economic forces in the region, including declining markets and an exhaustion of the timber, which was used for fuel, caused the operations to fail. Both Faesch sons died at a young age and by 1821, the entire property was sold at auction to Israel Crane of Bloomfield (Montclair) and William Scott of Powerville (today Boonton Township).[31] Scott, an industrialist operating a gristmill and forge, constructed a new road from the east side of the river in old Boonton to his operations in Powerville circa 1822; the extent of his operations is unknown.

Origins and Early Operation of the Boonton Ironworks, 1829-1851

The Boonton Ironworks and the Morris Canal both began construction in the vicinity of Boonton in 1829 and started operations in 1831. During the late 1820s, in anticipation of construction, the Morris Canal Company acquired property in Boonton from William Scott along with the right to dam the Rockaway River above the Boonton Falls. In exchange, Scott received the right to use the canal as a raceway to power any mills built in the ravine below as long as the water eventually returned to the canal. This led to an increase in the value of his remaining property, which totaled approximately 200 acres.[32] The canal generally paralleled the Rockaway River along its north side. A gatehouse between the canal and pond above the dam controlled the flow of water from the river into the canal, and a floodgate allowed water from the canal back into the river. This source of abundant waterpower and relationship with the Morris Canal was essential to the technological success of the Boonton Ironworks; it was by far the largest such water-sharing arrangement on the canal[33] (see below for more on the Morris Canal's transportation significance under Criterion A).

By 1830, Daniel Wetmore, an iron merchant from New York, had acquired property in Boonton from William Scott and others, and by the following year had sold it to the New Jersey Iron Company, which he formed along with other investors.[34] The iron company constructed puddling furnaces and a rolling

[30] Arthur Cecil Bining, *British Regulation of the Colonial Iron Industry* (Philadelphia: University of Pennsylvania Press, 1933).
[31] Fischer, 6.
[32] Arthur Rabin, *Voices of America: Boonton, NJ* (Charleston, SC: Arcadia Publishing, 2001), 27.
[33] Barbara N. Kalata, *A Hundred Years a Hundred Miles: New Jersey's Morris Canal* (Morristown, NJ: Morris County Historical Society, 1983), 180.
[34] Deed, David W. Wetmore and wife to New Jersey Iron Company; Deed Book C3, page 258. Morris County Clerk Records Vault.

mill between the canal and the river for a cost of $283,000. Experienced iron workers and machinery were brought from England, with the first shipload of families and equipment arriving from Staffordshire in June of 1830 and a second shipload later that year.[35] Operation began in May 1831 under the supervision of Wetmore and William Green, who utilized the canal in the agreed-upon way, diverting the water into a retention pond to power its rolling mills. The ironworks depended on the canal to bring iron ore to the site and carry away the products.

Originally, everything was contained within the rolling mill building, but operations grew extensively in the following decades. Much of the Boonton Ironworks operations focused on the production of sheet iron and different kinds of bar iron. A charcoal furnace was built in 1833, and in 1840, the New Jersey Iron Company reported complete success of puddling[36] iron using anthracite coal, believed to be the first time this was ever accomplished. A newspaper article at the time stated this discovery would "…enable our iron manufacturers to supersede the foreign articles, and supply the market at greatly reduced prices."[37] In 1848, an iron furnace fueled by anthracite coal (resource #3) was built. By this time, the Boonton Ironworks also controlled its own iron mines making it a fully integrated works with the exception of relying on sources of coal in northeastern Pennsylvania. Boonton is believed to be only the second anthracite-fueled furnace constructed in New Jersey[3839] and its construction was supervised by Samuel Thomas, son of David Thomas, a Welsh ironmaster responsible for bringing hot blast manufacture in the British fashion to America in 1840[40] at the Crane Iron Company in Catasauqua,

[35] Lawrence Korinda, *Profile of Boonton: An Architectural and Historical Perspective* (Pittsburgh, PA: Carnegie-Mellon University, An Independent Study, May 6, 1975), 5.

[36] The first type of furnace to be designed specifically for anthracite coal was the puddling furnace. (In Britain, bitumen coal was the product used, which was also used west of the Alleghany Mountains) The puddling furnace, which was first developed in the 1780s in Britain, allowed for wrought iron to be produced at a large scale. It was first used in the United States in the early-19th century and required less skill than the bloomery or finery furnaces and also resulted in the fuel cost savings. In the puddling process, the furnace was separated into three parts thereby separating the combustion chamber from the pig iron so that the sulfur released from the coal during firing was not entrained in the iron. The produce from the puddling furnace was similar to the finery furnace, that is bars, sheets, and plates produced in the rolling mill but at a larger scale at lower costs. Reference: Gray & Pape, Inc., "National Historic Landmark: West Point Foundry Archaeological Site." (Washington, D.C., National Park Service, Oct. 2, 2020.) 12.

[37] "Important Discovery in the Iron Manufacture," *Staunton Spectator and General Advertiser* (August 20, 1840). https://chroniclingamerica.loc.gov/

[38] Rabin, 28. The first to use anthracite was Stanhope Furnace in Stanhope, Sussex County, which went into blast in 1841.

[39] By 1846, there were 42 anthracite-fired furnaces in Pennsylvania and New Jersey and by 1856, 121 in the country of which four were located in New Jersey. Reference: James Moore Swank, *History of the Manufacture of Iron in All Ages: And Particularly in the United States for Three Hundred Years, from 1585 to 1885* (The Author, 1884), 273-274.

[40] According to several sources, the use of anthracite coat in hot-blast furnaces was first experimented in the United States by Rev. Dr. Frederick W. Geissenhainer, a Lutheran clergyman living in New York City in 1837. His experiments showed that "iron ore could be smelted with anthracite coal by applying 'a blast, or a column, or a stream, or a current of air in or of such quantity, velocity, and density or compression as the compactness or

Pennsylvania. In the 1840s, cut nails were added as a Boonton Ironworks' product, with a factory (resource #6) built near the top of the adjacent inclined plane (resource #13) of the Morris Canal.

The transition from charcoal to anthracite as blast furnace fuel was a significant technological transition that remains of abiding scholarly interest since the challenges faced in America are poorly understood and ironmasters of the time either lacked the scientific knowledge to explain why some furnaces succeeded and others did not, or more likely chose not to write down their knowledge treating it as a trade secret. Pennsylvanian ironmasters began to experiment with anthracite in the 1820s but failed time and again since burning anthracite could not reach a high enough temperature to metal iron in the furnace without a preheated blast. Success was hard won but between 1838 and 1841 at least nine furnaces in Pennsylvania and one in New Jersey were smelting with anthracite. Several of the Pennsylvania furnaces have claimed to be the first, but it was probably the Baughman Guiteau & Company furnace at Mauch Chunk in 1838, not the David Thomas furnace at Catasauqua in 1840. The first to use anthracite in New Jersey was Stanhope Furnace in Stanhope, Sussex County, which went into blast in 1841. Anthracite furnaces required massive blowing engines and ovens in which air could be preheated before being blown into the furnace stacks loaded with iron ore, anthracite for fuel and limestone for flux. Variation in the configurations of ovens, pipes and methods of capturing waste heat to improve efficiency were numerous and very often closely held secrets for which archival documentation is non-existent or sketchy.[41]

The successful establishment of the Boonton Ironworks in the 1830s went hand-in-glove with the growth of residential and commercial areas for the ironworkers. Most of this community development, which in its early years had characteristics of a company town, stands today along Plane Street north of the ironworks and the Morris Canal. The company built houses, a store, and a school for the workers and their families along present-day Plane Street; however, the population soon outgrew this area and building expanded leading to the creation of Main, Church, and Birch Streets around 1833, portions of which are the Boonton Historic District. During this time the company constructed what is today known as the Esten House, which until 2022 stood adjacent to the inclined plane. Possibly originally constructed as a boarding house for single ironworkers, by the mid-19th century it was the home of George W. Esten, a carpenter in charge of the pattern shop and all carpentry at the ironworks; Esten eventually rose to superintendent of the ironworks. He was actively involved in the community, including founding several Sunday schools for the iron company. [42] He and his family lived in the house by the inclined plane until 1875 when they moved to a new house he built in the Park neighborhood on the south side of the river.

density and the continuity of the anthracite coal requires.'" (Swank, 267.) The first furnace using this technology was constructed near Pottsville, Pennsylvania. The doctor's first furnace did not produce for long, and he passed away before he could perfect the technology. (Swank, 267) Others were working on similar technologies and soon the hot-blast furnace was more widely employed but appears to have mostly been taken the technologies developed in Great Britain.

[41] Gordon, 155-160; Anne Kelly Knowles, *Mastering Iron: The Struggle to Modernize an American Industry, 1800-1868* (Chicago: University of Chicago Press, 2013), 151-169.

[42] Boonton Historical Society, "George Washington Esten," *Gem of the Mountains* (February 2021), 2-3.

In 1848, James E. Serrell surveyed the two-hundred acres for the New Jersey Iron Company for the purposes of laying out streets and property lots.[43] The iron company built homes for lease or purchase but also began to sell lots for residential and commercial development, encouraging its employees to buy land from them on what the company considered agreeable terms. While Boonton began as what was essentially a company town, it relatively quickly transitioned to most homes and businesses being non-company private property by the 1850s. In the following decades the character of the town changed dramatically with significant residential and commercial development along Main Street and to its north and southeast.[44] Much of the town's business district was concentrated along Main Street.[45] Furthermore, the company provided land and money to build schools and churches to meet the needs of the growing community including the First Presbyterian Church, Our Lady of Mount Carmel Church, St. John's Episcopal Church, and Boonton Methodist Church. These churches and their denominations generally reflected the workers who immigrated to the United States to work in the ironworks and mines and along the canal and railroads.[46]

The Heyday of Boonton Ironworks under Fuller & Lord, 1852-1876

Due to tariffs[47] and a decrease in the market price for nails in 1851, the New Jersey Iron Company was forced to close. During its existence, the Company produced 6,000-8,000 tons of bar iron or 100,000 casks of nails annually, and was described as having, "…the best facilities of power, machinery and transportation…"[48] The ironworks property was sold at auction in 1852 to Dudley B. Fuller (1800-1868), a commission merchant (i.e., middleman) for the iron company, and John Durand; both Fuller and Durand were two of the company's creditors.[49] Fuller formed a partnership with James Couper Lord (1827-1869),[50] utilizing the name of Fuller, Lord, & Company; the operation was commonly known as

[43] Korinda, 7.
[44] Korinda, 9.
[45] Acroterion, *Morris County Historic Sites Survey: Boonton,* (Morristown: Morris County Heritage Commission, 1986), 5.
[46] In broad terms, immigration in the early-to-mid-19th century tended to be from Great Britain, including England, Scotland and Wales, and from Ireland, Scandinavia, Germany, and Prussia. Immigrants from Asia, namely from China and Japan, came primarily to California beginning in 1849. After the Civil War, the U.S. Government began to place restrictions on immigration with Irish and German immigration continuing but a larger group of Europeans came from Italy, Hungary, Poland, Greece, and Armenia, and Jewish people from Russia to escape persecution. This level of immigration was instrumental in both the many successes of the Industrial Revolution and the expansion into the Mid-Western and Western portions of the United States that eventually brought competition to New Jersey's iron mines and iron-producing industries.
[47] "Sale of Boonton (N.J.) Iron Works," *Alexandria Gazette* (June 1, 1852). https://chroniclingamerica.loc.gov/
[48] "Sale of Boonton (N.J.) Iron Works."
[49] Deed, Abraham Toppen, Sherriff to Dudley B. Fuller and John Durand; Deed book Z4, page 68. Morris County Clerk Records Vault.
[50] In 1852, Dudley Fuller sold a one-third share interest of his Boonton property to James Brown (deed book Z4, page 466), who then in 1856 sold that same share to James Couper Lord (deed book M5, page 34). In 1857, Fuller sold a one-sixth share to Lord making them equal partners (deed book M5, page 54).

the Boonton Ironworks and experienced quick prosperity. As noted by Jacob W. Miller in his speech "The Iron State – Its Natural Position, Power and Wealth" presented to the New Jersey Historical Society in 1854:

> In the year 1851, one of the largest iron manufacturing establishments in the county of Morris was compelled, by the ruinous state of the iron trade in this country, to undergo the mortal process of a sheriff's sale. In the hands of its new owners, and under a more auspicious state of the market, its fires were re-kindled in 1852, and during the last year "Boonton Iron Works" [sic] used 11,600 tons of Jersey magnetic ore, consumed 23,000 tons of Anthracite coal, 3,000 tons of limestone, 6,600 tons of pig iron, employed in its operations 600 men, paid out for wages $22,000 per month, and manufactured 6,500 tons of nails and railroad spikes.[51]

In July of 1860, the Boonton Ironworks was the subject of an article in *Harper's New Monthly Magazine* called "Among the Nail-Makers," which provides a contemporary description of the ironworks. The article follows two brothers, dubbed Neutral Tint and Snell and later identified as John William Orr and Nathaniel Orr, as they traveled to Boonton in late 1859 to tour the ironworks. They traveled on the Morris Canal from Kenvil to Powerville, then traveled on foot to Boonton, on the way observing the town from atop Torn Mountain, remarking, "The village of Boonton is beautifully situated – so far as a charming prospect is concerned – upon the – almost precipitous – face of a bluff, which forms one of the sides of a deep ravine through which the Rockaway River empties its waters into the plain below."[52] The brothers were wood engravers and sketches that they made along their trip accompanied the article. They toured the ironworks over two days following the complete process for manufacturing nails from ore to finished product.

What the Orrs described was an integrated ironworks, which was sufficiently large and novel enough in the early 1850s to be worth an entire article in *Harper's,* which was on its way to becoming one of America's most recognizable and prestigious monthly magazines featuring literature, politics, finance and the arts. The men were also treated to a nighttime drawing off of the slag, also called lava, from the blast furnace into the Rockaway River, an eye-catching activity that later proved to alter the course of the river from the built-up cinders.[53]

The uniqueness of Boonton as an integrated ironworks is difficult to assess objectively because iron industry records and census records in the 1840s and the 1850s used non-standard nomenclature with most of the effort geared toward assessing production volumes of pig iron and bar iron in tons. For

[51] Jacob W. Miller, "The Iron State – Its Natural Position, Power and Wealth" Address, Delivered Before the New Jersey Historical Society at its Nine Annual Meeting, Held in Trenton, on Thursday, Jan'y 19th, 1854 (Newark: Printed for the Society at the Daily Advertiser Office, 1854), 12.
[52] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 153.
[53] Letter from George [illegible] to John Schultze, general manager of the estate of James Couper Lord, December 6, 1883. Boonton Iron Works Records, 1876-1900. North Jersey History and Genealogy Center, The Morristown and Morris Township Library.

example, it can be said with relative certainty that New Jersey ironmakers produced 11,000 tons of pig iron and 7,000 tons of bar iron in 1840, which was less than 4 percent of the total production of the entire United States. Pennsylvania, Ohio, New York, Kentucky, Virginia and Tennessee all surpassed New Jersey, with Pennsylvania by far the largest producer with over one-third the national total. The expansion of the American iron industry in the 1840s and 1850s was truly astounding with pig iron increasing from about 285,000 total tons produced in 1840 to 752,000 tons in 1856, an almost three-fold increase in about 15 years.[54]

Despite the iron industry's rapid and accelerating growth, integrated ironworks like Boonton Ironworks were still relatively rare and largely not becoming common until after the Civil War with the consolidation of the industry into large integrated companies like Cambria and Carnegie, which were to become household names. This lack of integration was because furnaces were pulled toward coal and iron mining regions to be close to the bulk raw materials, and rolling mills were pulled toward canals or railways near manufacturing cities so that they could quickly respond to the numerous manufacturers who needed iron to make secondary products. The Boonton Ironworks was uniquely well-positioned to integrate due to its symbiosis with the Morris Canal and proximity to high-grade, but relatively modest, bodies of iron ore in northern New Jersey. Its location on the main canal route from Pennsylvania's anthracite region to the manufacturing and port cities of Newark and New York placed it convenient to the manufacturers that need its rolled and cut nails and related rolled iron products like sheet. The number of comparative examples of integrated works were few during the antebellum period. The first American ironworks where almost all stages of production were at a single location is believed to have been the Mount Savage Ironworks in Allegany County, Maryland, established in 1839. Furnace companies existed in the hundreds but rarely considered forward linkages to iron processing at puddling furnaces or mills. The Lehigh Crane Iron Company briefly considered acquiring a rolling mill in 1844-46 but the board of directors let the idea drop. That the Boonton Ironworks took this leap forward in 1848 is of exceptional note and predates by six years the famed Cambria Iron Works of Johnstown, Pennsylvania, which integrated in 1853-54.[55]

Another factor complicating the challenges to succeeding with an integrated ironworks was recruiting, managing and retaining a wide range of unskilled, semi-skilled and skilled workers, many of whom held attitudes hostile to management in an enterprise with increasingly modern characteristics of top-down hierarchical organization. An anthracite furnace operation required foundrymen to oversee the charging of the furnace and keeping it in good repair; engineers to maintain the blowers and waterpower systems; chargers to load the furnace; keepers of the furnace to regulate the air pressure; casters to tap the furnace and cast the pigs; slag loaders to draw off and remove the slag from the casting house; and wagoneers to pile the iron pigs, load wagons, and supply sand and clay. The puddling and rolling mill operations required an entirely different set of labor skills including puddlers and their assistants to convert pig iron into wrought iron, rollers and catchers to mill the iron bars, heaters to preheat the iron in furnaces before it was worked, annealers for cooling the iron for strength, hammermen to operate the forges, machinists

[54] Benjamin F. French, *History of the Rise and Progress of the Iron Trade of the United States* (New York, 1858), 64; J. P. Lesley, *The Iron Manufacturer's Guide* (New York: Wiley, 1859), 747.
[55] Knowles, 168.

and blacksmiths for keeping the mills in good repair, and engineers to manage the waterpower system. Other operations at Boonton would have also had their own separate workforces including the nail factory, sawmill, storage sheds for raw materials and the offices. At its peak, the number of workers employed at Boonton number over 600 men.[56]

The scale and complexity of the operations at Boonton Ironworks are well illustrated by the 1868 Beers Atlas of Morris County (Figure 4).[57] It depicts the ironworks at its peak and in detail with the following buildings labeled: blast furnace (resource #3), office, nail factory (resource #6), store house, dumping sheds, annealing house, foundry, weigh house, black smith shop, rolling mill, nail plate mill, coal sheds, keg store house, saw mill, a second nail factory, and drying house. Other key features include the Morris Canal (resource #12) and inclined plane (resource #13); the Boonton Branch of the Morris & Essex Railroad with industrial spur to the ironworks including engine house (resource #16), turn table (resource #15), and trestle (resource #17); multiple foot bridges across the river; and walking paths and unmarked on the opposite side of the river.

Fuller and Lord achieved the operations' peak of production during the 1860s and into the early 1870s (by which time the operation was run by their estates); for example, it produced over 200,000 kegs of nails per year.[58] Fuller and Lord also owned portions of the mining operations in Hibernia and Mount Hope, and the Beach Glen, the Hope, the Mount Pleasant, and the Swede mines, thereby supplying their own iron to the ironworks. A second anthracite coal-fueled blast furnace (resource #3) was completed around 1868.[59] In the 1866 *New Jersey State Business Directory,* Fuller, Lord & Co. was listed under "Nail Manufacturers and Iron Founders, forges, etc."[60] During this period, the following men were employed in key roles at the ironworks: William G. Lathrop was the general agent; Philip Wootten was in charge of the furnace and forge; George W. Esten was the outside superintendent; G. M. Gage was in charge of the saw mill, H. W. Crane was in charge of transportation; Harry C. Jenkins (preceded in the same role by his father George Jenkins) was manager of the blast furnace, and Paul Glover was in charge of the foundry.[61]

Fire was always a concern at ironworks where so much hot metal, sparks and combustible materials existed in close proximity. In 1866, a stone arch bridge (resource #8) was constructed to carry a pipe

[56] Rabin, 28.
[57] *Atlas of Morris County., New Jersey from actual Surveys by and under the direction of F. W. Beers* (NY: F.W. Beers, A.D. Ellis & G.G. Soule, 1868), page 30.
[58] Rabin, 28. (The peak of operations for the Morris Canal was also in the 1860s through the 1880s.)
[59] "The New-Jersey Mineral Region: Iron, Zinc, Copper, Franklinite Lead and Graphite. Effects of War and Peace on Domestic Industry. Boonton, Rockaway, Dover, Franklin, etc. What is Finally Done with the Ore. The March of Improvement," *The New York Times* September 4, 1865.
[60] Talbott and Blood, *New Jersey State Business Directory for 1866,* (New York: Talbott and Blood, 1866), 150 and 177.
[61] **"**The New-Jersey Mineral Region: Iron, Zinc, Copper, Franklinite Lead and Graphite. Effects of War and Peace on Domestic Industry. Boonton, Rockaway, Dover, Franklin, etc. What is Finally Done with the Ore. The March of Improvement."

across the Rockaway River with a continuous water supply to the ironworks, separate from the water supply from the Morris Canal, which was used as a source of power to propel waterwheels and turbines. (See below for more on the stone arch bridge's significance under Criterion C).

The years of major growth and development surrounding the operations of the ironworks and the coming of the railroad may have been driving factors in the incorporation of the Town of Boonton, which separated from the Township of Boonton in 1867. Like their predecessors, ironworks owners' Fuller and Lord sold lots for residential development near Main Street[62] resulting in continued development radiating out from it. After the coming of the Morris & Essex Railroad branch line in 1867, residential development in Boonton moved to the other (south) side of the Rockaway River, to an area called the Park, which overlooks the ironwork's site and forms a discrete change in land use along the district's southern boundary. This area, which consisted of curved roads and "large high-style houses surrounded by mature specimen trees,"[63] was owned by Fuller and Lord who intended to construct residences for themselves and sell the remaining lots for residential development.[64] Fuller's home was constructed in 1867, however development in the Park area was limited until the 1880s, after Fuller's death. This section of town ultimately attracted businessmen from New York who settled in Boonton due to the convenience of commuting by rail from New York City.

