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 *Guidelines for Completing National Register Forms* (National Register Bulletin 16). Complete each item by marking "x" in the appropriate box or by entering the requested information. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, styles, materials, and areas of significance, enter only the categories and subcategories listed in the instructions. For additional space use continuation sheets (Form 10-900a). Type all entries.

1. Name of Property

historic name Cambria Iron Company

other names/site number Cambria Iron Works; Lower Works, Gautier Plant, Franklin Plant, Wheel Plant, Rod and Wire Plant, all of Cambria Steel Company; See continuation sheet

2. Location

street & number N/A ☐ not for publication

city, town Johnstown ☐ vicinity

state Pennsylvania code PA county Cambria code PA 021 zip code 15907

3. Classification

Ownership of Property	Category of Property	Number of Resources within Property	
		Contributing	Noncontributing
☒ private	☐ building(s)		buildings
☐ public-local	☒ district		sites
☐ public-State	☐ site	See continuation sheet	
☐ public-Federal	☐ structure		structures
	☐ object		objects
			Total

Name of related multiple property listing:
N/A

Number of contributing resources previously listed in the National Register None

4. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this ☐ 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 ☐ meets ☐ does not meet the National Register criteria. ☐ See continuation sheet.

Signature of certifying official — Date

State or Federal agency and bureau

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

Signature of commenting or other official — Date

State or Federal agency and bureau

5. National Park Service Certification

I, hereby, certify that this property is:

☐ 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:) _____

Signature of the Keeper — Date of Action

6. Function or Use

Historic Functions (enter categories from instructions)	Current Functions (enter categories from instructions)
INDUSTRY/manufacturing facility	INDUSTRY/manufacturing facility

7. Description

Architectural Classification (enter categories from instructions)	Materials (enter categories from instructions)
Other: Vernacular Industrial	foundation stone walls brick, tin roof wood, wrought iron, steel other steel, tin

Describe present and historic physical appearance.

Description of Property

The Cambria Iron Company, founded in 1852 in Johnstown, Pennsylvania, was established to supply iron rails for the burgeoning railroad network. Construction of four coke blast furnaces and a rolling mill began, and local and regional sources of water, coal, timber, and iron ore were utilized to feed the ironmaking process. The plant grew, adopted the Bessemer and open hearth steelmaking processes, and became the largest works in the United States by the 1870s. The capacity to produce manufactured rods, parts for agricultural implements, and wire drawing was added in 1878 with the building of the Gautier Works. The formation of the Cambria Steel Company in 1898 signalled massive growth, with the construction of several plants. A new facility for wire products was built in 1911 after Gautier's destruction in the 1889 Johnstown Flood. Initial construction of the Franklin Plant began in 1898 and continued throughout several decades. This plant contained large rolling mills, a by-product coke plant, blast furnaces, open hearth furnaces, and a steel car manufacturing facility. More building occurred when the Midvale Steel and Ordnance Company assumed control of the plant in 1916. The manufacture of rolled freight car wheels and other circular products began with the Wheel Plant's construction in 1917-1918. In 1923 Bethlehem Steel Company acquired the entire Johnstown Plant and embarked upon a major modernization plan which turned the facilities into a modern and coordinated steel mill. The Johnstown Plant, as it has evolved from the initial Cambria Iron Works, presently extends for approximately 12 miles along the Conemaugh and Little Conemaugh rivers.

Lower Works

The oldest section of the former Cambria Iron Company is the Lower Works, located on river bottom land nestled between the west face of Prospect Hill and the east side of the Conemaugh River just north of the confluence of the Little Conemaugh River and Stonycreek River in Johnstown, Pennsylvania. The integrity of the site regarding location, design, setting, materials, feeling, and association is good. The property retains the look and feel of an industrial plant, and finishing of steel products still occurs in several areas. The evolution of the iron and steelmaking process is visible in the changes of the buildings and structures themselves. Several buildings associated with iron and steelmaking remain, these being identified primarily with auxiliary or support services. Structures in the Lower Works closely identified with the iron and steelmaking process have been demolished, including blast furnaces, Bessemer furnaces, open hearth furnaces, and various mills associated with rolling rail. These were replaced with buildings

☒ See continuation sheet

8. Statement of Significance

Certifying official has considered the significance of this property in relation to other properties: See continuation sheet
[xx] nationally