Dudley Fuller died in 1868 and James Couper Lord in 1869 at the height of the ironworks' success. Fuller's will stipulated that his manufacturing and mining property in Boonton be held by his executors and run in a similar manner until an appropriate sale was made; all profits were to go to his wife and children.[65] Similarly, Lord's will stipulated that his businesses be held by his executors until appropriate sale, and if possible, should be made within five years.[66] In 1876, Lord's estate was granted ownership of the majority of the ironworks property by a decree of partition from the Chancery Court.[67]

The Boonton Ironworks only remained fully operational until 1876 due to several factors including the

[62] Alex D. Fowler, National Register nomination for Boonton Historic District, (April 1976), section 7, page 8.
[63] Acroterion, 3.
[64] The area is said to have been designed by Calvert Vaux, a prominent architect associated with propagating the Picturesque movement in the mid-to-late-19th century, but no concrete evidence of this exists. A landscape drawing exists for a "Plan of Property at Boonton, N.J. as laid out by Olmsted, Vaux, and Co. Landscape Architects," dated 1867, which was a design for the home of Dudley Fuller; however, it is not known if this landscape design was realized or if the firm designed the larger residential development in addition to Fuller's home. Vaux worked with other prominent architects and landscape architects, and his ideals helped to influence park and residential development in the growing suburbs of the late-19th century. Plan of Property at Boonton, N.J. as laid out by Olmsted, Vaux and Co. Landscape Architects, 1867/8. In the collection of the Boonton Historical Society.
[65] Ancestry.com. *New York, Wills and Probate Records, 1659-1999* [database on-line]. Provo, UT, USA: Ancestry.com Operations, Inc., 2015.
[66] Ancestry.com. *New York, Wills and Probate Records, 1659-1999* [database on-line]. Provo, UT, USA: Ancestry.com Operations, Inc., 2015.
[67] Final Decree in Partition, Between Edward C. Lord, etc. and George Fuller., etc.; Deed book Q9, page 1. Morris County Clerk Records Vault.

economic Panic of 1873; a damaging fire at the ironworks in August of 1873;[68] the discovery of iron in the western part of the United States, which dramatically changed the iron industry in New Jersey overall by the late-19th century; and the market's shift from cut nails to wire nails. The ironworks ceased to function at its previous levels ever again, and the Boonton fell into an economic decline. After 1876, parts of the ironworks were leased intermittingly but they never resumed full operation.

Boonton Ironworks in Decline and Subsequent Industries, 1876-1929

The estate of James Couper Lord remained owner of the ironworks' various related properties for more than a half century from the time Lord died in 1876 to the time the estate donated the land and ruined ironworks to the Town of Boonton in 1929. The Lord family attempted time and again to find partners to restart ironmaking or to find industrial tenants, but none resulted in long-term stability or employment levels seen prior to 1876. The archived business records from 1876-1900[69] provide a glimpse into the ongoing day-to-day business of maintaining the property. Included in the records are offers to purchase machinery or lease portions of the ironworks; estimates for needed repairs at the ironworks; the price of nails; and instructions to a lessee about firefighting precautions, among various other business correspondences. Some correspondences reference a Mrs. Lord, presumably James Couper Lord's widow, and a Mr. Nicoll, his son-in-law, married to his daughter Grace, indicating his family remained involved with running the estate. In 1879-1880, the blast furnaces were repaired, and members of Lord's family were present for a ceremonial test lighting.[70] During the 1880s, Joseph Wharton[71] leased portions of the property and tried to revive the ironworks. Correspondence from 1886 indicates there was some dispute with Wharton; it is noted the furnace was not in blast that year and the following year the property was noted as for sale. An undated 13-page description found in the records, possibly from when the property was for sale, titled "Discription [sic] of Real Estate belonging to Est of J Couper Lord at Boonton, NJ," describes the ironworks in detail including the conditions of the various buildings and features and estimated costs to repair them. That same year, the Boonton Iron and Steel Company agreed to lease the rolling mill for five years. These records, although far from transparent, suggest that the integrated ironworks that Fuller and Lord had worked to maintain was breaking apart with the blast furnace operations separating from the puddling and rolling mill operations. This essentially represented a devolution of the business model that had resulted in several decades of success, resulting in operations that looked more and more like those characteristic of northern New Jersey's iron industry that was finding itself at an increasing economic and technological disadvantage to the large and

[68] "Great Fire in Boonton, N.J.," *New York Times* (August 26, 1873). Retrieved through ProQuest Historical Newspapers: The New York Times with Index, *New York Times (1857-1922)*.
[69] Boonton Iron Works Records, 1876-1900. North Jersey History and Genealogy Center, The Morristown and Morris Township Library.
[70] "Boonton Iron Works," *Morris County Chronicle* (December 26, 1879). https://chroniclingamerica.loc.gov/
[71] Wharton, a well-known businessman, is also famous as the founder of the Wharton School at the University of Pennsylvania. In addition to his involvement with New Jersey's iron industry, Wharton's legacy in the state also includes his vast landholdings in south Jersey, which now form the center of Wharton State Forest, a New Jersey state park. Source: Yates, W. Ross, *Joseph Wharton: Quaker Industrial Pioneer* (Bethlehem, PA: Lehigh University Press, 1987).

increasingly integrated iron and steel works in places like Bethlehem, Johnstown and Pittsburgh, Pennsylvania, as well as works all around the Great Lakes at Buffalo, Cleveland and Chicago.[72]

The property did not sell, and the blast furnaces, nail machines, and many other buildings were dismantled in the 1890s. On the 1892 Sanborn map, it is noted "The blast furn's & adjoining bldg's are slowly being torn down," and several buildings are indicated as being dilapidated and vacant.[73] At the time, the Lincoln Iron Works and the Boonton Iron and Steel Company were leasing the rolling mill with puddling furnaces; the New York Agricultural Works was leasing the iron foundry and an adjacent manufacturing building; the Wrought Iron Paint Company were leasing a small grouping of buildings; and the Interchangeable Tool Company, W. C. Boone Manufacturing Company, and Loando Hard Rubber Company were occupying buildings near the lower nail factory, some of which had been enlarged. On the 1900 Robinson Map of Boonton, the majority of the ironworks property and the residential area on the opposite (south) side of the Rockaway River were still owned by Lord's estate and two smaller parcels near the Morris Canal were owned by Fuller's estate.[74]

Various industries continued to occupy the former ironworks site in the early-to-mid-20th century utilizing portions of some remaining 19th-century buildings, as well as constructing several new buildings. Some portions of the property were sold while others were leased by Lord's estate. The Boonton Iron and Steel Company continued to operate a portion of the site until 1913.[75] The property continued to suffer from fires during this period, including in 1909 and 1911.[76] In 1921, four industries occupied the former ironworks property: Paige and Jones Chemical Company, George Benda, Inc., Louis Sacks Iron Foundry, and Hubbard Oven and Manufacturing Company. George Benda, Inc., manufactured bronze powder called "Bendalin," which was used for gilding radiators and other similar applications.[77] The Louis Sack's Iron Foundry opened in 1909, manufacturing iron lasts for shoemakers and repairers. The Paige and Jones Chemical Company opened in 1919, manufacturing varnish used in printer's ink, Clarion core oil, and Clarion cutting oil; they employed around twenty men.[78] The Hubbard Oven and Manufacturing Company of Chicago, which began operation in 1919 in the general location of the old rolling mill, produced portable baker's ovens and employed over thirty local men.[79] Other industries in Boonton at that time, though not located at the former ironworks, included E. A.

[72] Lease agreement, John Crosby Brown, et als, Extrs to the Boonton Iron and Steel Co.; Deed book L12, page 200. Morris County Clerk Records Vault; Robert B. Gordon and Patrick M. Malone, *The Texture of Industry: An Archaeological View of the Industrialization of North America* (New York: Oxford University Press, 1992), 159-164.
[73] "Boonton Morris Co., NJ," (NY: Sanborn-Perris Map Co., Limited, 1892), sheets 5 and 6.
[74] E. Robinson, "Map of Boonton, Morris Co. NJ," (NY: E. Robinson & Co., 1900).
[75] "Steel Works Shut Down," *Newark Evening Star and Newark Advertiser* (August 5, 1913). https://chroniclingamerica.loc.gov/
[76] "Boonton Iron Works Is Partially Burned: Modern Part of Plant, However, Is Saved," *Newark Evening Star and Newark Advertiser* (May 13, 1911). https://chroniclingamerica.loc.gov/
[77] Russell J. Conn, *Boonton: Our Own Town* (Boonton, NJ: Hitchcock Press, 1921), 9.
[78] Russell J. Conn, *Boonton: Our Own Town* (Boonton, NJ: Hitchcock Press, 1921), 13.
[79] Conn, 13.

Stevenson and Co., Inc., Yale Piston Ring Co., Van Raalte Co., Pelgram and Meyer, E. H. Bowers Manufacturing Co., the Boonton Rubber Manufacturing Co., and the Anderson Silk Co.[80] These industries and manufacturing establishments attracted a small wave of development in Boonton; this included new immigrant communities settling in the outer regions of the centrally developed sections of the town. Boonton's residential development continued into the early-20th century but never to the scale as seen in the mid-to-late 19th century. The estate of James Couper Lord remained owner of a large portion of the former ironworks property on the north side of the Rockaway River until 1925, when the Jersey Corporation, a group of electrical power companies that had been leasing part of the ironworks since 1912, purchased the remaining property.[81]

Grace Lord Park, 1929 to present (after the period of significance)

In 1929, the estate of James Couper Lord deeded the large park space on the opposite (south) side of the river to the Town of Boonton in honor of Grace Lord Nicoll, daughter of James Couper Lord. The deed stipulated the property was, "to be used for a public park to be known as 'Grace Park'…"[82] This scenic park space had been a popular destination since the late-19th century, largely in connection with the development of the adjoining Park residential neighborhood. An 1873 article in the *Boonton Weekly Standard* stated, "On the opposite side of the river from the town, quite an extensive park has been projected and diverse fine residences have been erected."[83] The path along the west/south side of the Rockaway River with views of the Falls was known as Lover's Lane. Beginning in the 1870s, the park began to attract summer visitors, and there was discussion in the 1880s of building a hotel near the falls.[84] In the early-20th century, the former residence of Dudley Fuller was made into a summer resort called the Puddingstone Inn. During the 20th century, Grace Lord Park featured a bandstand; was the site of concerts, annual Christmas caroling, and various organized events; had an organized life-saving corps for supervised swimming in the river, known as the town beach; and was the starting point for Town parades. By 1949, in addition to the park, the Town of Boonton had acquired all of the core of the former Boonton Ironworks[85] property, with the exception of two industrial lots that remain today in private ownership. Limited built remains exist from the ironworks, canal, and railroad and there are aboveground and underground archeological remains throughout sections of the park.

2. Significance in the Area of Transportation (Criterion A)

[80] Conn, 11.
[81] "Jersey Utility Buys Old Iron Nail Mill: Boonton Factory, Deserted for Thirty Years, Has Valuable Water Power Rights," *New York Times*, July 20, 1925, page 20. Deed, James Couper Lord Estate Co. to The Jersey Corporation; Deed book P29, page 178. Morris County Clerk Records Vault.
[82] Deed, James Couper Lord Estate Co. to The Mayor and Board of Aldermen of the Town of Boonton; Deed book A32, page 408. Morris County Clerk Records Vault.
[83] Korinda, 46 quoting 1873 article in the *Boonton Weekly Bulletin*.
[84] Korinda, 46.
[85] Deed, Jersey Central Power & Light Company and Town of Boonton; Deed book O37, page 321. Morris County Clerk Records Vault.

Summary – The Boonton Ironworks Historic District is illustrative of significant pattern of events in transportation history that illustrate just how essential the mid-19th-century "transportation revolution" of canal and railroad technology was to the transformation of the United States into an industrial nation. These patterns of transportation events, typically described as steps in the planning, construction, opening, operation, improvement and abandonment of canal and rail systems, played out at local places throughout the country in myriads of site-specific ways. In this instance, what is clearly observable in the surviving resources at Boonton Ironworks is the spatial organization and infrastructure needed to link an innovative integrated ironworks of the mid-19th century with first a combination canal and waterpower system, beginning in 1829-31, and later a railroad branch line in 1867. These transportation systems also are informed by the topography of the historic district with the canal framing the ironworks' northern boundary and the railroad branch line its southern boundary, with tendrils from both the canal and railroad systems extending into the ironworks, illustrative of just how complex the initial construction and evolution of these systems were. This connective tissue consists of evidence of above and underground water supply systems directing water from the canal to the races and wheelpits that held the wheels and turbines that once powered machinery throughout the ironworks, as well as storage areas for the anthracite and iron ore that arrived by canal. This ironworks water supply system is symbiotic with the Morris Canal, which is also individually listed on the New Jersey and National Registers of Historic Places as a 107-mile-long cross-state corridor. Within the Boonton Ironworks Historic District is a section of the canal prism and Inclined Plane 7 East, one of the engineering marvels that set the Morris Canal apart from but a handful of other canals that relied entirely on locks to lift and lower canal boats. From a railroad perspective, a bridge, turntable and railroad grades provide evidence of the planning and operation of industrial spurs that extended throughout the ironworks to deliver raw materials and removed finished product and waste. Both the canal and railroad were essential to connecting Boonton ironworks with markets in Newark, New York City and other manufacturing centers; the Morris Canal remained in operation at the works until 1929.

The Morris Canal - Overview

Prior to the completion of regional railroad systems at the end of the middle third of the 19th century, it was generally accepted that overland transportation was inferior to that of waterways for freight and bulk products like ore, coal and lime. Regions of the Northeast and upper Midwest, in particular, for a time relied on canal systems to reduce both the time and the cost of overland haulage.[86] Businessmen in northern New Jersey recognized the success of canals elsewhere, particularly New York State's Erie Canal completed in 1825, and precursor canal systems in England and France that dated to the 18th century, and began to plan for such technology in order to better manufacture and transport the iron products of their region.

The first major transportation advance in the area came with the creation of the Morris Canal, the construction of which began in 1825. Throughout its existence, the Canal carried anthracite coal from Pennsylvania and the iron ore from the hills of northwestern New Jersey to the forges and furnaces in

[86] Spiro G. Patton, "Canals in American Business and Economic History: A Review of the Issues." *Canal History and Technology Proceedings*: Volume VI March 28, 1987, ed. Lance E. Metz, 5 and 7.

Morris, Sussex and Warren Counties in New Jersey. The iron product was then transported along the canal from New Jersey to New York harbor. The canal was intended to inject new life into New Jersey's colonial iron industry, which suffered in the early national period due to a want of an efficient and abundant fuel source and a means of transporting the iron product to market. George Macculloch, a businessman from Morristown, had the idea to build the canal using water from Lake Hopatcong to connect the drainage of the Rockaway River with that of the Musconetcong River.[87] On December 31, 1824, the New Jersey Legislature granted a charter to the Morris Canal and Banking Company for the construction of the canal. Macculloch's idea came to fruition as the Morris Canal was built section-by section over the course of seven years. When construction finished in 1831, the canal connected Phillipsburg to Newark and required 23 lift locks and 23 inclined planes in order to accommodate a 1,674-foot change in elevation.[88]

In November 1831, when the first full trip was undertaken on the Morris Canal between Phillipsburg on the Delaware River and Newark at the mouth of the Passaic River, the course of the waterway extended for a distance of just over 90 miles. This journey generally took around five days to complete. An 11.75-mile extension was opened from Newark to Jersey City in 1836, giving the canal an overall length of 102.15 miles. With other associated feeders and basins, the overall canal length was almost 110 miles.

In sharp contrast to New Jersey's other major canal, the Delaware and Raritan, which was constructed in 1831-34 as a "contour" canal (i.e., it followed a meandering course taking the line of least topographic resistance), the Morris Canal struck out boldly across the physiographic "grain" of the rugged New Jersey Highlands. From its western terminus on the Delaware River, the route climbed 760 feet to the summit at Lake Hopatcong, and the easterly arm rose a remarkable 914 feet from sea level. These substantial elevation differences along the canal route were overcome by an innovative canal-building technology: water-powered inclined planes, as opposed to cumbersome flights of locks, were used to climb changes in elevation greater than 20 feet. The particular engineering feature is one of the Morris Canal's principal claims to fame and sets it apart from other canals in the region.

Again, in contrast to the Delaware and Raritan Canal, which used a 22-mile-long feeder canal as its main source of water supply, the Morris Canal drew water from a variety of smaller drainages along its route. The summit level, however, made use of Lake Hopatcong in the Musconetcong drainage, one of the largest water bodies in the western part of the State.

The canal operated for almost a century, reaching its apogee in terms of volume in the mid-1860s. Numerous settlements along its course experienced intensified development during these years. These included several well-established, pre-existing towns (such as Phillipsburg, Washington, Dover, Boonton, Paterson, Newark and Jersey City) as well as many smaller villages. A number of new communities also sprang up, entirely owing their existence to the canal (e.g., Port Murray, Rockport and North Hackettstown). From its peak years after the Civil War, there followed a slow decline as the faster and year-round railroad service became more widely available. In 1872, the canal was leased to

[87] Macasek, 8.
[88] Macasek, 8-9.

the Lehigh Valley Railroad but continued to serve its local customers until it was finally abandoned in 1918. In 1922, the ownership of the Morris Canal was transferred to the State of New Jersey and finally closed in 1924 with dismantling taking place in the late 1920s and early 1930s.

Morris Canal at Boonton

The Morris Canal ran lengthwise through Boonton and included three important components: Locks 12 East and 13 East and Inclined Plane 7 East (resource #).[89] The inclined plane was located immediately adjacent to where the ironworks would develop. The Morris Canal's 23 inclined planes overcame 1,450 feet of the 1,674 feet of vertical rise and fall along the canal. The first planes were essentially experimental, each were constructed differently, and most did not perform well. David Bates Douglas, a professor at West Point was hired to improve the inclined plane; a task that was undertaken by Ephraim Beach when Douglas left to teach at New York University.[90] Plane 7 East at Boonton was one of the two initial planes changed to lock-type planes; in this configuration the boats entered locks at the tops and bottom of the plane before being transported via a chain connected to the cradle cars that wound around a sheave wheel under the lock floor. The wheel was powered by the canal water operating a wooden waterwheel set adjacent to the plane. As the canal proved successful, the amount of product, primarily iron and coal, necessitated improvements, the first of which occurred between 1840 and 1841 and included enlarging the locks and widening the planes to accommodate larger boats. However, the lock-type planes were unable to accommodate the heavier cargo at the transition from basin to plane, so sectioned boats were used beginning in 1845, allowing the boats to pass over one section at a time. Despite these improvements, the lock-type planes were cumbersome, could not transport the large quantities of coal coming from the Lehigh Canal, the heavy loads of iron ore coming out of Morris and Sussex County mines, were of aging materials, and slowed the traffic along the canal.[91] The Inclined Planes were rebuilt between 1845 and 1860. The lock-type planes were converted to summit-type planes; the overshot wood water wheel was abandoned for the "Scotch motor," or cast-iron turbine; and the mechanisms and rails were also modified. During this period, the canal was also expanded to Jersey City. The most prosperous period for the Morris Canal was between 1855 and 1870. In 1863, canal revenue peaked at over $300,000, and it has been said that two-thirds of all cargo shipped east on the canal was unloaded at Boonton.[92] However, the advances in railroad transportation impeded on the Canal's prosperity causing a steady decline in cargo transported along the Canal in the late-19th century. The Canal, after years of struggling, was taken over by the State of New Jersey and systematically abandoned between 1922 and 1929.

[89] The numbering of locks and inclined planes along the Morris Canal were in reference to their order and location east or west of Lake Hopatcong, which served as the Canal's main water source.
[90] Kevin W. Wright, *Morris Canal and the Age of Ingenuity: Climbing Mountains to Solve America's First Energy Crisis* (Gloucestershire, England: Fonthill Media, LLC, 2016), 65.
[91] Wright, 99-105.
[92] William J. (Capt. Bill) McKelvey, *The Transportation History of Boonton, NJ* (Totowa, NJ: The Garbely Publishing Company, 2018), 11.

The Morris and Essex Railroad at Boonton

As much as the Morris Canal improved transportation conditions and had a positive impact, particularly on iron mining and production, and held its own against the expanding railroads in the mid-19th century after the improvements were made, it could not compete in the long term. The railroads, originally feeders of the canal connecting the canal to the scattered mines and manufacturing facilities, became the competition.[93] The President of the Morris Canal, William H. Talcott, noted in 1865:

> The Morris and Essex Railroad was completed so far as to commence carrying coal and ore in the early part of last year. This road will now become a strong competitor for the way trade hitherto transported on the canal, particularly that of coal and iron ore, dividing this trade with the canal, and very likely compelling the work to be done at rates less remunerative than heretofore.[94]

In addition to the Morris Canal, Boonton was served by a branch of the Morris & Essex Railroad beginning in 1867. The Morris and Essex Railroad had been incorporated by the New Jersey Legislature over three decades earlier in 1835 with the right to construct a railroad connecting Newark and Morristown. The original segment of the Morris and Essex Railroad was in operation by 1836, and by 1859 had been extended west to Hackettstown with plans for additional expansion east and west as well as construction of branch lines off the main line. The Delaware, Lackawanna & Western Railroad leased the Morris & Essex Railroad beginning in 1868, taking control of the Boonton Branch at that time. [95]

In 1867, a branch line between Denville and Boonton began operation carrying passengers, mail and freight. Boonton Ironworks' owner James Couper Lord was a director of the Morris & Essex Railroad and was influential in the creation of the Boonton Branch, a clear indication of just how closely connected the railroad and ironworks were to become. In fact, the branch line's terminus was at the Boonton Ironworks, with a freight depot and engine house (resource #16) located off Morris Avenue, and a turntable (resource #15) opposite the depot used to change the direction of the locomotives. Historically and based on the historic images, the railroad turntable consisted of a stone-lined circular pit with a steel bridge supporting steel rails and a wood platform, which rotated the trains. This bridge balanced on a center pivot within the pit, which also served as a support. The outer rail was typically laid on the pit's perimeter and supported the end of the steel bridge. This rail was attached to wood supports set between the inner ring of stone of the pit almost like a set of teeth. Turntables were either moved manually with brute force or by a windlass system; the Boonton turntable was manually moved. Turntables were also typically fitted with positive locking mechanisms so the train could be aligned with

[93] Wright, 137.
[94] Wright, 139. (Note: the endnote for this quote appears misplaced in Wright's book and this quote may have been either 1864 or 1865.)
[95] Korinda, 35. In 1869, a second line, the Boonton, Paterson & New York branch of the Morris & Essex Railroad was constructed, first carrying coal then followed by passenger service in 1871. Around 1884, a new passenger station was built east of the original depot on the opposite side of Morris Avenue, and this station was in turn replaced by another in 1904 on Myrtle Avenue. The current passenger station is located on Main Street and was constructed in the 1990s.

the entrance and exit tracks. Based on the historic maps, access to the turntable from the main track was at a switch a few 100 yards before reaching the railroad trestle at its south/east end. Once on the turntable, the train could be moved approximately 30 degrees to align with a second section of track set perpendicular to the turntable, which led to an engine house set to its southeast. The industrial spur built directly into the ironworks continued past the depot, turntable and engine house and crossed the Rockaway River on a timber trestle from the southeast to reach the ironworks. This spur fulfilled the same role as the Morris Canal, transporting raw materials to the ironworks and finished products to market.

In 1905, the railroad trestle was damaged by a flood and subsequently replaced the following year by the existing single-track, four-span, steel bridge with reinforced concrete substructure (resource #17). The bridge functioned until circa 1970 when it fell out of use due to a lack of industry at the Boonton Ironworks site. (See below for more on the railroad trestle's significance under Criterion C).

3. Significance in the Area of Engineering (Criterion C)

Summary - A property is significant under Criterion C if the property is both important for its expression of architectural or engineering design and construction technology, and if the principal features of its design and construction are sufficiently intact to convey that significance. The Boonton Ironworks Historic District is significant under this criterion for two surviving bridge features that are fine examples of their individual type, the Arch Bridge (resource #8) and the Railroad Trestle Bridge (resource #17). The Arch Bridge is a fine example of a vernacular nineteenth-century stone arch bridge constructed with the primary purpose of carrying a water pipe for fire suppression and the secondary purpose of a pedestrian bridge. It may be a unique resource based on its distinctive historic use. Based on historic maps, there were at least two other footbridges that crossed the Rockaway River to access the Boonton Ironworks, but both appear to have been frame construction and solely for pedestrian use. The Railroad Trestle Bridge is a rare surviving example of a double-intersection Warren truss system and is a good example of the construction methodologies of the 19th century being incorporated into later works.

Stone Arch Bridges

The stone arch bridge is the earliest surviving bridge type in New Jersey as it was the first permanent bridge type built in the United States. Colonists brought the technology for their design and construction with them, although construction of these bridges still was rare due to the time and expense to building them. They were relatively small structures and typically were constructed by local masons of stone gathered or quarried nearby.[96] Toward the end of the eighteenth century, stone arch bridges were constructed at major city crossings and on heavily-trafficked highways, and in the nineteenth century their construction was spurred by the networks of turnpikes, canals, and railroads that crossed the state.[97] By the late-nineteenth century, construction of metal truss bridges began to supplant stone arch bridges,

[96] Marvin A. Brown, Early Stone Arch Bridges of Somerset County, New Jersey Multiple Property Documentation Form, 1992, section E, page 1.
[97] Brown, section E, page 1.

and this was then joined by concrete bridge construction in the early-twentieth century. The majority of surviving stone arch bridges are road bridges, though some stone arch canal features, such as culverts and aqueducts, as well as some railroad bridges survive. Stone arch bridges are significant as surviving examples of first-generation bridge technology in the state and country.[98]

There is a range of subtypes of arch stone bridges. The simplest are small, single-span bridges and culverts of random rubblestone construction, such as the so-called "country bridges" found throughout Hunterdon County that are somewhat crude in their design. While these would have been some of the earliest stone arch bridges constructed, this type also was constructed into the twentieth century on small, rural roads. By the late-eighteenth century, slightly more refined arch stone bridges emerged utilizing semi-coursed or coursed rubblestone with dressed voussoirs or ring stones. By the 1820s and 1830s, arch bridges began to feature coursed ashlar masonry of smooth or tooled dressed blocks with thin, regular mortar joints, and this continued through the nineteenth century.[99] The construction of engineered stone arch bridges began with the emergence of the railroad around the mid-nineteenth century. As these bridges became important features of railroads, their construction was reported and analyzed in engineering literature of the day.[100] Sophisticated, higher-style bridges were also constructed in cities and on major roadways, and utilized string courses, buttresses, and various decorative elements at the stone. There was a revival of stone arch bridge construction during the late 1930s, as the Works Progress Administration employed out of work people to construct bridges and other transportation improvements throughout the country using local materials and local labor. Stone arch bridges were the most prevalent bridge type constructed through the program and varied greatly but were often fairly rustic in nature.[101]

The Arch Bridge at the Boonton Ironworks

Fuller and Lord are said to have hired John Carson, Sr., a Scottish mason who lived in Boonton, to build the bridge to carry a pipe for a constant water supply and therefore reliable fire protection to the ironworks; the water was piped to fire hydrants at key points throughout the ironworks.[102] The single-span arched bridge was constructed of cut fieldstone (appears to be predominantly schist) that was either quarried locally or may have come from Mt. Hope, in nearby Rockaway. A cast iron keystone plate on the downstream side of the arch is inscribed with "FL-18-66," in three lines; this is believed to stand for Fuller and Lord, 1866. Just before the bridge was complete John Carson was injured by a premature blast meant to break stone for the east-side approach to the bridge. He died several months later from his injuries.

[98] A. G. Lichtenstein & Associates, Inc., The New Jersey Historic Bridge Survey, September 1994, 54.
[99] A. G. Lichtenstein & Associates, 54
[100] Thomas E. Boothby, Cecelia J. Rusnak, John Hawkins, and Ageliki Elefteriadou, Stone Arch Bridge Inventory, Phase II, Hunterdon County, New Jersey, 1998, 8.
[101] Stone Arch Bridges, "The WPA Stone Arch Bridges," https://stonearchbridges.com/2020/08/04/the-wpa-stone-arch-bridges/ (accessed December 2021).
[102] Dick Lewis, "There Goes the Mill Bell," in *The Boonton Years: 1867-1967, ed. Maudie Fischer* (Boonton, NJ: Boonton Public Library, 1967), 37.

The arch bridge appears on a circa 1867 map of the property of Fuller and Lord[103] labeled as "B. Furnace Bridge" and the path leading to the bridge is labeled as a footpath, showing the bridge served a double purpose of carrying the water pipe and also as a footbridge as early as the time of its construction. On the 1886 Sanborn Map, a pipe extends across the bridge and "this 16" w. pipe connects with pond ¼ mile distant and at elev. of 100'," is notated below. On the 1892 Sanborn map[104] the words "stone arch bridge," have been added across the bridge. A photograph taken between 1890 and 1901 is the earliest known image of the bridge and shows it much as it appears today except for a wooden post-and-rail fence instead of the existing chain-link fence.

The 1994 *New Jersey Historic Bridge Survey* found eleven nineteenth-century stone arch bridges survive in Morris County. However, many bridges, including the one in Boonton, are not included in this count as the survey only included bridges with a span of at least twenty feet that are under the National Bridge Inspection Standards jurisdiction of New Jersey and certain railroad bridges. No known comparable study exists for non-road bridges in Morris County or the State. Hunterdon County to the southwest, which is said to have the largest number of stone bridges in the country with over 120, conducted a survey of the smaller stone arch bridges that were excluded from the *New Jersey Historic Bridge Survey,*[105] The survey termed these as "country bridges" as they are smaller in scale and vernacular in nature, but again are all road bridges. The Multiple Property Documentation Form for the Stone Arch Bridges of Somerset County includes nineteenth-century road, canal, and railroad bridges, though only a few dozen are believed to have been constructed in total and even fewer survive today.[106] In Morris County, construction of the Morris Canal included some stone arch culverts and stone and frame bridges and aqueducts, which perhaps are more contextually similar to the Arch Bridge from the Boonton Ironworks than road bridges, but still are quite different and from earlier in the nineteenth century; few of these survive today. There are no known direct comparisons to the Arch Bridge from the Boonton Ironworks.

The Arch Bridge was individually listed on the New Jersey and National Registers of Historic Places in 2022 under Criterion C. The masonry is reflective of 19th-century craftsmanship with the effects of time and natural erosion taking a toll on the stone only in localized areas. While less of a distinguishing feature in comparison to the sprawling industrial complex that once made up the ironworks, the bridge was a key functional structure that was crucial to fighting fires to an operation that was inherently dangerous and subject to fires. The bridge also served an aesthetic function both historically and today, contributing to the picturesque nature of the park, particularly as the bridge overlooks the falls to the north. The arch bridge maintains its simple aesthetic today through the retention of its original materials and appearance, and based on the historic photographs, is little changed since its original construction with the exception of chain-link fence and the concrete cap on the walkway, which appears to have

[103] Aug. J. Rossi, C.E., "Block D, Boonton Park Property," undated, possibly from circa 1867. In the collection of the North Jersey History & Genealogy Center of the Morristown & Morris Township Library.
[104] Sanborn Map and Publishing Company, "Boonton, New Jersey," (NY: Sanborn-Perris Map Co., Limited, 1892), plate 5.
[105] Boothby, executive summary.
[106] Brown, section E, pages 7 and 9.

originally been cinder. The bridge also continues a functional use today, allowing pedestrian passage over the Rockaway River as part of the trails in Grace Lord Park, serving as a link between the modern-day use of the site as a passive recreational park and the historic use of the site as the Boonton Ironworks.

Railroad Trestle Bridge

The Railroad Trestle Bridge (resource #17) was constructed in 1906 to replace the circa 1867 wooden railroad trestle that was damaged by a flood. The 19th-century wood railroad trestle was constructed to carry an industrial spur of the Morris & Essex Railroad (leased soon after to the Delaware, Lackawanna & Western Railroad) directly to the Boonton Ironworks, while the existing metal bridge supported later industrial enterprises at the former ironworks site. The present trestle was constructed as a single-track, four-span steel trestle with reinforced concrete substructure; the two outer spans of the bridge are deck girders fabricated by the Fort Pitt Bridge Works and the two inner spans are double-intersection Warren deck trusses. This truss system is a rare surviving example of double-intersection Warren trusses; few remain today with known examples only found in nine states. [107] The bridge retains elements of its early fabric as it utilized portions of the 19th-century stone retaining walls and abutments that were built to support the wooden railroad trestle.

Bridge building beginning in the early 1890s changed from bridges made of primarily wrought iron to structural members fabricated through the open-hearth process of steelmaking. For a period in the late-19th century iron and steel were used in the assembly of bridges, but by the early-20th century steel had been universally applied to new bridge construction. Also, pinned joints were favored in the 19th century but this also transitioned to riveted connections. As a result, there were improvements in field-riveting techniques that made riveted connections surpass pinned construction in the building of bridges. By the turn of the 20th century, there were two types of truss bridges, one was the Pratt[108] and the other was the Warren.

The Warren Truss was patented by British engineers, James Warren and Willoughby Monzoni in 1846. In its original form, it is composed of "a series of equilateral triangles in which the diagonals carried both compressive and tensile loads."[109] After initial patenting, vertical members were added and set between the

[107] Parsons Brinckerhoff and Engineering and Industrial Heritage, "A Context for Historic Bridge Types: NCHRP Project 25-25, Task 15," (October 2005), 3-43.

[108] "The Pratt truss was first developed in 1844 under patent of Thomas and Caleb Pratt. Prevalent from the 1840s through the early twentieth century, the Pratt has diagonals in tension, verticals in compression, except for the hip verticals immediately adjacent to the inclined end posts of the bridge. Pratt trusses were initially built as a combination wood and iron truss but were soon constructed in iron only. The Pratt type successfully survived the transition to iron construction as well as the second transition to steel usage. The Pratt truss inspired a large number of variations and modified subtypes during the nineteenth and early twentieth centuries." ("The Pratt Truss": Available from the Internet: https://www.roads.maryland.gov/OPPEN/V-Pratt.pdf. Accessed: 2 December 2022.)

[109] "The Warren Truss", Available from the Internet: https://www.roads.maryland.gov/OPPEN/V-Warr.pdf. Accessed: 2 December 2022.

parallel top and bottom chords; these vertical members served as braces for the triangular web system. There are many variants on this type including the double intersection "in which two triangular truss systems are superimposed with or without verticals."[110] According to the National Register Nomination for the Blackledge River Railroad Bridge, located in Colchester, Connecticut, the double-intersection Warren Truss was appropriate for railroads due to its stiffness. "The two overlaid webs resisted the reversal of stresses as a load moved across the bridge."[111] In this configuration, the deck trusses carried the tracks above the top chord and provided an advantage: unlimited vertical clearance. Where a through truss would carry the track between the top and bottom chords and thereby limit clearances.[112]

The Railroad Trestle Bridge is a good example of the construction methodologies of the 19th century being incorporated into later works but also of the prolific construction instituted by the Delaware, Lackawanna & Western Railroad in the early decades of the 20th century to support a new era of industrial growth and development after the loss of the iron industry in the state left a giant void. The bridge functioned until circa 1970 when it fell out of use due to a lack of industry at the Boonton Ironworks site.

4. Significance in the Area of Industrial Archeological Data Potential (Criterion D)

Summary - The Boonton Ironworks Historic District is significant under Criterion D for the documented presence of ironworks, canal and railroad-related archeological features that have yielded, or may be likely to yield, information important to industrial history at a local and regional level. Also present are material deposits, principally in the form of traces of raw materials and copious volumes of waste products, which may have the potential to yield information about evolving metallurgical and technological processes. In many instances, these processes were not well-documented by contemporary written records, or they may be compared with data recovered from other iron-working sites of the mid-19th century. The Boonton Ironworks site has significant potential to yield data about construction methods, use and preparation of raw materials, deployment of powered machinery and manual labor, working conditions, and the quality of intermediary and finished ferrous products. Specifically, the site has the potential to shed light on the transference of technology to smelt iron from coal, a technique only brought to the United States from England about a decade prior to the process being used at Boonton in 1848. The district contains a nearly complete set of remains of an integrated industrial enterprise demonstrating a full range of iron production with iron ore, anthracite, lime or perhaps other flux materials entering the site and leaving as pig iron or finished cast-iron or wrought-iron products. Iron production was greatly advantaged by the presence of the Morris Canal, which not only provided the coal used to heat the furnaces and forges and a ready transport to market but directed the flow of significant quantities of water that was used throughout the complex to provide power. In 1867, with the completion of the original wooden trestle over the Rockaway River, the Morris & Essex (then Delaware,

[110] "The Warren Truss".
[111] Bruce Clouette and Matthew Ross, "National Register Nomination: Blackledge River Railroad Bridge, Colchester, New London County, Connecticut", (Hartford, Connecticut: Connecticut Historical Commission, 1986.) Statement of Significance and Section 8, page 1.
[112] Clouette, Section 8, page 1.

Lackawanna & Western) Railroad also provided raw materials and carried away finished products. Archeological data reveals important and complex spatial and technological associations among the ironworks, canal and railroad, leading industrial sectors that set-in motion unprecedented historical change locally and within the region.

Historic Archeological Context: The Transition from Charcoal to Anthracite-Fueled Iron Manufacture at Boonton and Other Regional Iron Furnaces from the 1830s to the 1840s

The Boonton Ironworks Historic District archeological context relates to the material remains associated with a transition from a "backward integrated, plantation-style, charcoal ironworks" to a "forward-integrated, mineral ironworks," as defined by economic historian Peter Temin in his classic *Iron and Steel in Nineteenth-Century America, An Economic Inquiry*.[113] Plantation-style ironworks had to be located near the sources of their fuel – forests for charcoal – and raw materials – mines for iron ore – and tended to be operated by a single individual ironmaster with control of all of the processes that led up to the smelting of iron ore into pig iron. By their very nature, plantation-style ironworks had limitations set by shipping costs, availability of labor, and the nature of their singular product. In contrast, a mineral furnace could be located some distance from sources of fuel and ore, especially after the construction of canals and railways, and they tended to be owned by joint-stock corporations that brought together managers, engineers and skilled workers with responsibility for various aspects of the production processes, including value-added post-furnace processes such as converting pig iron to wrought iron, or manufacturing finished products such as cast-iron stoves or wrought-iron nails.

The transition from plantation-style to mineral ironworks was one fraught with pitfalls. Ironwork furnaces of both styles were substantial capital investments, and once in use were difficult to abandon or to improve through scaling up or integrating backward into new sources of raw materials or forward into new products. Even a small change in a source of iron ore, for instance, could result in the introduction of trace elements such as phosphorus, which would make iron brittle and could not be detected until improved metallurgical techniques of the later 19th century. Charcoal ironmasters often lacked the financial resources and technical, metallurgical knowledge to successfully move from one style to the next, even as competition from more forward-leaning ironworks demanded it. Furthermore, every step in this transition was likely to impact physical plant, and the most common course was to try and adapt existing infrastructure to evolving materials and technologies, rather than tearing down and starting anew[114]. From an archeological standpoint, ironwork sites can offer rare insights into the technological processes and metallurgical hurdles faced during this critical period in the development of American iron and steel technologies.

While the owners of the Boonton Ironworks did have financial connections with some iron mines, they brought, at first, charcoal, ore and lime, and later coal, to the site via a canal they did not own. They were able concentrate more on the forward integration of the iron business because of readily available

[113] Peter Temin, *Iron and Steel in Nineteenth-Century America, An Economic Inquiry* (Cambridge, Massachusetts: The M.I.T. Press, 1964).
[114] Gordon, 233.

labor, transportation, and markets. In this instance, the forward integration of the ironworks included the means to produce more than just pig iron. Boonton Ironworks had a foundry for cast-iron products melted from pig iron, puddling furnaces for converting pig iron into wrought iron, a rolling mill for producing wrought-iron bars and sheets, and a sheeting and nail mill for flattening and cutting iron into nails and spikes. They also produced wooden kegs used to package the nails for shipping to markets. Archeological data exists in the ruins and foundations of the blast furnace, foundry, puddling mill, rolling mill, and sheeting and nailing mill. Each had to be carefully located and planned in relation to the preceding and proceeding processes, had to be considered in terms of material inputs and waste flows, and had to work within a shared waterpower system where the energy requirements needed to be carefully balanced due to practical limits on efficiency and capacity. Basic archeological data such as horizontal and vertical distances between each of the ironworks' processing areas can provide important insights.

Boonton Ironworks' location within a gorge through which the Rockaway River flows, was selected primarily because of the head of water created by the waterfall at the western end of the district. The elevation difference provided a significant potential energy that could be used to power the ironworks. Unusually for a mid-19th-century ironworks, this potential was first demonstrated and enhanced by a transportation canal, the Morris Canal, which had finished an operating inclined plane at Boonton by 1828.[115] This utilized the northern edge of the gorge to create a sloping plane on which boats were pulled up a total elevation gain of 80 feet. The canal utilized water from the Rockaway River, gathering via a dam above the falls, to run the reaction turbine that pulled the boats. The canal company realized that this water could also be diverted for other uses at this location because of the added water volume provided by the dammed Rockaway River, far exceeding the canal's needs. The presence of the canal also brought raw materials and shipped finished goods to the ironworks. This water-sharing relationship, legalized in contract documents, was realized in a complex system of sluices, gates, raceways (water channels) and wheel pits that left strong archeological expressions.

The Boonton Ironworks was originally built with a charcoal furnace, likely with the intention that this fuel would also be supplied via the canal. Charcoal iron furnaces were common in the iron-producing regions of Pennsylvania and New Jersey during the 18th century and during the colonial period were limited in the mid-18th century by British laws to only making unfinished products such as pig iron. Charcoal would be loaded from the top into a stone or brick-lined furnace with ore and often limestone used as a flux. This would be lit and kept under blast by the application of a constant stream of air through the tuyere below the crucible at the base of the furnace. This tuyere was supplied air through bellows or a mechanical pump most often powered by a waterwheel and later by steam engines. The constant blast of ambient temperature air would heat the furnace to a point where the ore would melt and pool within the hearth at the base of the furnace. This molten iron would be drawn off into the sand floor of a casting house where it was guided through primary channels connected to multiple smaller channels. The cooling iron in these smaller channels became "pigs" of iron because they were laid out like baby pigs suckling on a sow. The average charcoal iron furnace consumed about 150 acres of forest

[115] "Inclined Plane at Boonton Falls," *Centinel of Freedom*, Vol. XXXII, Issue 17 (August 5, 1828), 3.

per year and forests needed about 20 years to regenerate before being harvested, so most plantation-style furnaces required about 30,000 acres of forest under rotating harvests to be sustainable. Charcoal also did not travel long distances well, tending to crumble into dust when jostled. Even by 1833 the ironworks in Boonton appears to have been having trouble acquiring enough charcoal to keep the furnace in blast, offering 5 cents per bushel to anyone who could supply it.[116] The furnace features that survive at Boonton Ironworks are potentially rich sources of data on furnace construction and operation.

Although the first anthracite blast furnace was not built at Boonton until 1848, they appear to have been experimenting earlier than this with the coal that was readily available from the adjacent canal. A newspaper article from August 4, 1840 reports that the company had been successful in puddling iron with anthracite coal, a different process from smelting iron in a furnace.[117] Puddling iron was a process in which pig iron was melted and purified in a reverberatory furnace that used a flame from a coal fire at one end of the furnace to pass over a covered hearth. The heat would be reflected down on to hearth where the iron was puddled into a ball. These puddled balls of iron were either transferred to a hammer or to a squeezer. The resulting flat piece of iron was then cut and taken to a rolling mill. The linear piece of iron was then passed back and forth through the rolls of a rolling mill to create iron bars or rails. The location of these early coal-fired puddling furnaces at Boonton Ironworks was not entirely clear although they may have been in with the buildings labeled as "Rolling Mills" on the 1840 map of the Jersey Iron Works. It is also unclear without archeological data how waterpower may have been used in this process, possibly as air for the hearth and power for a trip hammer.

It is commonly accepted that Samuel Thomas helped convert Boonton's charcoal-fueled [Blast] Furnace 1 (Resource #3) to anthracite coal in 1848. Thomas helped his father, David Thomas, a Welshman who immigrated to the United States, successfully use anthracite at the Lehigh Crane Works in Catasaqua, Pennsylvania in 1840 and again, using an American-style stove on top of the furnace that recirculated wasted heat, in 1842.[118] The conversion of Furnace 1 would have involved the recirculation of hot gases escaping out of the top of the furnace to create a hot blast into the tuyere. This process allowed for higher temperatures within the furnace stack to be achieved and maintained to keep the anthracite (or "hard coal") coal lit. The hot gases were also often used to heat water for steam power, which, in turn, could be used to run the air pumps that provided the blast. This conversion to the use of anthracite coal allowed for a great increase in the production of pig iron from roughly 1,820 tons to 5,000 tons of pig iron per year.[119] The exact details of how this conversion was conducted at Boonton are unknown, but the potential for archeological data to survive in the area of Furnace 1 is high as it would have likely required at the very least an expansion of the casting house and changes in the process of disposing of increasing amounts of slag waste. No notes or plans exist, although there are several historic photographs that show both furnaces at Boonton with enough clarity that their hot blast systems may be partially reconstructed.

[116] "Charcoal," *Jerseyman*, (May 15, 1833), 4.
[117] "Important Discovery in the Iron Manufacture," *Centinel of Freedom*, Vol. XLIV, Issue 5 (August 4, 1840), 2; Gordon, 16.
[118] Gordon, 157.
[119] Wendt, 36.

Historic Archeological Context: The Physical Remains of the Operations of Scale of a Mid-19th Century Integrated Ironworks, 1850s to the 1870s

With this great increase in production capacity came several forward integrations and scaling up of the Boonton Ironwork infrastructure, which is reflected in the archeological record of the site as expressed by its surficial ruins. . Perhaps most notable was the completion of the first nail factory (Resource #6) in 1851 that produced iron sheeting that was then cut into nails. A new nail factory was built to the southeast of the original only about a year later in 1852 by the new owners of the ironworks, Dudley B. Fuller and James Couper Lord, who renamed the enterprise the Boonton Ironworks. The 1850s expansion of the ironworks and its changing focus on producing nails and spikes, is illustrated in detail in an 1860 article in *Harper's New Monthly Magazine* that detailed a trip along the Morris Canal, which included a tour of the Boonton Ironworks, in 1859.[120] This detailed tour was given by the then supervisor of the ironworks, Henry Jenkins, and includes illustrations of the ironworks from above, an image of the blast furnace, workers tapping the furnace, the interior of the casting house, the dumping of hot slag into the Rockaway River, workers at a puddling furnace, a puddler at work, a puddler using a ball-trolly to transport puddled iron, puddled iron being squeezed, a puddling ball train (rolling mill), cutting bars, cutting nail plates, a nail machine, cutting and trimming barrel staves and filling casks with nails. (See Figures 26 through 41) The textual description also follows the process completely from the intake of raw materials to the shipping of nails casks and emphasizes the integrated nature of the ironworks:

> Not the least interesting among the many subjects of study is the beautiful and complete system by which every process and manipulation is so arranged that the most inexperienced person may follow the material from the heaps of coal, limestone, and ore at the upper end of the raving, through the blast furnace, puddling furnaces, rolling mill, nail shops, packing room, to the canal below the plan where the nails and other manufactured articles are shipped for market. This system is also evidenced in the fact that nothing whatever is wasted, from the coal dust, which is used to make soil, to the chips and shavings in the cooper's shop, which are used in starting fires in the puddling furnaces and throughout the mills.[121]

In 1867, James C. Lord, part owner of the ironworks and also director of the Morris & Essex Railroad, arranged to have a line from Denville end at Boonton, within the ironworks site. This line could provide ore and coal to keep the ironworks running during the winter when the Morris Canal ceased operations. A second anthracite furnace was completed in 1868 around the time the ironworks reached its largest extent. Both of these furnaces utilized different hot blast systems. As with the conversion of Furnace 1, there are no notes or drawings that survive that detail how the conversion was done. It is not clear if the latest 1860s technologies were incorporated into the new converted furnace or if the technology was orally transmitted by skilled ironmasters. The supervisor at the time was Henry Jenkins, the son of

[120] "Among the Nail-Makers", *Harper's New Monthly Magazine,* No. CXXII, Vol. XXI (July 1860).
[121] "Among the Nail-Makers," 154-155.

George Jenkins who was made the supervisor in 1848 at the request of Samuel Thomas (his son-in-law).

In addition to the furnaces, the ironworks is described during this period in a county history:

> There are in the large mill twelve double puddling furnaces, seven large heating furnaces, four trains of 18-inch and two trains of 16-inch rolls and two rotary and two crocodile squeezers. The average production of puddle bars was three hundred and twenty tons per week. The nut mill contained four furnaces and four nut machines. In the two nail factories there were 150 nail machines, with the capacity of producing when run to the full extent 200,000 kegs per year. There were in the saw-mill three sets of stave machines, with a capacity of 20,000 staves per day. For this 1,000 cords of chestnut logs were required each year, and for making the heading about 400,000 feet of whitewood and pine boards. The staves were piled in sheds to season thoroughly before they were used in the cooper shop. Over 2,000,000 staves and over 900,000 keg-hoops were used in turning out annually an average of about 150,000 kegs. From seventy to eighty kegs were considered a fair product for ten hours' work, although some young experts have been known to turn out from one hundred to one hundred and twenty in ten hours. The mills, furnaces, foundry and various shops and storehouses cover fully six acres of ground. As motive power for this vast concern 1,500 horsepower was required, and was derived from four large overshot waterwheels, six turbine wheels and three steam engines. The amount of money paid out monthly in 1865 was $30,000.[122]

This account provides useful detail regarding the extent of the ironworks and its production capacity, including the production of kegs, used to ship the nails to markets such as Newark.

Boonton Ironworks' period of scaling up from the 1850s to the 1870s is generally understood due to the contemporary non-specialist accounts and a run of maps dating to this period; however, a finer grained, archeologically based understanding of how this early integrated ironworks remained successful over an approximately 25-year period remains to be extensively documented. Archeological resources remain at Boonton that could answer important data for analyzing the physical properties and chemical composition of residual raw, product and waste materials, as well as specific sequences of demolition, adaptation and expansion in each of the plant's main process areas from the blast furnace to the nail mill.

Historic Archeological Context: Adaptive Industrial Uses and Decline, 1880s to the 1920s

In addition to the Financial Panic of 1873, the Boonton Ironworks were gravely hurt by a large fire in August of that year that destroyed the lower nail factory, sawmill, three storehouses, three sheds and several smaller buildings. Although Fuller and Lord had died in 1868 and 1869, respectively, the estate continued to operate the ironworks until 1876.[123] The furnaces were

[122] "Boonton," *History of Morris County, New Jersey* (NJ: W.W, Munsell and Co., 1882), 180-181.
[123] Wendt, 122.

briefly refurbished and relit in 1880, though they were only in blast for a few months. A new supervisor, Tooke Straker, was appointed in 1880. Straker worked for Joseph Wharton, a successful iron magnate from Philadelphia who operated the ironworks at a much-reduced capacity until 1883 when it appears to have closed for good.[124]

The Boonton Ironworks buildings that had survived the fires, continued to deteriorate. The iron industry had also changed after the Civil War, mostly because of the ever-increasing demands of the American railroad industry, which demanded inexpensive, wrought-iron products, particularly rails, in great quantities. It became increasingly difficult for companies owned by individuals or small partnerships to compete with the scale of production offered by the emerging larger corporations that owned multiple furnaces and rolling mills that could also use their monetary influence to guarantee supplies of ore and fuel.[125]

Although most ironworking ceased on site, several businesses did move into the remaining buildings, including businesses that were able to utilize the remaining water power infrastructure, including one that utilized the large amounts of slag left on site to create slag paint. In the early 20th century, because of its position near the gatehouse on the canal that controlled the sites' water supply (Resource #5), the first nail works was torn down and replaced by a Boonton Electric Company hydro-electric plant (Resource #7). Little is currently known about how these companies modified the waterpower system and various buildings of the Boonton Ironworks to accommodate new machinery and processes, offering another avenue for archeological investigation.

Categories of Archeological Information at Boonton Ironworks Historic District

Archeological remains within the Boonton Ironworks Historic District are considered likely to have the potential to shed light on several facets of 19th-century industrial history. The site of the Boonton Ironworks went through several evolutionary changes during the course of its history, from a common charcoal iron furnace producing pig iron with materials and water supplied by the unique Morris Canal, early experimentation with puddling iron with anthracite, the development of its rolling mills, its conversion to an anthracite furnace, and finally the introduction and significant expansion of its nail-making capabilities. These changes are visible in the modification of the narrow river gorge landscape of the site and in archeological features that are visible at the ground surface; and in the subsurface record, in the form of buried architectural and structural remains, artifacts, waste materials and other items of material culture, which provide the means for answering a variety of research questions.

The main categories of archeological information for this 19th-century industrial complex are: spatial and cultural landscape data reflecting the layout and operation of the industrial (e.g., roads, railways, waterways, topography); structural remains of industrial buildings and related waterpower and

[124] Wendt, 137.
[125] Paul Paskoff, *Industrial Evolution, Organization, Structure, and Growth of the Pennsylvania Iron Industry, 1750-1860* (Baltimore, Maryland: The Johns Hopkins University Press, 1983), 134.

infrastructure features; cultural deposits and middens reflecting industrial activity; industrial raw materials, products and waste; and objects of material culture. More specifically, industrial remains are likely to consist of the following: the foundations and footings of the furnace, foundry, rolling mill, nail mill, sawmill, carpentry shop, pattern shop, cooper shop, heading mill, drying sheds, annealing house, weigh house, blacksmith shop, a variety of storage sheds, stables and offices, and raw and waste materials from industrial processes.

The main categories of archeological information for the 19th-century transportation features are: the bed of the Morris Canal; elements of Inclined Plane 7 East (the bed, inclined plane and archeological elements of its powerhouse and waterpower system; and elements of the Morris & Essex Railroad (rail beds, sidings, embankments, bridge, sheds, coal and ore chutes).

Comparative Examples of Ironworks Archeological Sites

Although many ironworking sites survive in New Jersey, these are largely limited to singular blast furnace sites that concentrated on making pig iron and/or forges for wrought iron, not integrated works that also manufactured finished products, like sheet metal or nails. Batsto Village (including a furnace site), Hanover Furnace, Allaire Village (including a furnace site), Split Rock Furnace, Clinton Furnace, Oxford Furnace, and Long Pond Ironworks are all listed on the National Register, but only the Long Pond Ironworks has seen significant, published archeological investigations.[126] This plantation-style ironmaking complex began producing iron in a charcoal furnace and forge from nearby mines in the mid-18th century before shutting down by the end of the century. The forge was reopened in the 1830s, and by the 1860s a new charcoal furnace was built and put into blast by Cooper & Hewitt, the owners of the Trenton Iron Company, to supply quality iron for their rolling mill in Trenton, New Jersey. In the 1870s they converted one of the furnaces to use anthracite, but changes in the market, largely connected with a preference for all-steel rails, caused them to cease iron production at Long Pond in the 1880s.[127] Long Pond Ironworks was investigated in the 1960s by archeologist Roland Robbins who uncovered the base of the colonial furnace, located the limits of the casting house, and documented features such as a tuyere and casting arches, casting floor, drain along the edge of this floor, wheel pit and tailrace. He also investigated the bosh, crucible, and hearth's stone lining at the base of the furnace.[128] In the 1980s archeologist Edward Rutsch conducted mapping as part of a management plan for the site and summed up his work and that of Robbins in an article in 1992.[129] This ironworks contrasts well with the Boonton Ironworks. At the same time charcoal furnaces were being converted to use anthracite at Boonton, new

[126] Batsto Village has been systematically investigated but the results of these investigations have not been published.
[127] Hunter Research, Inc. "Site Preservation Plan, Long Pond Ironworks, West Milford Township, Passaic County," New Jersey (2007). Prepared for the Friends of Long Pond Ironworks.
[128] Roland Robbins, "Archaeological Site Reports at the Long Pond Ironworks" (1982), *The North Jersey Highlander*, Fall/Winter: 25, 25-59.
[129] Edward S. Rutsch and Brian H. Morrell. "An Industrial Archaeological Survey of the Long Pond Ironworks, West Milford Township, Passaic County, New Jersey" (1992), *The Journal of the Society for Industrial Archaeology*, Vol. 18, 41-60.

charcoal furnaces were being built at Long Pond. This difference is largely due to the availability of fuel. Coal was readily available at Boonton and charcoal was still readily available in the New Jersey Highlands.

Further afield, significant archeological analysis, including Historic American Engineering Record documentation, has been conducted at the National Register-listed Adirondack Iron and Steel Company site in Essex County, New York. This charcoal furnace complex, which concentrated on the production of pig iron, also started in 1830 like Boonton but was out of use by the 1850s. The lack of later development of the site, which is located in a remote area at the headwaters of the Hudson River, resulted in the preservation of significant portions of the ironworks. The investigations were able to determine that even though the furnaces were never converted to burn anthracite, they were upgraded with the latest hot blast equipment by 1844, only four years after the introduction of such a system in the United States. This suggests that anthracite furnaces were not the only alternative. The archeological remains of the furnace stacks in the Boonton Ironworks Historic District have the potential to yield this type of comparative data and can contribute to the story of 19th-century iron production.

Large, forward-integrated ironworking sites like Boonton are less common and most of these appear to be archeologically impacted by the later, 20th-century enlargement and development of their sites. Of particular note are the sites of the Trenton Iron Company in Trenton, New Jersey, the Bethlehem Iron Company (later Bethlehem Steel) in Bethlehem, Pennsylvania, and the Lehigh Crane Iron Company site in Catasaqua, Pennsylvania. While the remains of the Lackawanna Iron & Steel Company ironworks in Scranton, Pennsylvania are preserved, they have been documented but not systematically investigated.

One of the only comparable ironworks sites that exists largely as a below-ground archeological resource that has been subject to systematic archeological investigation is the West Point Foundry Archaeological Site in Putnam County, New York, 42 miles northeast of Boonton. This site, which has only one standing building remaining, was listed in the National Register in 2010 and became a National Historic Landmark in 2021. The foundry operated from 1820 to 1911 and produced a wide catalog of cast iron items; of particular note was the design and manufacture of Parrott guns and their projectiles for the United States military. This site is similar to the Boonton Ironworks as an integrated industrial complex that brought in iron ore, charcoal and limestone to produce pig iron, which it then turned into finished products through various techniques. It also started with a charcoal furnace and that was later converted to burn anthracite sometime in the 1840s and used water power extensively. The site was studied archeologically starting in the 1978, then again in the 1990s in connection with an environmental cleanup and finally in 2002 to 2008 by the Michigan Technological University. These investigations uncovered and documented the water power system, including the battery pond, the boring mill, the gun platform, the blowing engine area, and worker's housing.[130] The resulting information, "helped illustrate the various activity areas and chief industrial operations of one of the most important industrial sites in the country. The work not only mapped the location of known and newly found features of the foundry complex, but also provided information on how the various foundry activities were conducted, how they

[130] Peter, D. Shaver, "West Point Foundry Archeological Site, National Register of Historic Places Registration Form" (2010). Section 7, 6.

were inter-related, and revealed a better understanding of the workforce…."[131] More specific research questions were developed as part of the investigations of the West Point Foundry Archeological Site, and these are incorporated into the potential questions enumerated below.

Significant Scholarly Research Questions under Criterion D

Potential research questions that the archeological remains within the Boonton Ironworks Historical District may be able to address are:

- *The high integrity of the site provides an opportunity to address locally and regionally significant questions about crucial aspects in the revolutionary development of the iron industry during the 19th century. What were the sequence of physical changes made to the site in converting it from charcoal to anthracite-fueled furnaces? What were the sequence of physical changes made in integrating and scaling up the ironworks? How does these compare spatially and temporally with other ironworks' sites?*
- *The waterpower system was crucial to the operation of the ironworks. Information about how this system was regulated, shared and channeled to the various buildings and harnessed for a wide variety of processes is likely to persist below ground in the form of gate structures, head races, tail races, wheel and turbine pits, remnants of wheels and turbines and the machines they powered. Was this waterpower system replaced or supplemented with steam engines?*
- *How much silica, limestone, and magnesia are present in the slag? Waste materials may reflect information about the change from charcoal to anthracite furnaces. Specifically, silica content of the slag may indicate whether the ore being used was lower grade with a high silica context or higher grade with a lower silica content. Limestone content provides information about the need to remove sulfur from the ore.*
- *How were the by-products of the ironworks processed and reused for other products?*
- *What are the physical and chemical qualities of the finished pig iron? Finished products, such as pig iron, are also likely to be found, and an analysis of this metal could reveal a great deal about the quality of iron being produced. How fast you let the iron cool determined the type of pig iron. Gray iron is better for machining, while white iron was used for items requiring greater strength.*

The archeology of the Boonton Ironworks site, by providing data on the overall design, layout and activity areas of the furnace, foundry, rolling mills and nail factories and on its products and waste, can inform archeologists, historians and scholars of the iron industry about the evolving level of ironworking technology in use and production processes throughout an important period in American industrialization. The extent to which these aspects of industrial ironworking drew directly on metallurgical practice and knowledge developed in England and Wales and refined in Pennsylvania and

[131] Shaver, Section 7, 6.

United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet

Boonton Ironworks Historic District
Name of Property
Morris County, NJ
County and State
Name of multiple listing (if applicable)

New Jersey is of extreme interest to industrial archeologists, as well as industrial and economic historians. How much, for example, was the operation of Boonton Ironworks rooted in technology developed in colonial New Jersey or brought across the Atlantic by ironworkers hired by the emergent industrial magnates? While the first furnace at Boonton was probably a traditional New Jersey charcoal furnace, it was relatively quickly converted into an anthracite furnace by a Welsh immigrant whose father first refined the process in Wales. Almost 18 years later the second furnace was converted to anthracite. Was it run as a charcoal furnace simultaneously with the anthracite furnace? Was it converted with new technologies of the 1860s or by internal improvements made by Boonton's ironmaster? How effective was it? Industrial archeological study of the buildings and structural remains at the Boonton Ironworks offers an opportunity to consider these types of technological influences in detail. As has been done at other ironworking sites, analysis of archeologically recovered furnace-related waste (charcoal, cinder, ash and, particularly, slag) can help answer metallurgical questions concerning the furnaces production and technological competence.

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United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

Boonton Ironworks Historic District
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Morris County, NJ
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Section number 10 Page 1

Verbal Boundary Description

Beginning at the southeast corner of Block 112, Lot 1 proceed southwest 40 feet. Turn northwest and proceed 37 feet. Turn southwest and proceed 365 feet and then slightly northwest 75 feet. Turn south and proceed 10 feet to the north side of Morris Avenue then proceed southwest 191.42 feet following the curve of the road. Following the road, proceed southwest 298.69 feet then slightly west and proceed 69 feet to the southeast corner of Block 112, Lot 3. Follow the lot's boundary west 45.18 feet to the southwest corner of Block 112, Lot 3. Turn northwest and proceed 294.74 feet to the northwest corner of Block 112, Lot 3. Following the boundary of Block 112, Lot 5, proceed southwest 93.05 feet. Next proceed in a general northwest direction following the undulating boundary of Block 112, Lot 5 for approximately 2,379.41 feet. Turn southwest and proceed 201 feet to the north side of Rockaway Street. Turn northwest and follow a curve 45.80 feet to the east side of Essex Avenue. Proceed north 234.59 feet to a point, then turning northeast, follow a curve 176.51 to the south side of Main Street. Proceed northeast along the south side of Main Street 473.24 feet to a point where Block 34, Lots 1 and 23 abut. Turn southeast and proceed along the curved northern boundary of Block 34, Lot 1 approximately 1,252.3 feet. Turn southwest and proceed 8 feet, then southeast 178 feet, then northeast 8 feet, then southeast 76.03, then northeast 9 feet, then southeast 28.84 feet, then southwest 16.66 feet, then southeast 287.38 feet, all the while following the northern boundary of Block 34, Lot 1. Turn northeast and proceed 3 feet to the south side of Plane Street. Proceed 625.48 feet southeast along the south side of Plane Street to the point where Block 34, Lots 1 and 1.03 abut. Following the irregular eastern boundary of Block 34, Lot 1, turn southwest and proceed 98.28 feet, then southeast 25 feet, then southeast 177.21 feet, then southwest 86 feet to where it abuts Block 34, Lot 24. Following the eastern side of Block 34, Lot 24, proceed southeast 167.79 feet then turning more easterly, southeast proceed 211.91 feet. Turn southwest and proceed 340 feet to where it intersects the east end of Block 34, Lot 2. Then proceed southeast 105 feet following a curve to the place of beginning.

Boundary Justification

The district boundary corresponds with the legal boundaries of Lots 1, 2, 3, 3.01, and 5 of Block 112 and Lots 1, 1.01, 1.02, 25, and 26 of Block 34 in the Town of Boonton. This approximately 62-acre area includes the core of the former Boonton Ironworks and property across the Rockaway River that was historically associated with the ironworks and owned by Lord's estate into the twentieth century.

United States Department of the Interior
Here
National Park Service

Boonton Ironworks Historic District
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Section number Photo Log Page 1

Photo Log

Name of Property: Boonton Ironworks Historic District
City or Vicinity: Boonton Town
County: Morris State: New Jersey
Photographer: Beth A. Bjorklund (Photos 1, 2, 4, 10, and 12)
James S. Lee (3, 5-9, 11, and 13)
Borbas Engineering (Photo 14)

Date Photographed: January 4, 2019 (Photo 14)
August 7, 2021 (Photos 5, 7, 8, and 9)
October 30, 2020 (Photo 10)
October 11, 2022 (Photos 3, 6, 11, and 13)
October 21, 2022 (Photos 1 and 2)
December 2, 2022 (Photos 4 and 12)

Description of Photograph(s) and number, include description of view indicating direction of camera:

Photo 0001: View of a trail in Grace Lord Park that follows the path of the Rockaway River; camera facing southeast.

Photo 0002: View of Grace Lord Park at its north entrance at Essex Avenue near W. Main Street.; camera facing east.

Photo 0003: View of the Retaining Wall below the remains of the brick engine house; camera facing northwest.

Photo 0004: View of the remains of the circa 1863 brick engine house from the ironworks; camera facing northeast.

Photo 0005: View of the remains of Furnace 1; camera facing south.

Photo 0006: View of the Arches that carried a railroad siding; camera facing northeast.

Photo 0007: View of a Water Control Structure with concrete and stone elements; camera facing

north.

Photo 0008: View of the eastern wall of the Nail Factory; camera facing east.

Photo 0009: View of the remains of the Boonton Electric Company; camera facing south.

Photo 0010: View of the 1866 arch bridge; camera facing northwest.

Photo 0011: View of the Morris Canal bed within Canal Side Park; view facing northwest.

Photo 0012: View of Inclined Plane 7 East; camera facing northwest.

Photo 0013: View of the Morris & Essex Railroad Turntable; camera facing west.

Photo 0014: View of the 1906 railroad trestle bridge with 19th-century stone retaining walls; camera facing west.

Boonton Ironworks Historic District

New Jersey and National Registers Nomination
Boonton Town,
Morris County,
New Jersey

Boundary and tax map

Legend

- SR & NR District boundary
- Coordinates
- Tax Parcels

0 130 260 520 780 Feet

Datum: NAD 1983 State Plane New Jersey

53.31 Acres

NJDEP,
Historic Preservation Office
December 2022


Highland Ave
Lake Ave
W Main St
Pine St
Hill St
Oak St
Green St
Liberty St
Boonton Ave
Spruce St
Cedar St
Birch St
Cornelia St
School St
William St
Church St
Union St
Birch St
Mechanic St
Division St
Main St
Plane St
Morris Ave
Myrtle Ave
Interstate 287
Interstate 287
Washington St
Monroe St
Essex Ave
Fairview Ave
Reserve St
Reserve St
Rockaway St
South Ln
Rockaway River
12
13
14
8
4
3
7
5
6
7
14
13
9
2
10
11
14
17
15
16
Legend
Historic District Boundary
Resource #1: Potential Buried Remains from the Boonton Ironworks and Later Industries
Resources #2-11: Boonton Ironworks Resources*
Resources #12-13: Morris Canal Resources*
Resources #14-17: Railroad Resources*
Tax Parcel Boundaries (NJ CRGIS)
* Outlined resources have visible elements
0 62.5 125 250 375 500
Feet
N


Highland Ave
Lake Ave
W Main St
Hill St
Pine St
Oak St
Green St
Liberty St
Boonton Ave
Spruce St
Cedar St
Birch St
Cornelia St
School St
Church St
William St
Union St
Birch St
Union St
Mechanic St
Essex Ave
Fairview Ave
Rockaway St
Rockaway River
Reserve St
Reserve St
South Ln
Plane St
Main St
Division St
Morris Ave
Myrtle Ave
Interstate 287
Interstate 287
Monroe St
Washington St
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Legend
Historic District Boundary
Photograph Number and Direction
Tax Parcel Boundaries (NJ CRGIS)
N
0 62.5 125 250 375 500
Feet

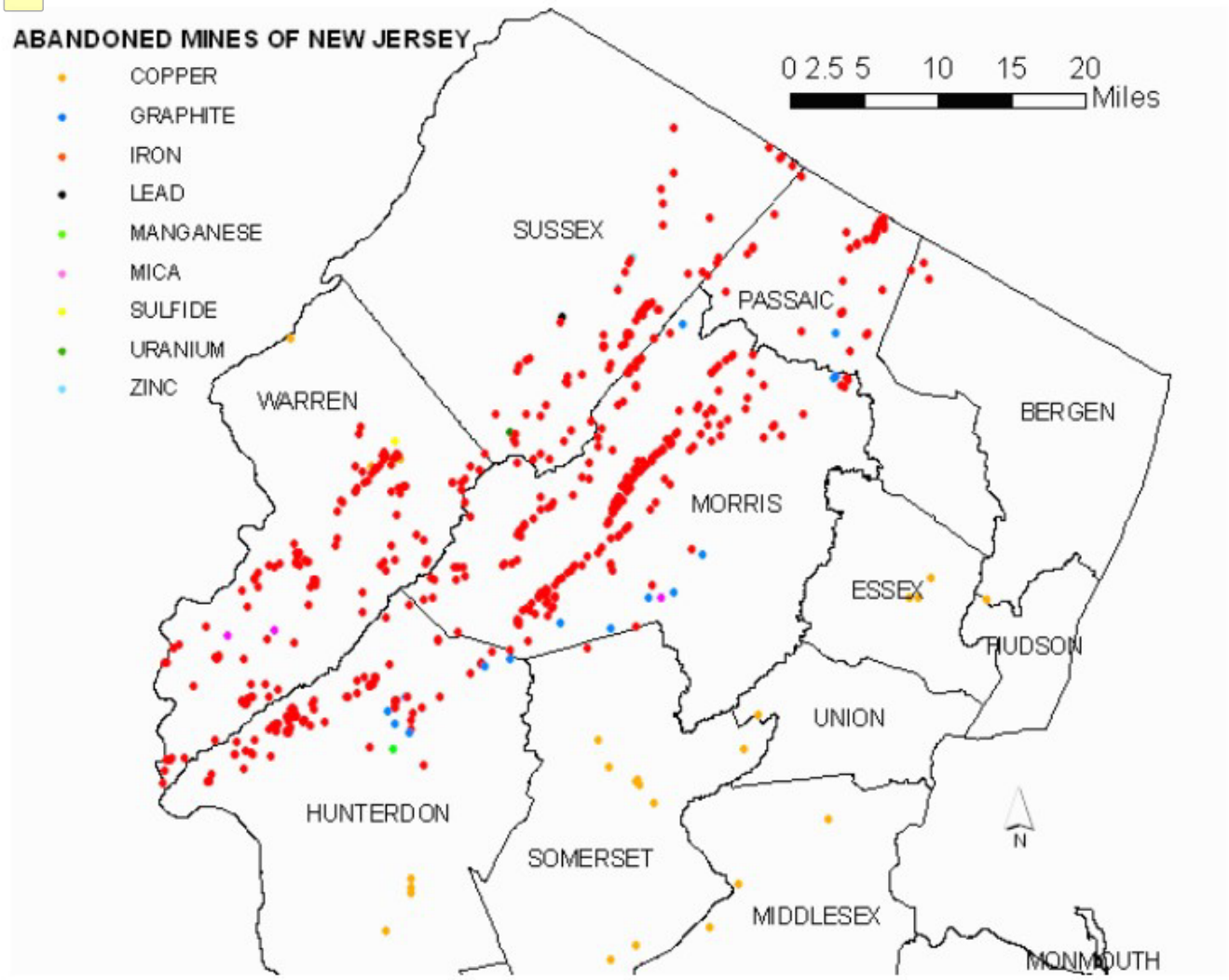


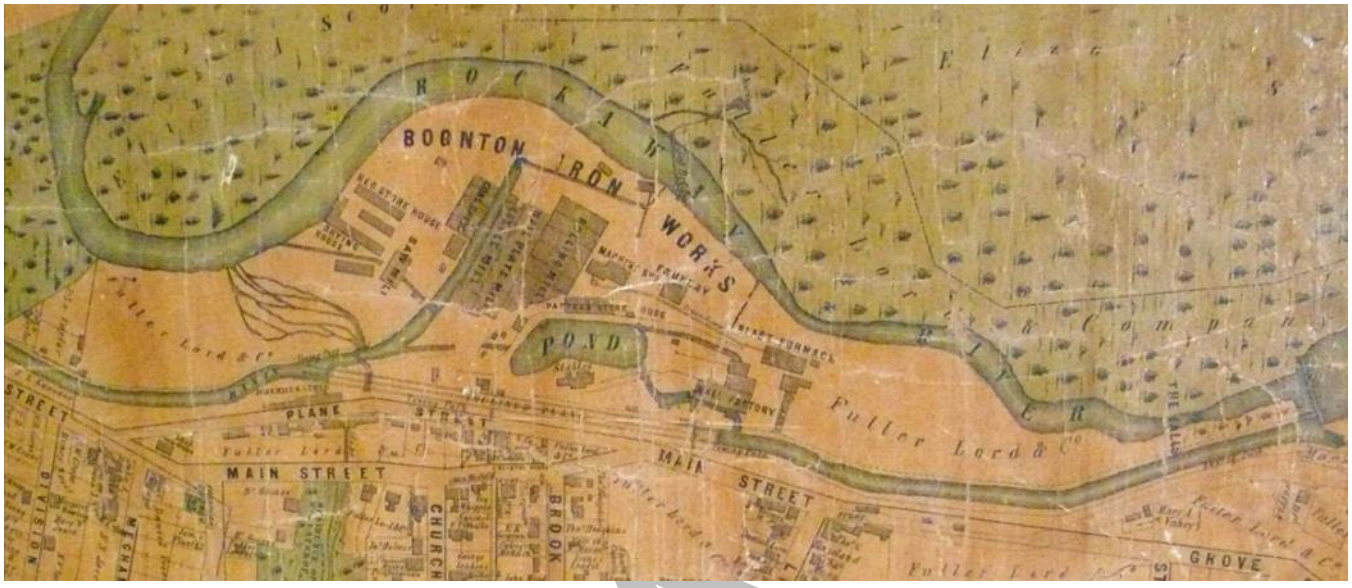
Figure 1. Map showing the abandoned mines of New Jersey with iron mines noted in red. Note the extensive number of mines in Morris County and the Highlands region.[1]

[1] "Abandoned Mines of New Jersey," NJ DEP – New Jersey Geological and Water Survey. https://www.nj.gov/dep/njgs/geodata/dgs03-2.htm#image

north

Figure 2. 1848 survey of Boonton showing the ironworks when owned by the New Jersey Iron Company.[2]

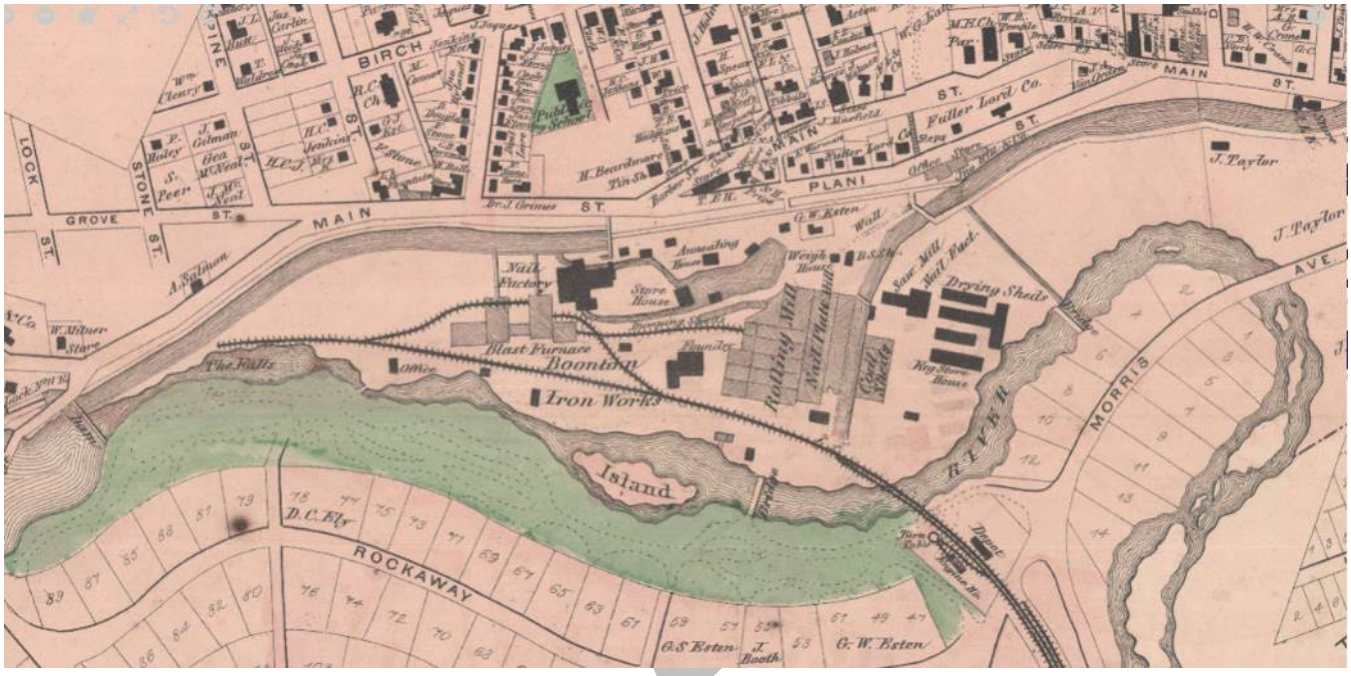
[2] *Survey of Boonton New Jersey by James E. Serrell, Civil Engineer*, 1848. Courtesy of the Boonton Historical Society.



north

Figure 3. 1857 map of Boonton showing the ironworks after being acquired by Fuller, Lord & Co.[3]

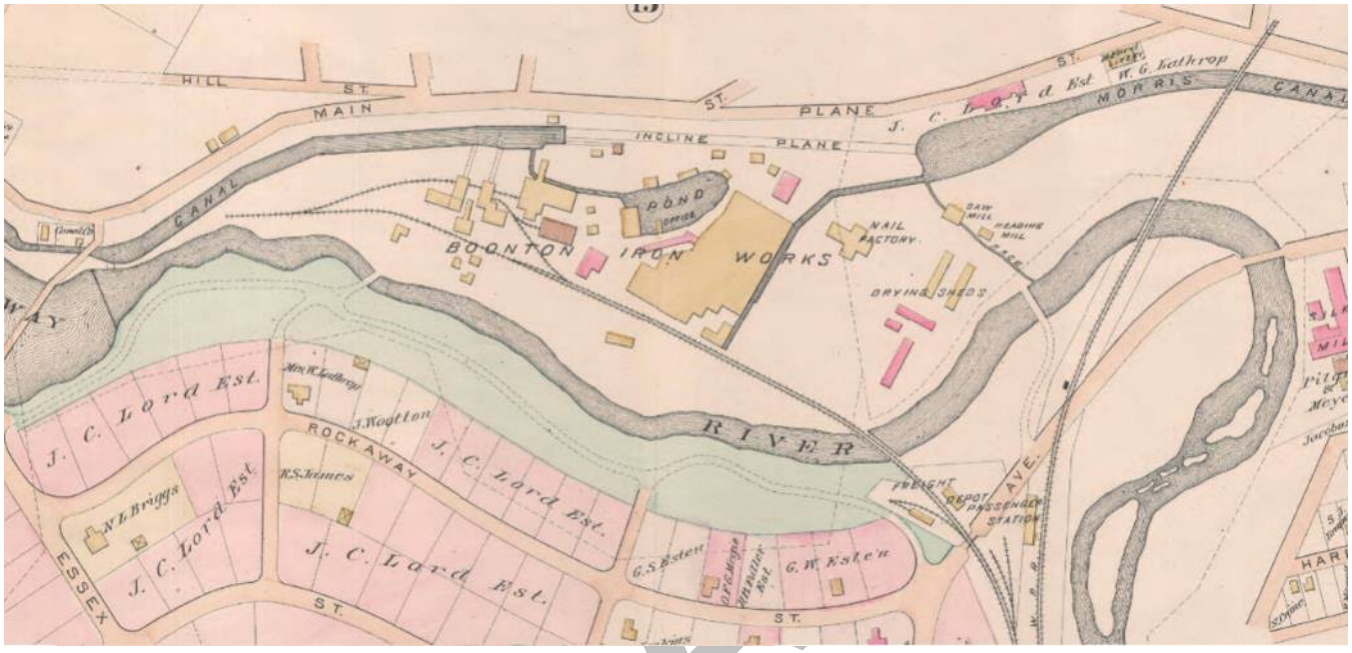
[3] *Map of Boonton Morris Co. NJ surveyed drawn & Published by Thomas Hughes*, 1857. Courtesy of the Boonton Historical Society.



north

Figure 4. 1868 atlas of Morris County showing the Boonton Ironworks during its peak of operation.[4]

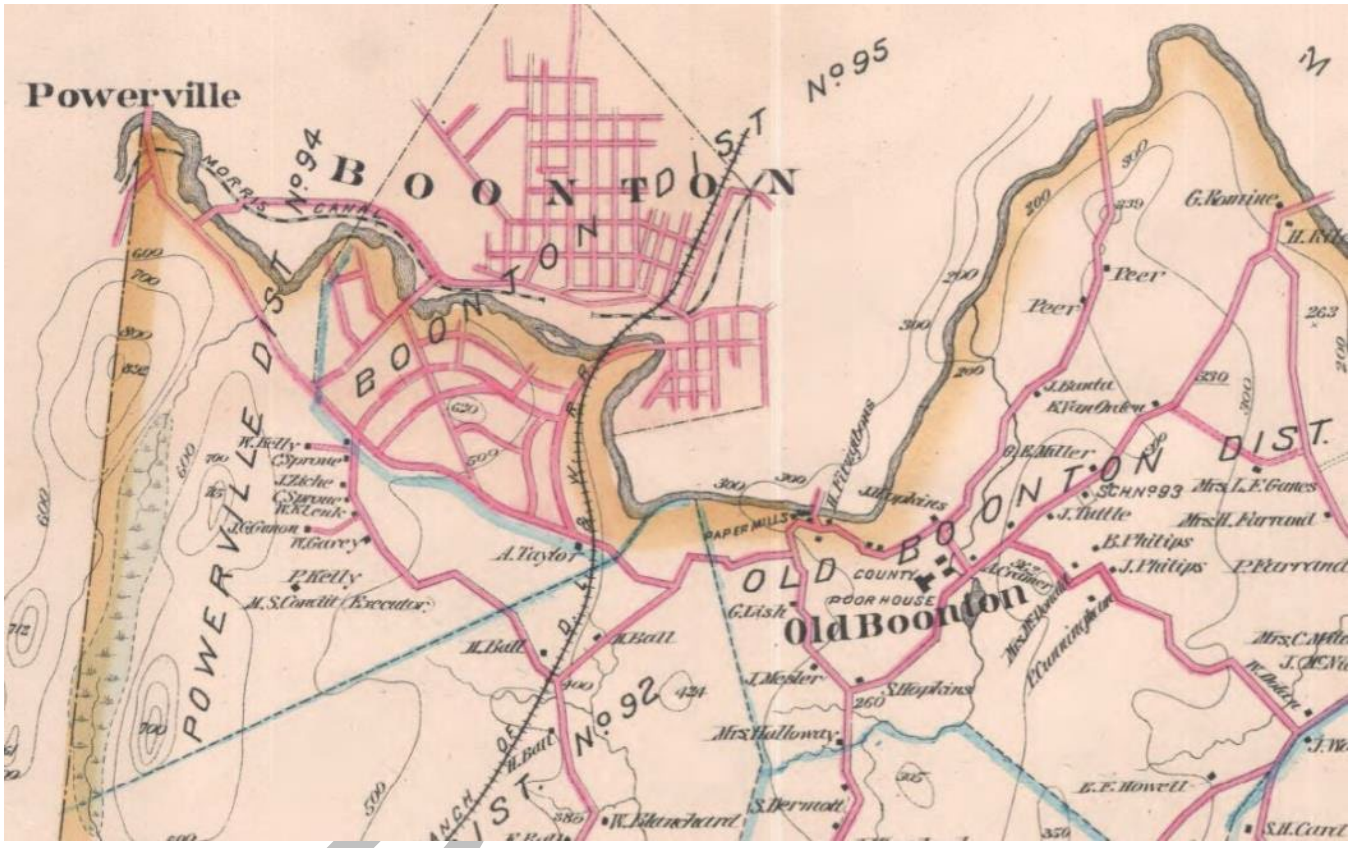
[4] *Atlas of Morris Co., New Jersey from actual Surveys by and under the direction of F.W. Beers* (New York: F.W. Beers, A.D. Ellis & G.G. Soule, 1868), plate 30. Courtesy of the North Jersey History & Genealogy Center, Digital Collections, Morristown & Morris Township Library.



north

Figure 5. 1887 atlas of Morris County focusing on the Boonton Ironworks and related features of the historic district.[5]

[5] *Atlas of Morris County, New Jersey compiled from Official Records, Private Plans & Actual Surveys* (New York: E. Robinson, 1887), plate 16. Courtesy of the North Jersey History & Genealogy Center, Digital Collections, Morristown & Morris Township Library.



north

Figure 6. 1887 atlas of Morris County showing the juxtaposition between Old Boonton and the current Boonton.[6]

[6] *Atlas of Morris County, New Jersey compiled from Official Records, Private Plans & Actual Surveys* (New York: E. Robinson, 1887), plate 14. Courtesy of the North Jersey History & Genealogy Center, Digital Collections, Morristown & Morris Township Library.

United States Department of the Interior
National Park Service

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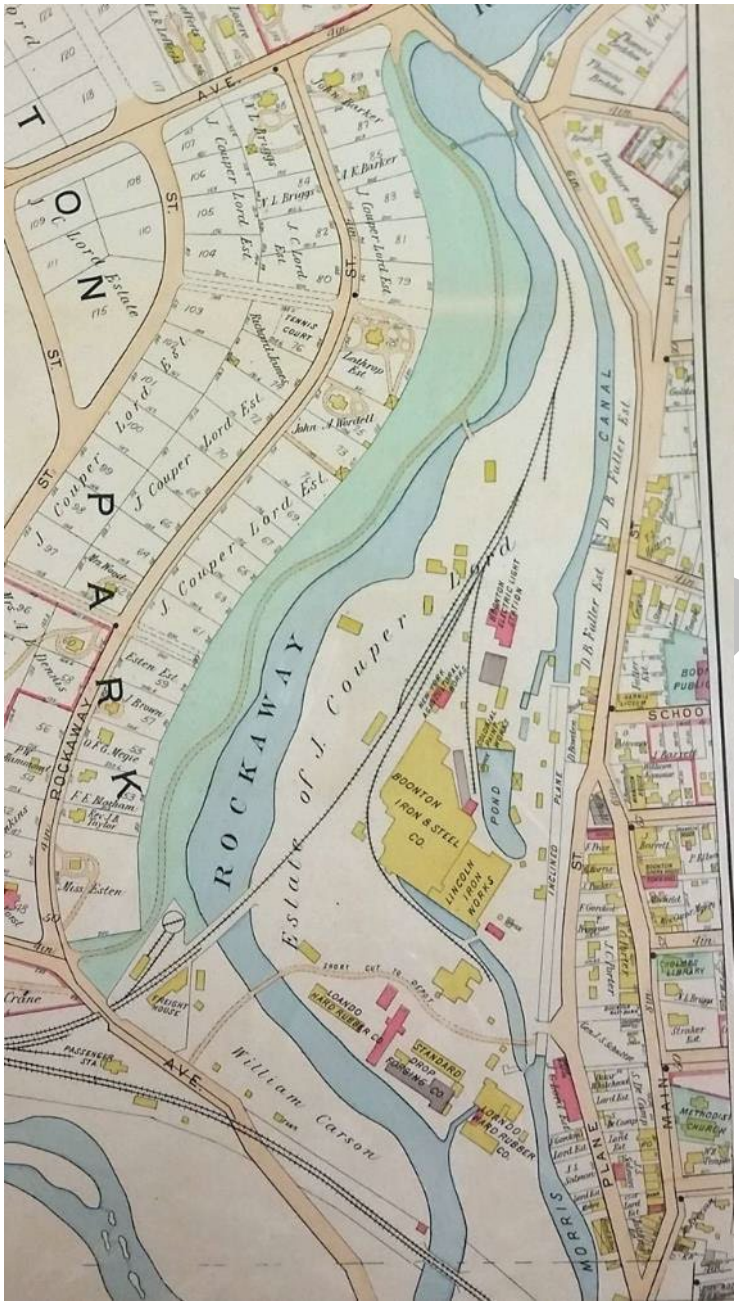
National Register of Historic Places Continuation Sheet

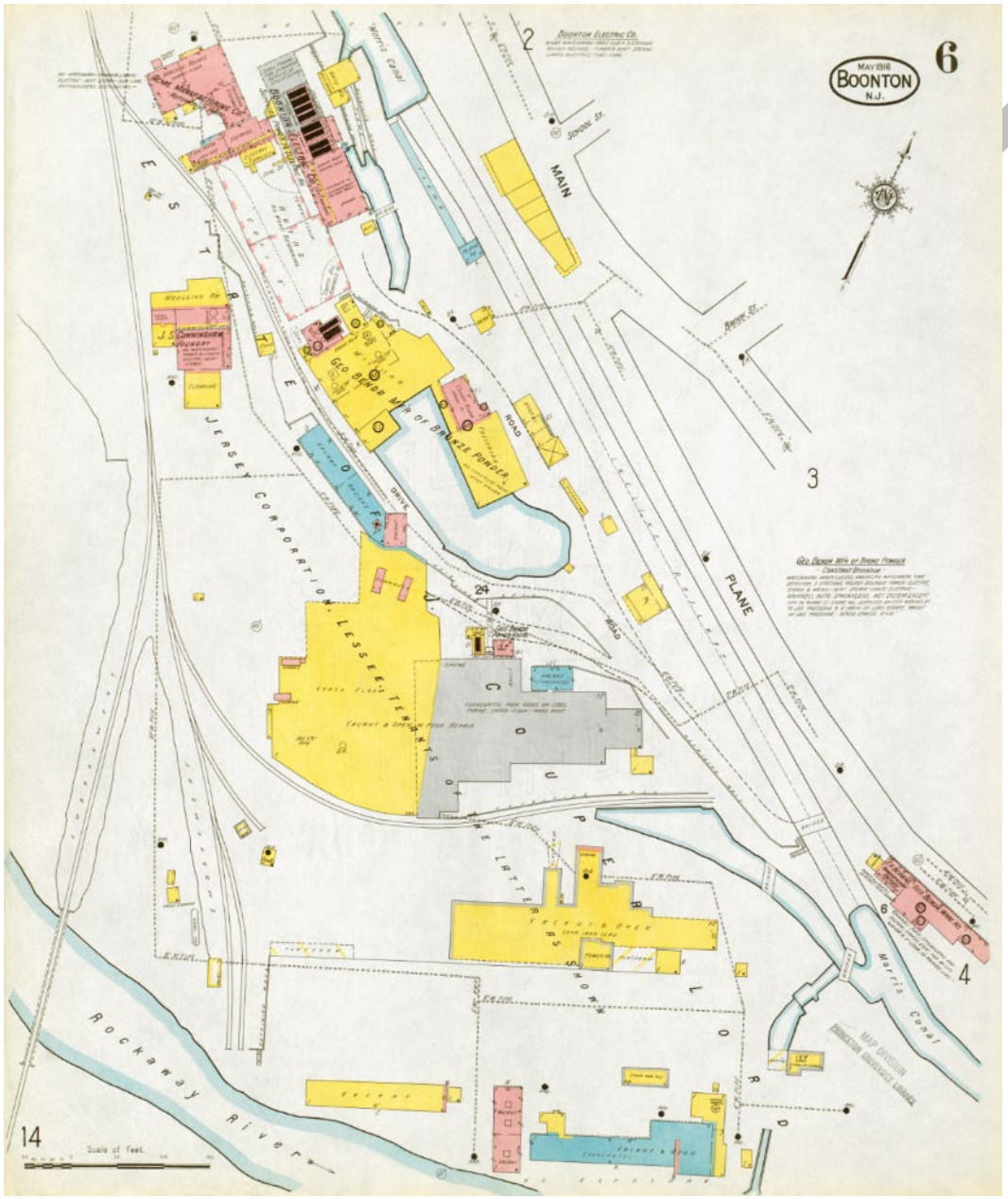
Section number Figures Page 7



north

Figure 7. 1900 Robinson Map of Boonton showing the businesses that were leasing the former ironworks property at that time, which was still owned by the estate James Couper Lord.[7]

[7] E. Robinson, "Map of Boonton, Morris Co. NJ," (New York: E. Robinson & Co., 1900). Available on file at the North Jersey History & Genealogy Center at the Morristown & Morris Township Library.



north

Figure 8. 1916 Sanborn Insurance Map of Boonton showing the businesses that were leasing the former ironworks property at that time, which was still owned by the estate James Couper Lord. Note several of the buildings are labeled as vacant and open.[8]

[8] Sanborn Map Company, "Boonton, Morris Co., New Jersey," (New York: Sanborn Map Company, 1916), sheet 6. Available online from Princeton University.

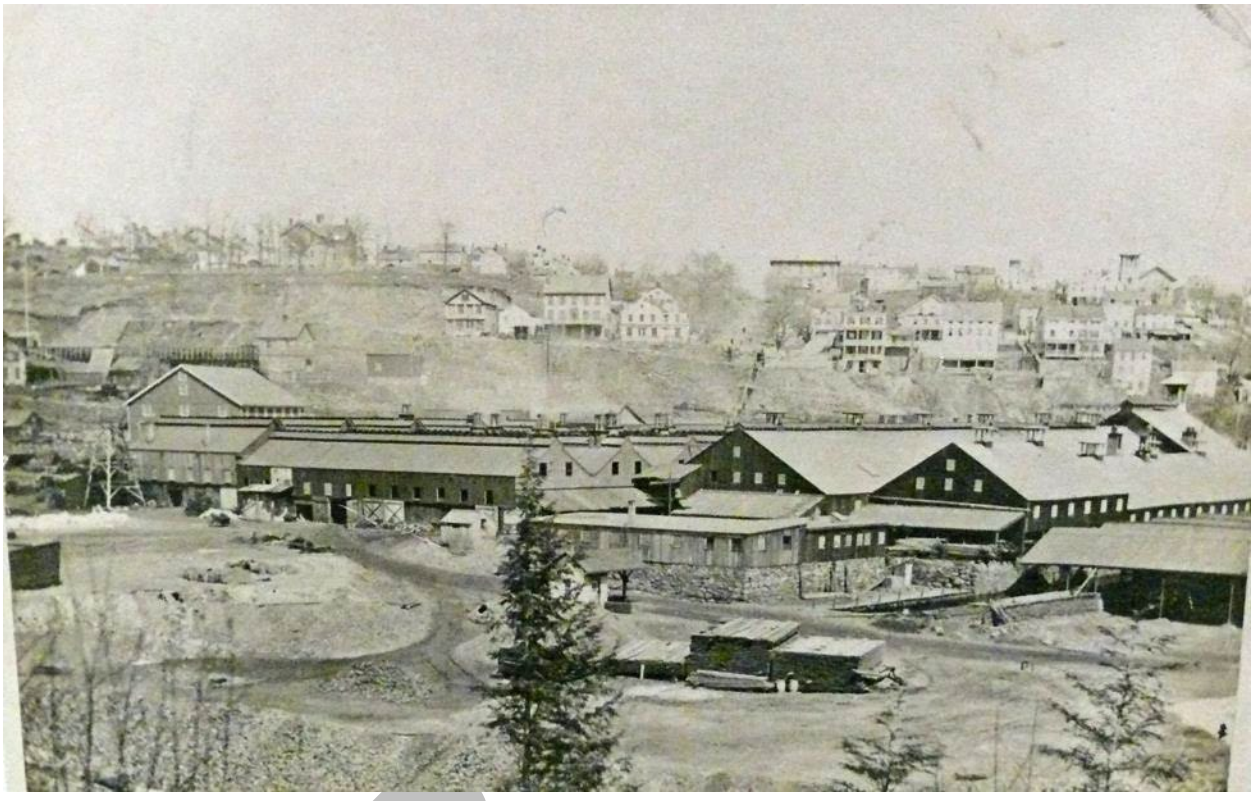


Figure 9. 1870 view of a portion of the Boonton Ironworks focusing on the rolling mill with Plane and Main Streets visible behind.[9]

[9] Courtesy of the Boonton Historical Society.

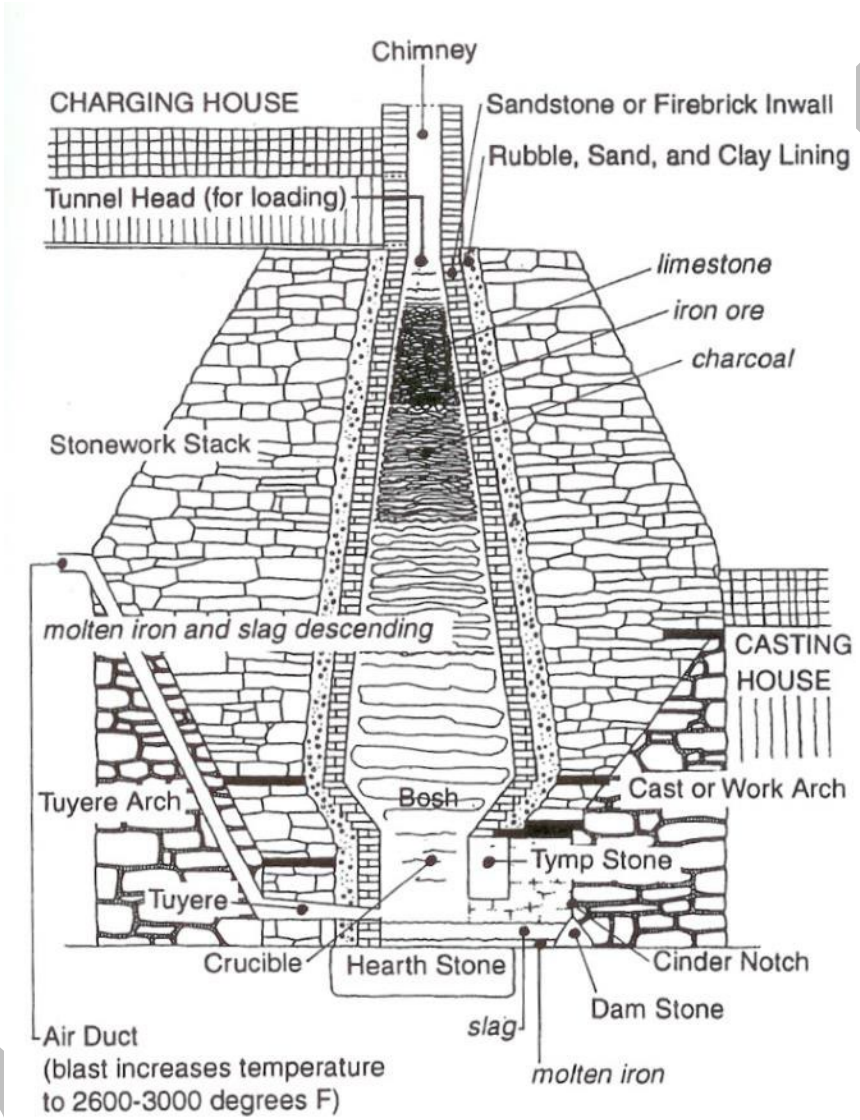


Figure 10. Cross section of a typical blast furnace.[10]

[10] Eggert, Gerald G. *The Iron Industry in Pennsylvania*. Harrisburg: Pennsylvania Historical Association, 1994.

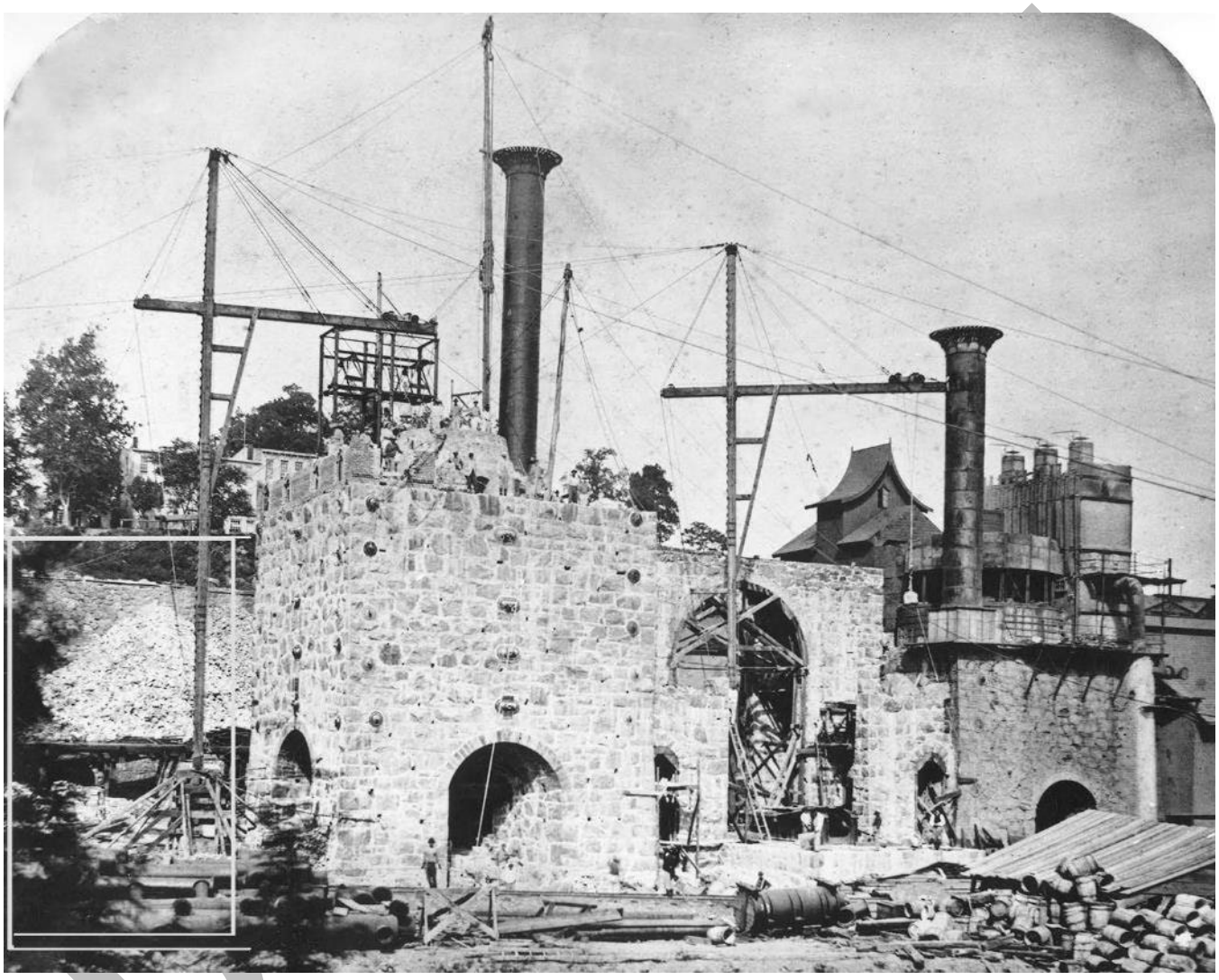


Figure 11. Circa 1868 view of the second blast furnace under construction at the Boonton Ironworks.[11]

[11] Courtesy of the Canal Society of New Jersey.

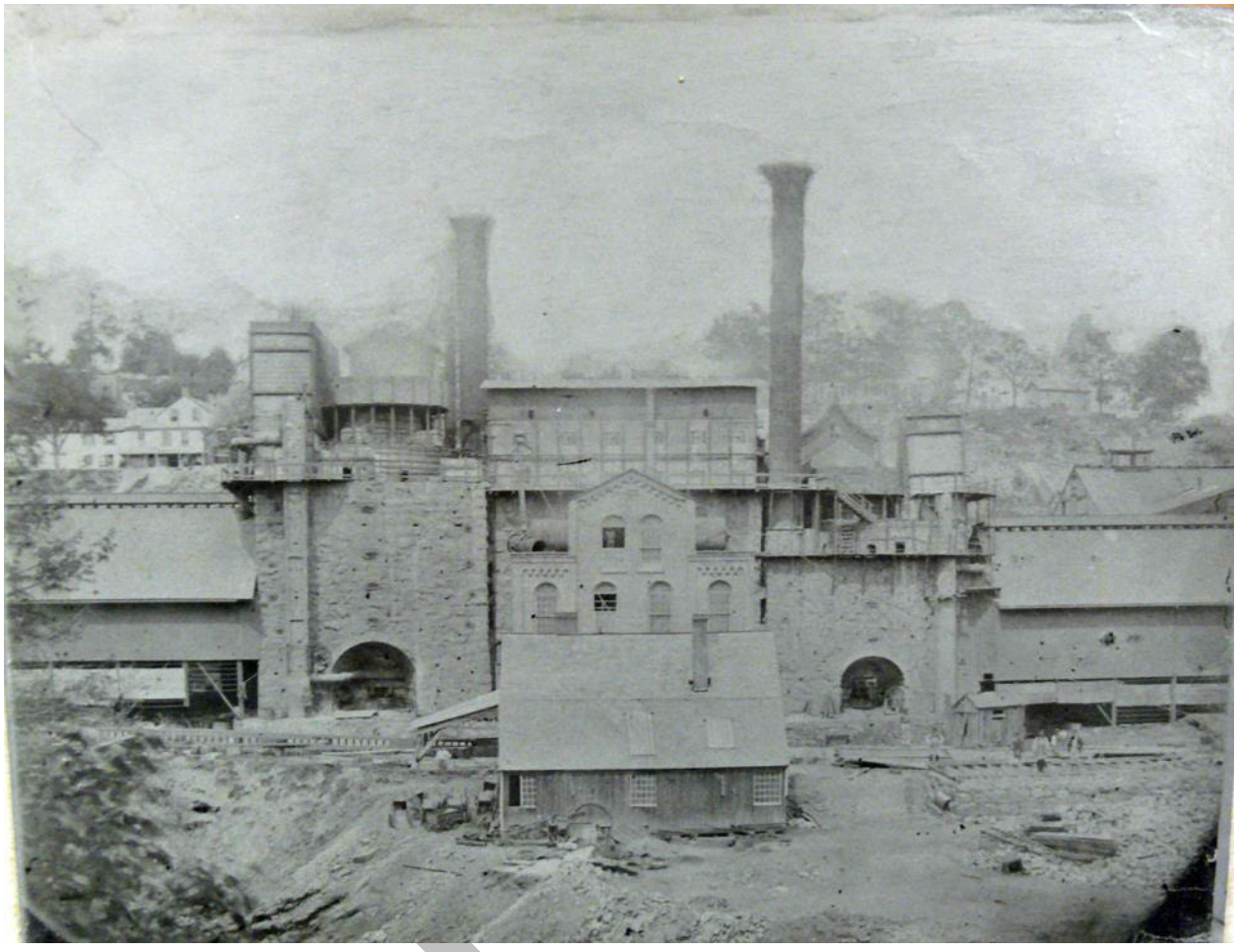


Figure 12. Undated view showing the blast furnaces at the Boonton Ironworks.[12]

[12] Courtesy of the Boonton Historical Society.

Figure 13. C.1870s view of the railroad leading to the Boonton Ironworks from the south/southeast.[13]

[13] Courtesy of the Boonton Historical Society.

Figure 14. Undated view of the railroad siding leading to the Boonton Ironworks at the north/northwest end.[14]

[14] Courtesy of the Boonton Historical Society.

Figure 15. Undated (pre-1896) view of the railroad turntable and the original wooden railroad trestle with the Boonton Ironworks in the background.[15]

[15] Courtesy of the Boonton Historical Society.

Figure 16. Undated (pre-1896) view of the original wooden railroad trestle when the river was high at flood stage. Note the rubblestone retaining walls along the river banks that were incorporated into the 1906 steel railroad trestle that replaced the wooden one.[16]

[16] William J. (Capt. Bill) McKelvey, *The Transportation History of Boonton, NJ* (Totowa, NJ: The Garbely Publishing Company, 2018), 24, citing the Boonton Historical Society.

Figure 17. C.1890s view of the arch bridge that was built to carry a constant piped water source to the Boonton Ironworks for fire protection.[17]

[17] Detroit Publishing Co., "Old Stone Bridge, Boonton, NJ," 1890-1901. Library of Congress, Prints & Photographs Division, Detroit Publishing Company Collection.

Figure 18. Undated (partial) view of the stone foundation with arches believed to be part of the trestle system that carried rail cars to the filling house and first nail factory. Note the stone wall behind that held up the Morris Canal above.[18]

[18] Courtesy of the Canal Society of New Jersey.

Figure 19. C.1900 view showing the Morris Canal and its proximity to the Ironworks visible to the left.[19]

[19] Courtesy of the Boonton Historical Society.

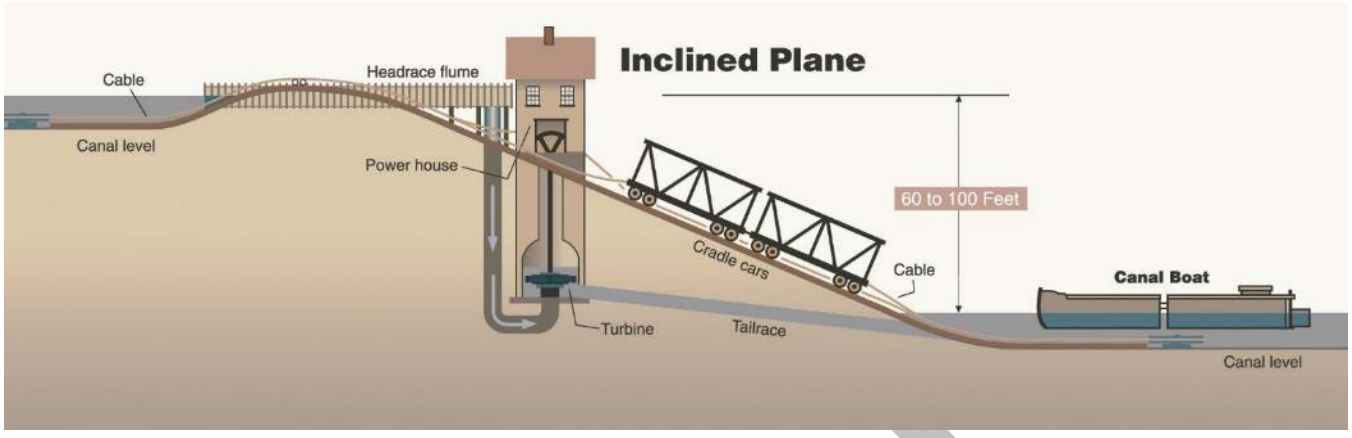


Figure 20. Diagram of an inclined plane.[20]

[20] Courtesy of the Canal Society of New Jersey.

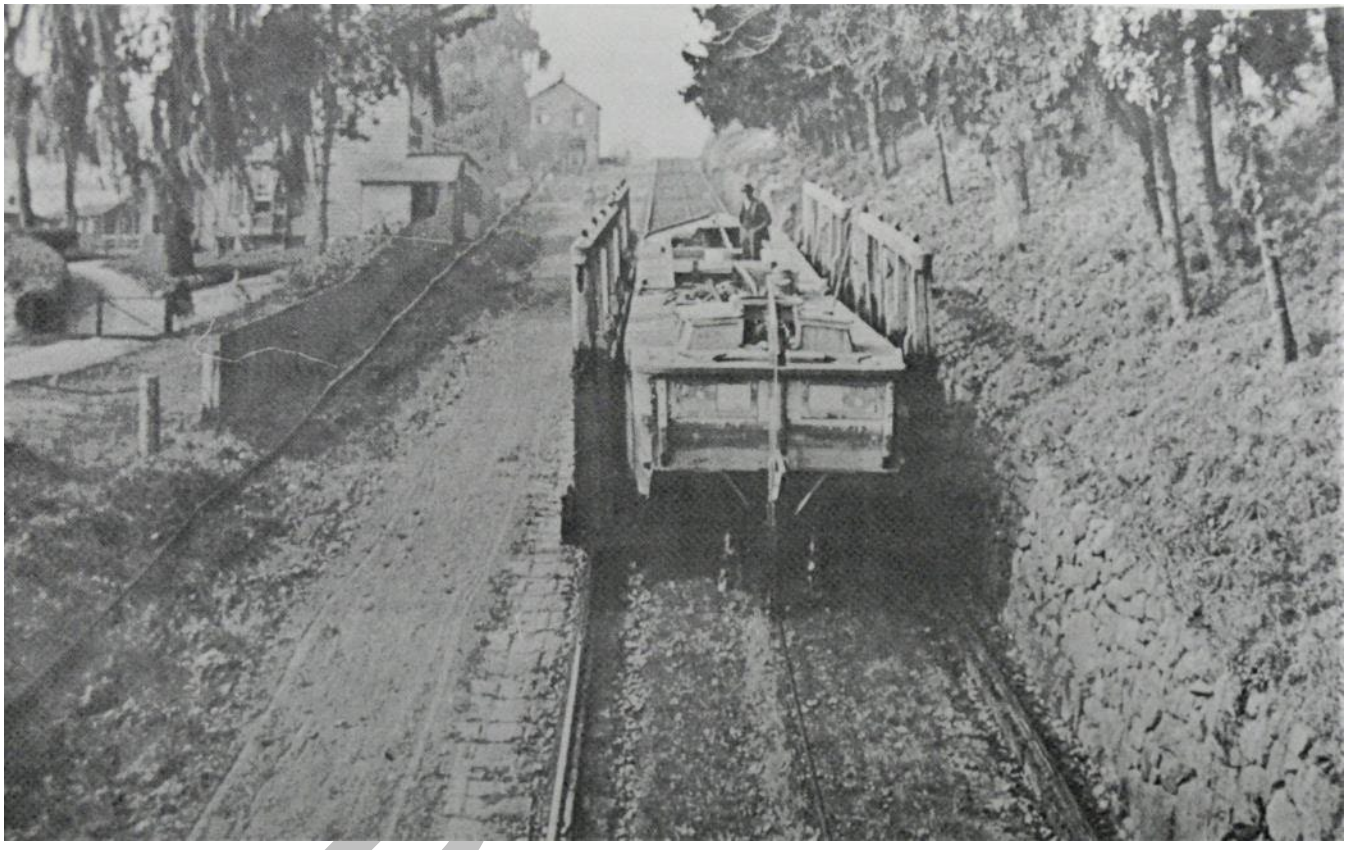


Figure 21. Undated image of a boat on Inclined Plane 7 East with the Esten House visible adjacent to the plane.[21]

[21] Courtesy of the Boonton Historical Society.

Figure 22. Circa 1890s image of the blast furnaces being dismantled.[22]

[22] Courtesy of the Boonton Historical Society.

Figure 23. 1906 partial view of the former Ironworks following a fire that destroyed many of the buildings.[23]

[23] Courtesy of the Boonton Historical Society.

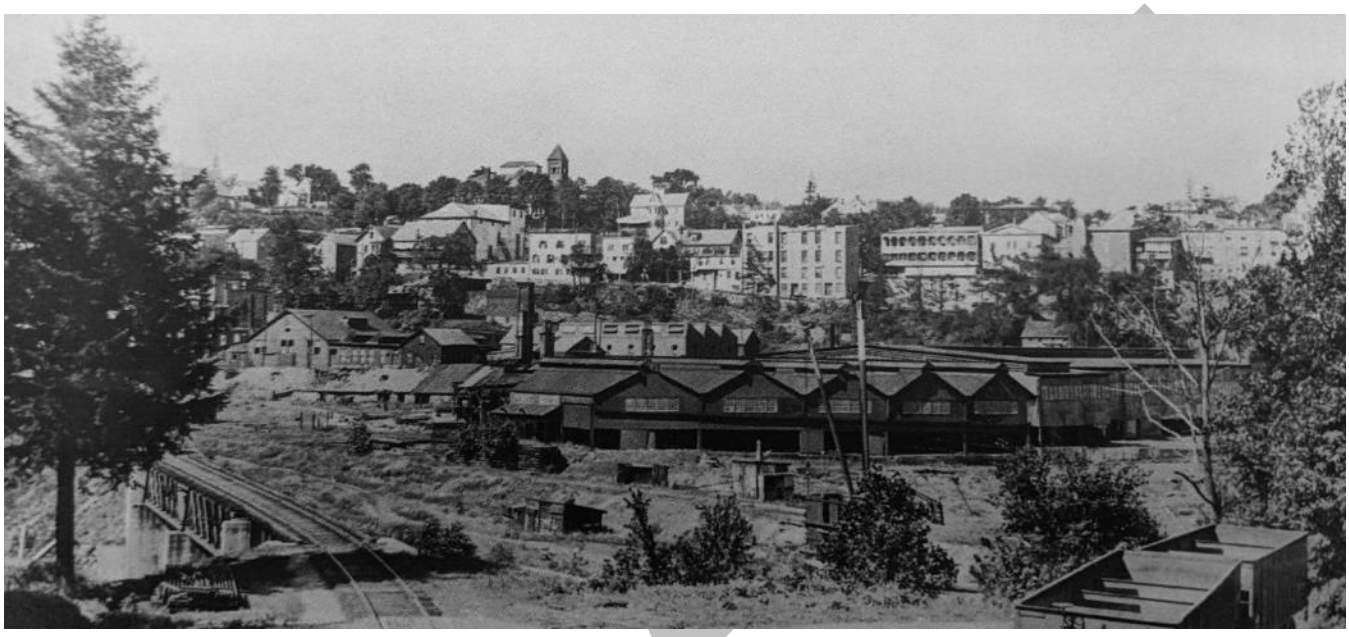


Figure 24. Post-1906 undated view looking northwest toward the Ironworks with the Railroad Trestle visible at the left.[24]

[24] Courtesy of the Boonton Historical Society as cited in: William J. (Capt. Bill) McKelvey), *The Transportation History of Boonton, NJ* (Branchville, NJ: Garbely Publishing Co., 2018), 68.

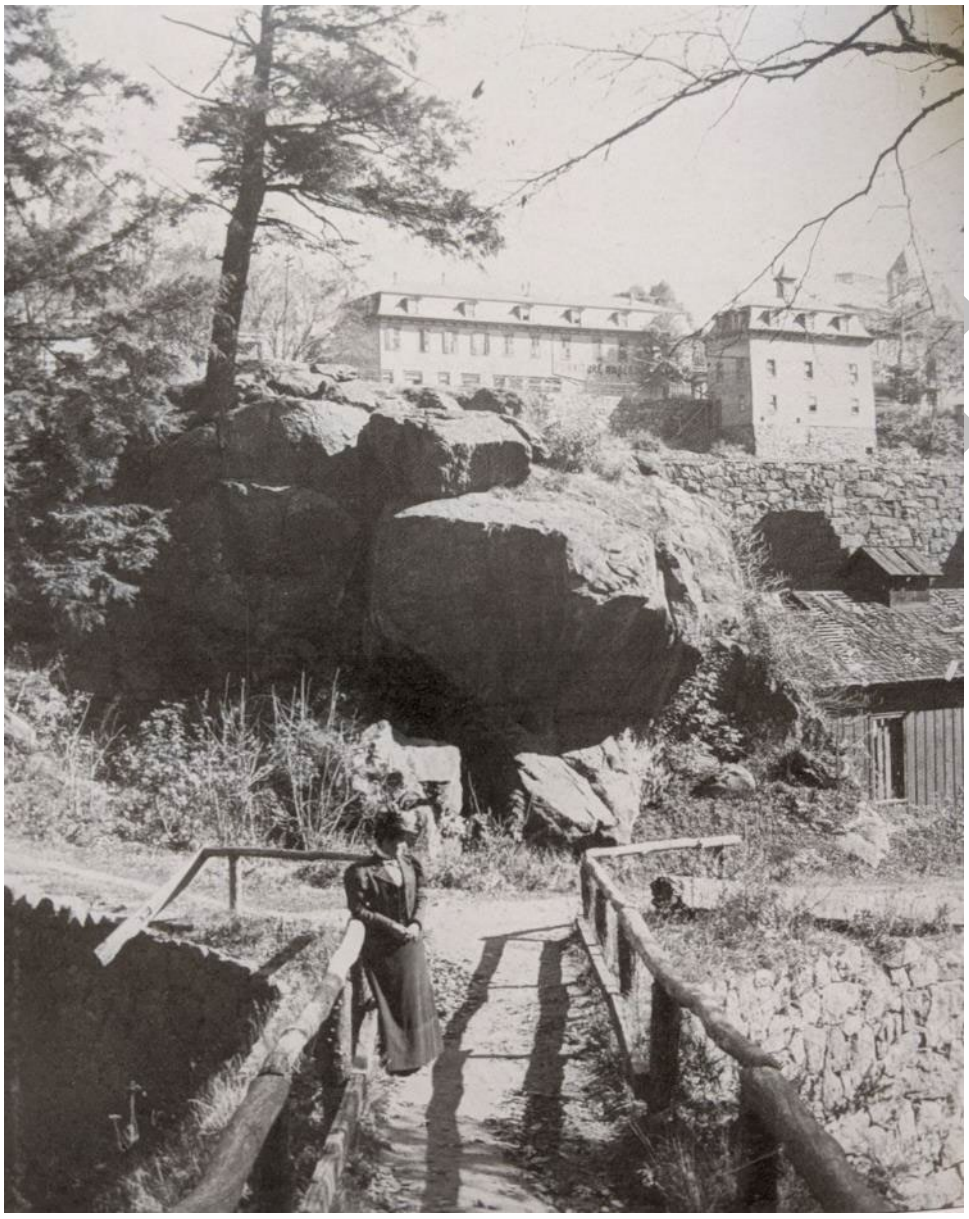


Figure 25. 1908 view looking northeast from above the arched bridge.[25]

[25] Boonton Historical Society, *Images of America: Boonton* (Charleston, SC: Arcadia Publishing, 2017), frontispiece.

Figure 26. Drawing depicting the Boonton Ironworks included in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[26]

[26] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 145.

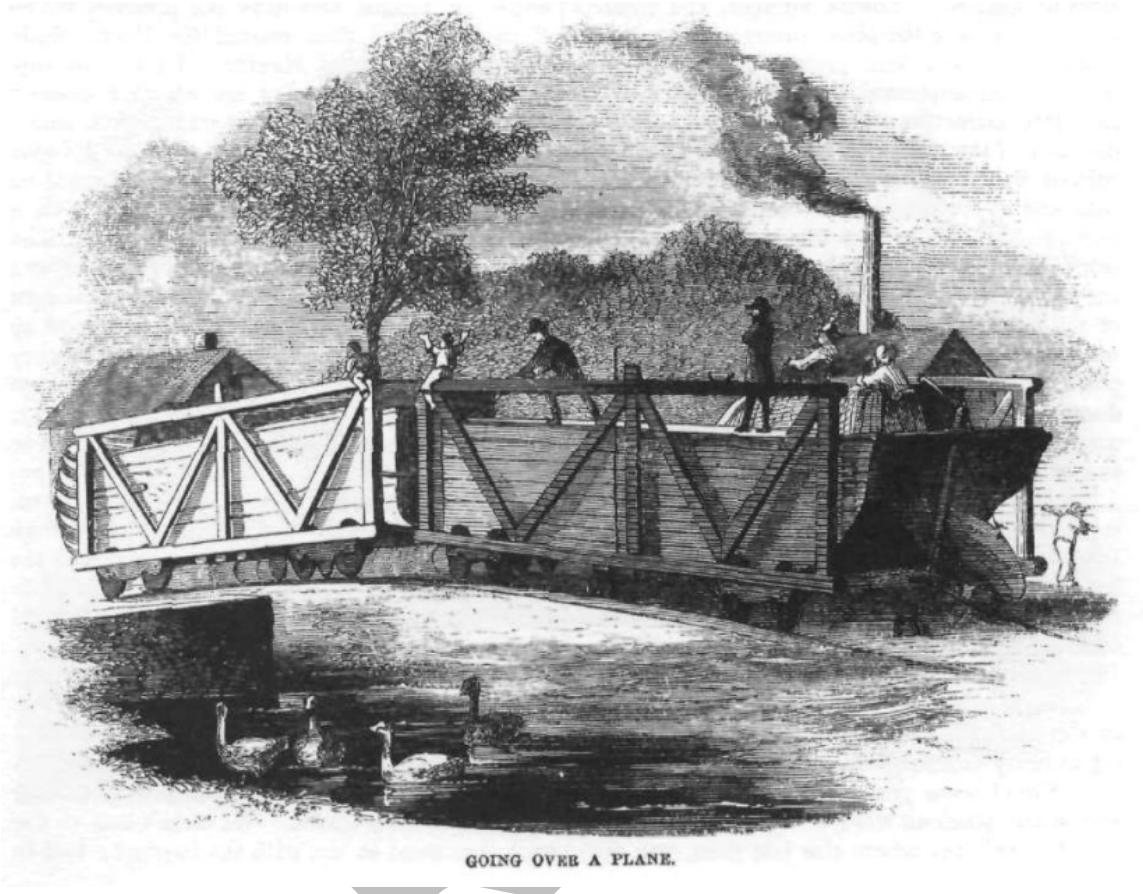


Figure 27. Drawing depicting canal boats passing over a plane in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[27]

[27] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 150.

Figure 28. Drawing depicting the blast furnace at Boonton in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[28]

[28] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 154.

Figure 29. Drawing depicting workers tapping the furnace in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[29]

[29] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 155.

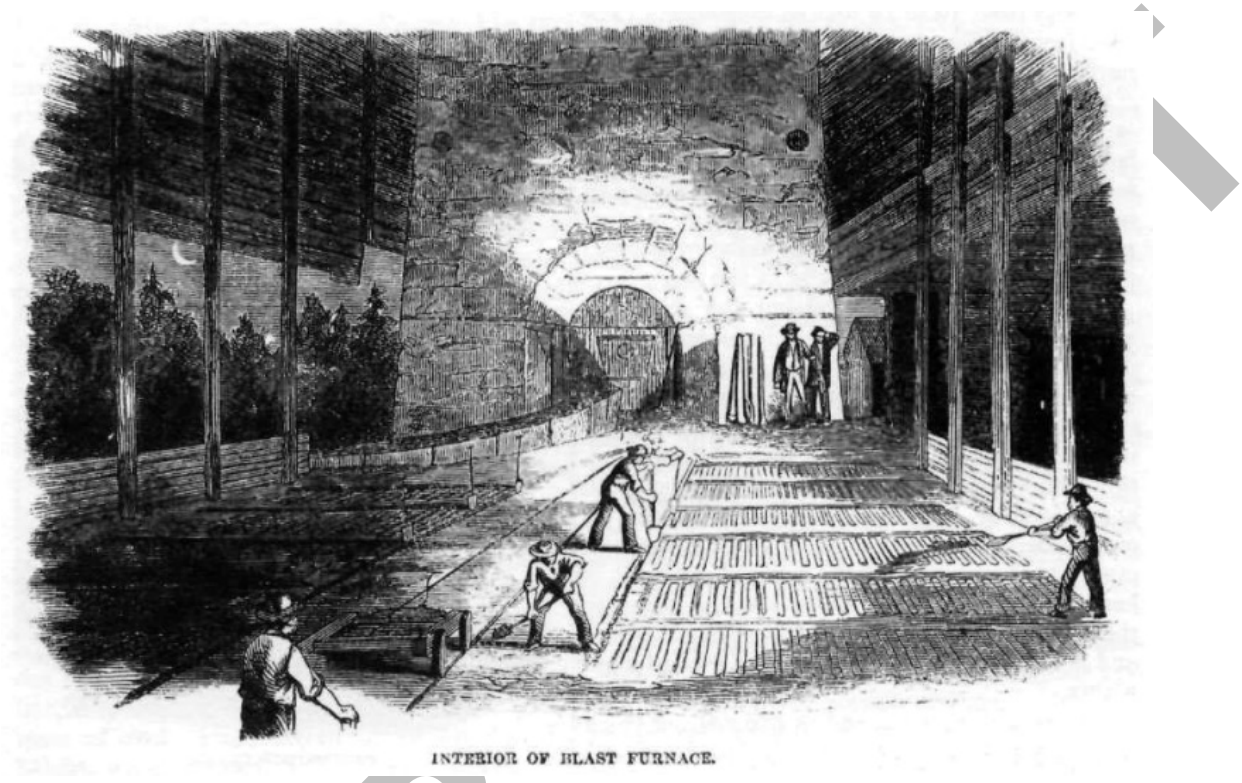


Figure 30. Drawing depicting the interior of the casting house at Boonton in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[30]

[30] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 156.

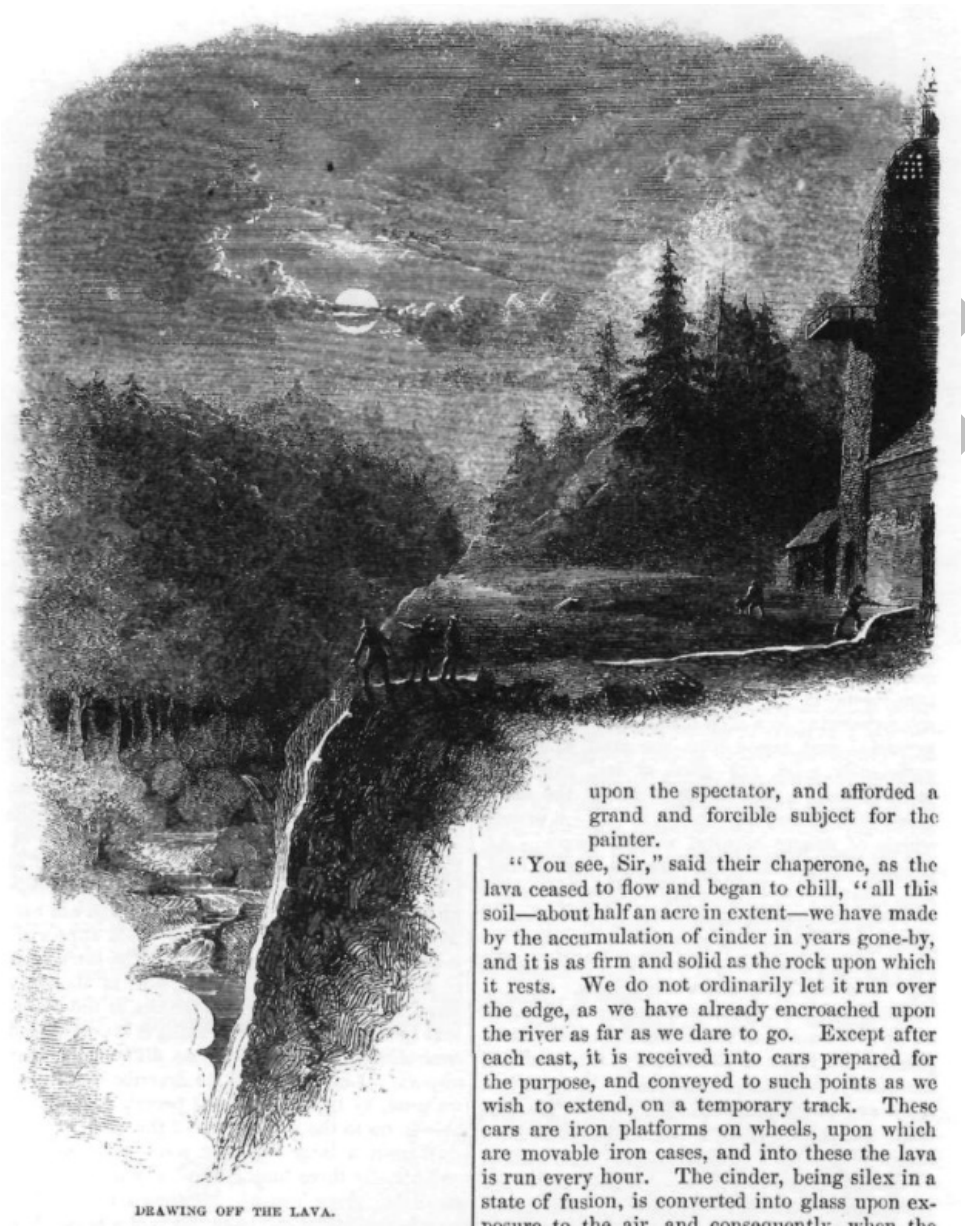


Figure 31. Drawing depicting the drawing off of the slag from the blast furnace into the Rockaway River in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[31]

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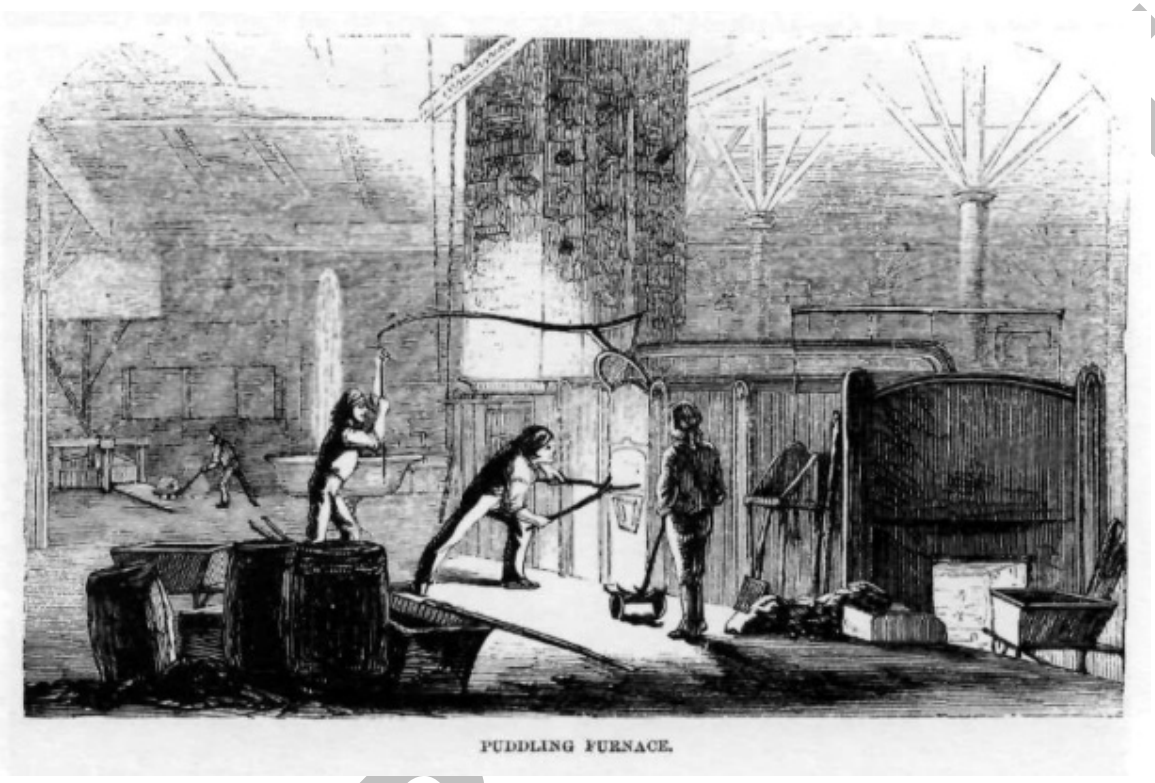

Figure 32. Drawing depicting the interior of the puddling furnace in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[32]

[32] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 158.

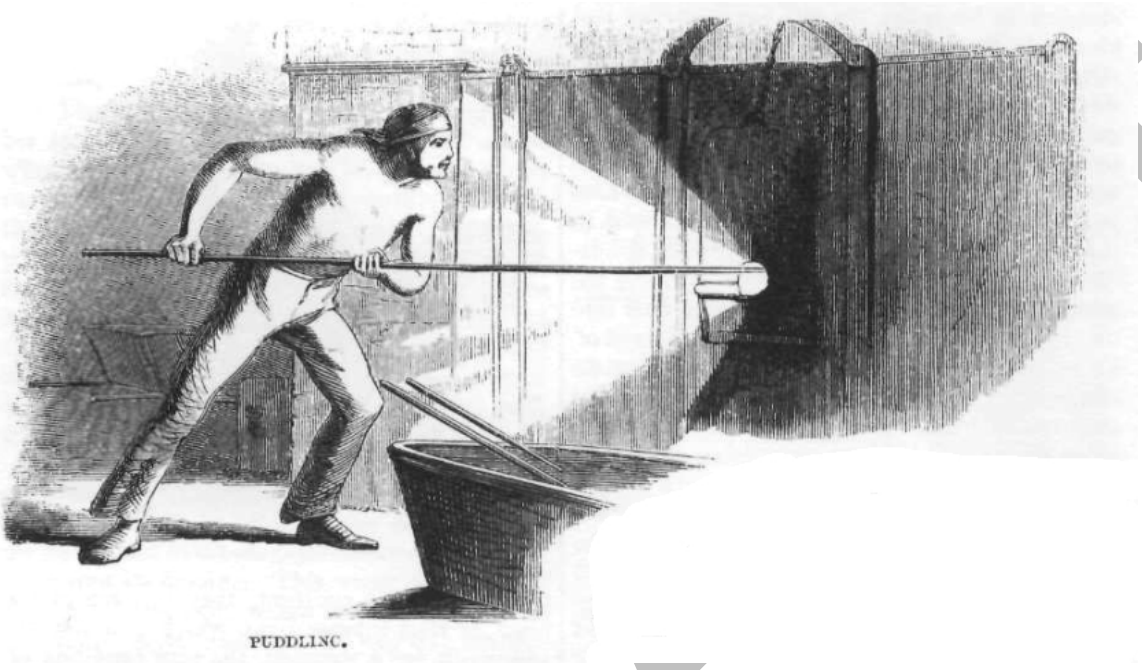

Figure 33. Drawing depicting a puddler at work in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[33]

[33] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 159.

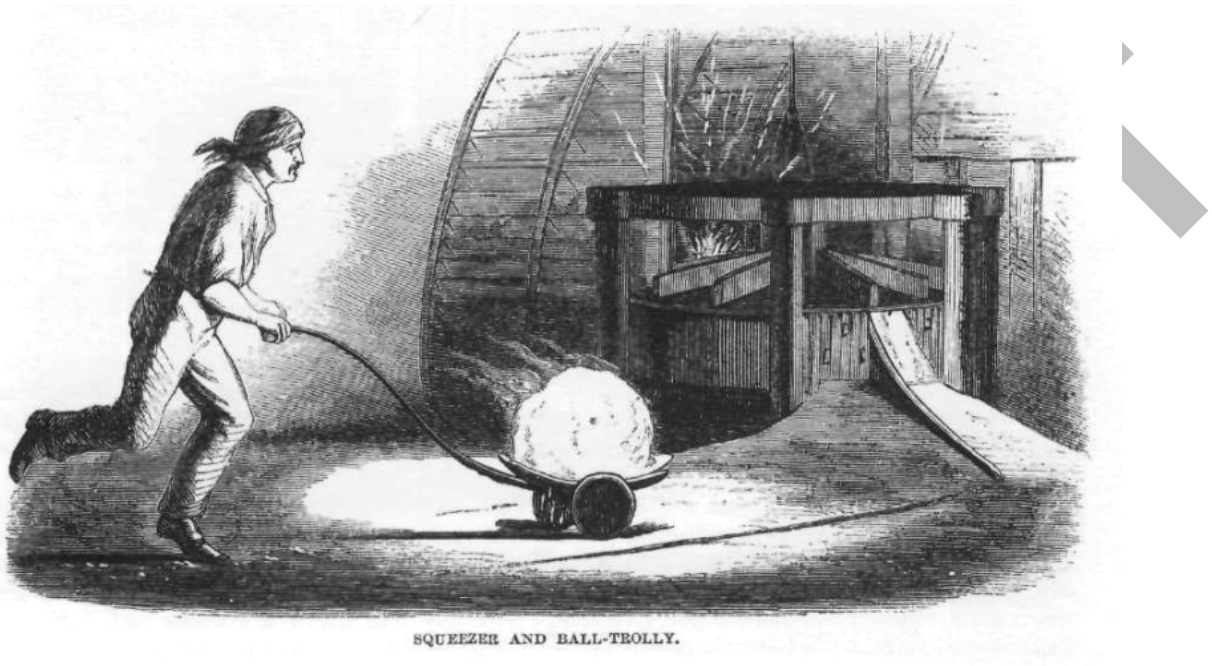

Figure 34. Drawing depicting a puddler using a ball-trolley to transport puddled iron in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[34]

[34] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 159.

Figure 35. Drawing depicting puddled iron being squeezed in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[35]

[35] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 160.

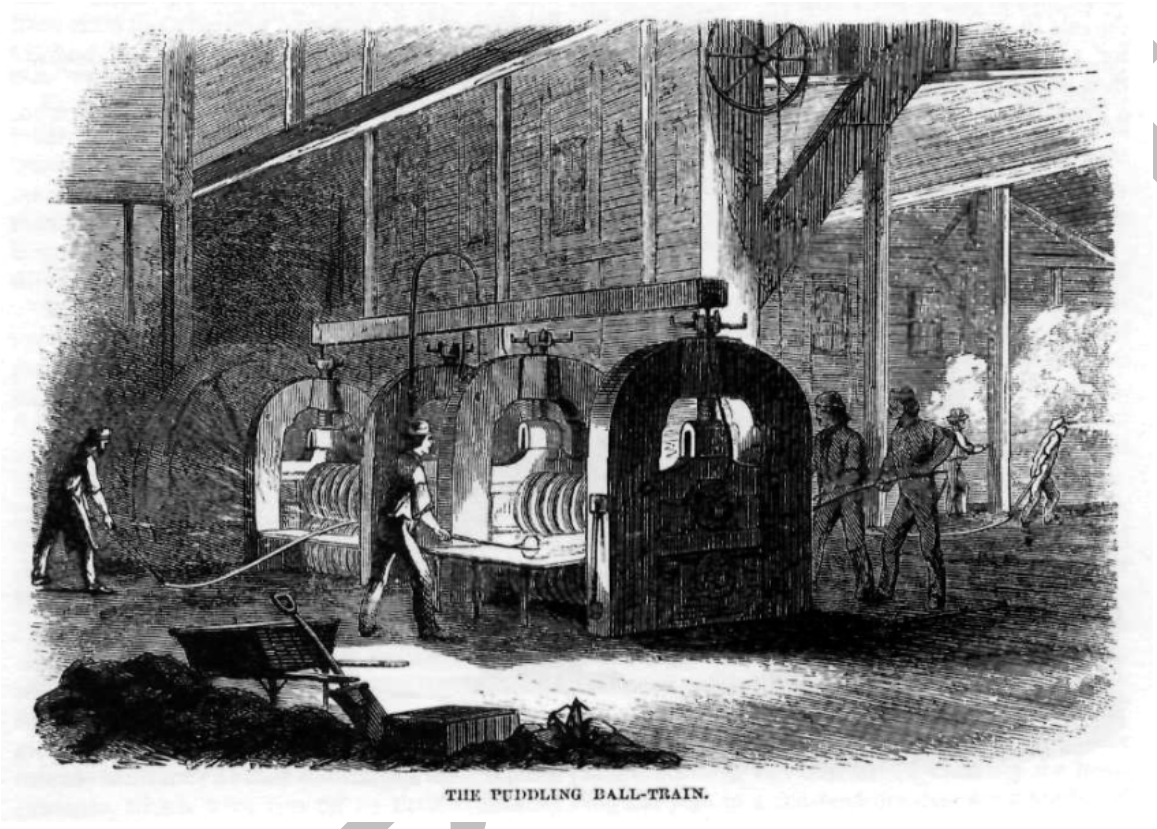

Figure 36. Drawing depicting a puddling ball train (rolling mill) in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[36]

[36] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 160.

Figure 37. Drawing depicting a worker cutting bars in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[37]

[37] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 161.

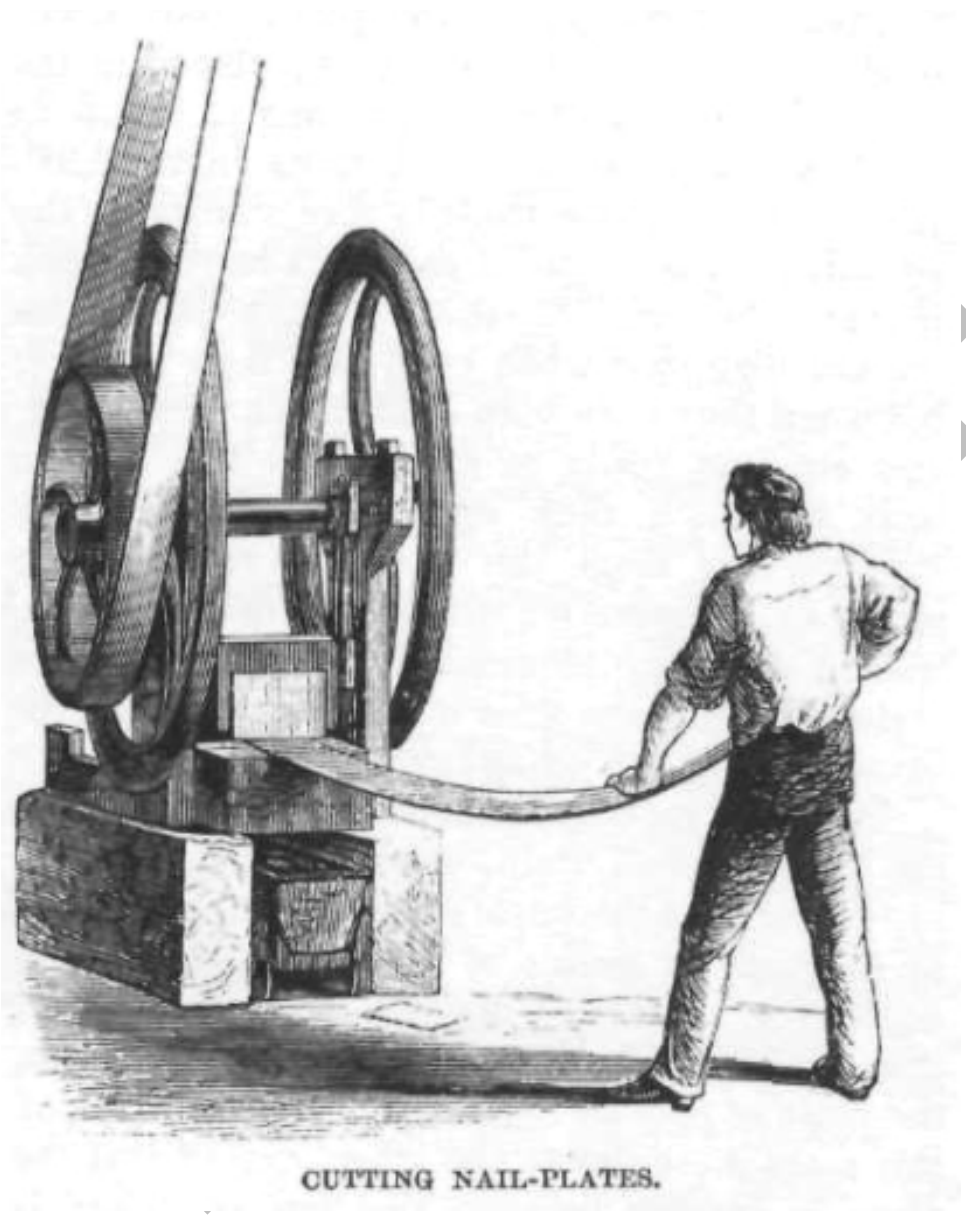

Figure 38. Drawing depicting a worker cutting nail plates in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[38]

[38] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 161.

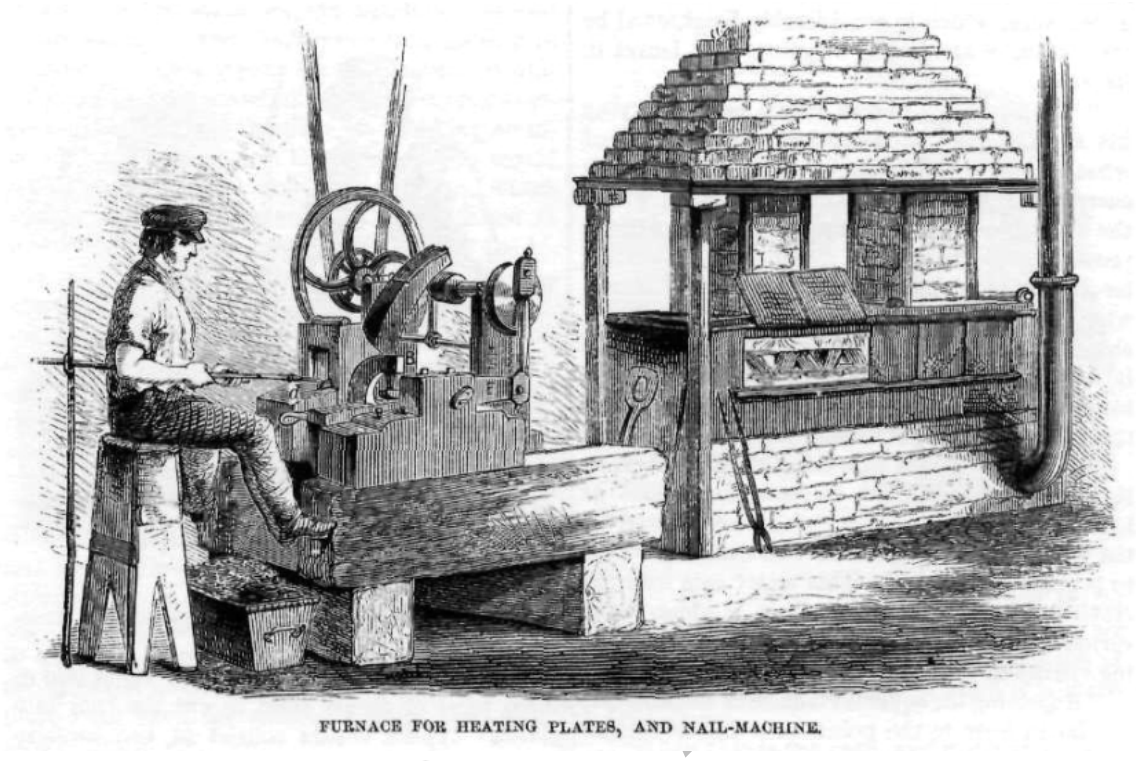

Figure 39. Drawing depicting a nail machine in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[39]

[39] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 162.

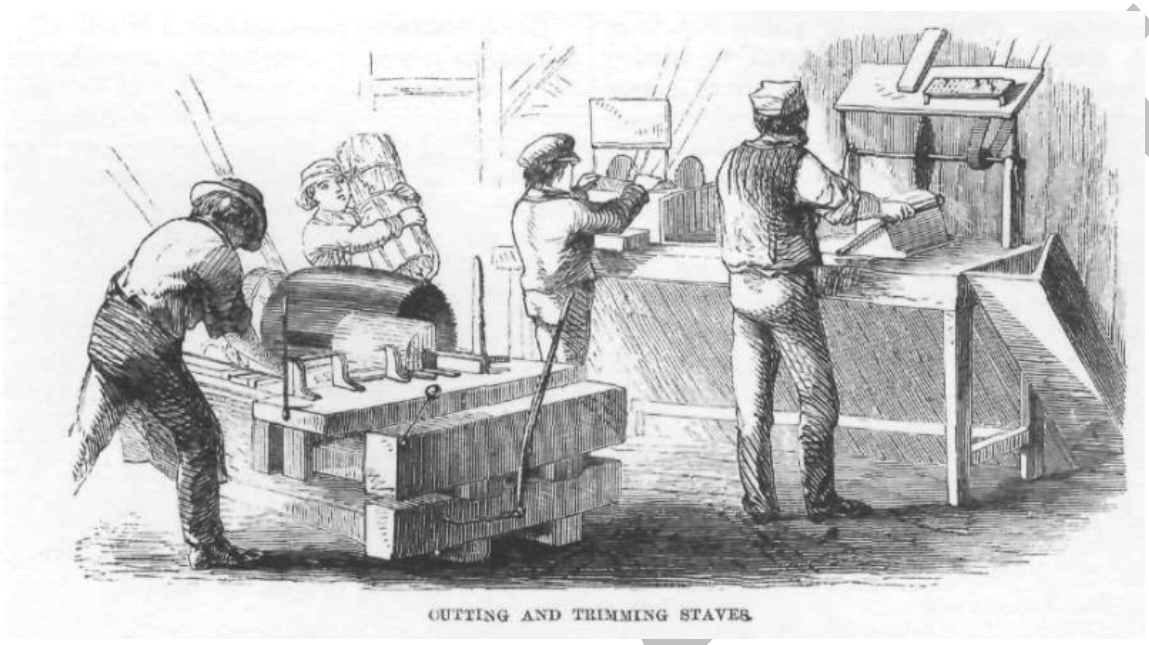

Figure 40. Drawing depicting workers cutting and trimming barrel staves in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[40]

[40] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 163.

Figure 41. Drawing depicting a worker filling casks with nails in the 1860 article "Among the Nail-Makers" in *Harper's New Monthly Magazine*.[41]

[41] "Artist-Life in the Highlands and Among the Nail-Makers: An 1859 Visit to Northern New Jersey's Iron Industry and the Morris Canal," Reprinted from *Harper's New Monthly Magazine* with an Introduction by Robert Goller (Published by the Canal Society of New Jersey, 1994), 164.

United States Department of the Interior
Here
National Park Service

Boonton Ironworks Historic District
Name of Property
Morris County, NJ
County and State
Name of multiple listing (if applicable)

National Register of Historic Places Continuation Sheet

Section number Photo Log Page 1

Photo Log

Name of Property: Boonton Ironworks Historic District
City or Vicinity: Boonton Town
County: Morris State: New Jersey
Photographer: Beth A. Bjorklund (Photos 1, 2, 4, 10, and 12)
James S. Lee (3, 5-9, 11, and 13)
Borbas Engineering (Photo 14)

Date Photographed: January 4, 2019 (Photo 14)
August 7, 2021 (Photos 5, 7, 8, and 9)
October 30, 2020 (Photo 10)
October 11, 2022 (Photos 3, 6, 11, and 13)
October 21, 2022 (Photos 1 and 2)
December 2, 2022 (Photos 4 and 12)

Description of Photograph(s) and number, include description of view indicating direction of camera:

Photo 0001: View of a trail in Grace Lord Park that follows the path of the Rockaway River; camera facing southeast.

Photo 0002: View of Grace Lord Park at its north entrance at Essex Avenue near W. Main Street.; camera facing east.

Photo 0003: View of the Retaining Wall below the remains of the brick engine house; camera facing northwest.

Photo 0004: View of the remains of the circa 1863 brick engine house from the ironworks; camera facing northeast.

Photo 0005: View of the remains of Furnace 1; camera facing south.

Photo 0006: View of the Arches that carried a railroad siding; camera facing northeast.

Photo 0007: View of a Water Control Structure with concrete and stone elements; camera facing

north.

Photo 0008: View of the eastern wall of the Nail Factory; camera facing east.

Photo 0009: View of the remains of the Boonton Electric Company; camera facing south.

Photo 0010: View of the 1866 arch bridge; camera facing northwest.

Photo 0011: View of the Morris Canal bed within Canal Side Park; view facing northwest.

Photo 0012: View of Inclined Plane 7 East; camera facing northwest.

Photo 0013: View of the Morris & Essex Railroad Turntable; camera facing west.

Photo 0014: View of the 1906 railroad trestle bridge with 19th-century stone retaining walls; camera facing west.

United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

Boonton Ironworks Historic District
Name of Property
Morris County, NJ
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Name of multiple listing (if applicable)

Section number Photos Page 1

Photo 0001: View of a trail in Grace Lord Park that follows the path of the Rockaway River; camera facing southeast.

Photo 0002: View of Grace Lord Park at its north entrance at Essex Avenue near W. Main Street.; camera facing east.

United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet

Boonton Ironworks Historic District
Name of Property
Morris County, NJ
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Section number Photos Page 2

Photo 0003: View of the Retaining Wall below the remains of the brick engine house; camera facing northwest.

Photo 0004: View of the remains of the circa 1863 brick engine house from the ironworks; camera facing northeast.

Photo 0005: View of the remains of Furnace 1; camera facing south.

Photo 0006: View of the Arches that carried a railroad siding; camera facing northeast.

Photo 0007: View of a Water Control Structure with concrete and stone elements; camera facing north.

Photo 0008: View of the eastern wall of the Nail Factory; camera facing east.

Photo 0009: View of the remains of the Boonton Electric Company; camera facing south.

Photo 0010: View of the 1866 arch bridge; camera facing northwest.

Photo 0011: View of the Morris Canal bed within Canal Side Park; view facing northwest.

Photo 0012: View of Inclined Plane 7 East; camera facing northwest.

Photo 0013: View of the Morris & Essex Railroad Turntable; camera facing west.

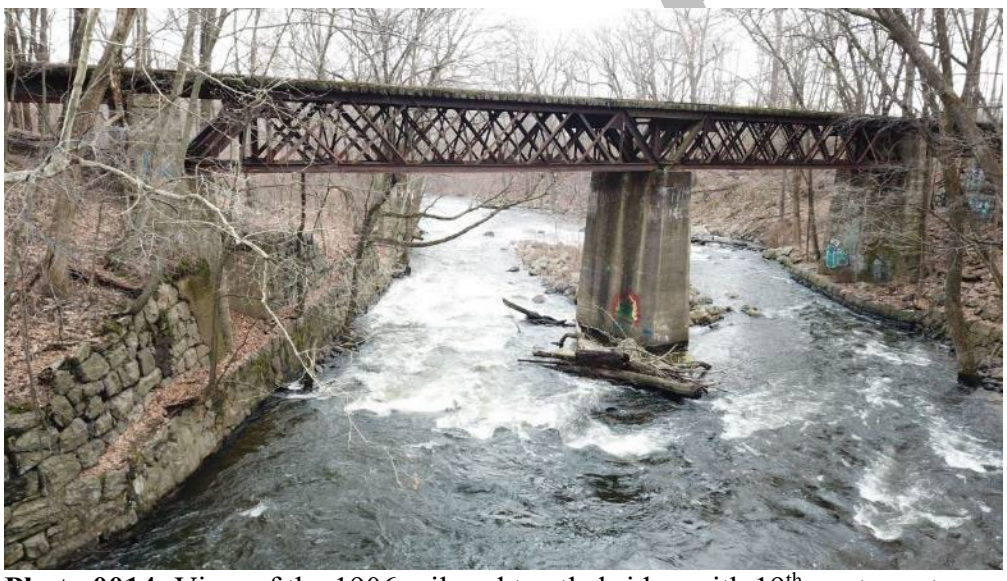

Photo 0014: View of the 1906 railroad trestle bridge with 19th-century stone retaining walls; camera facing west.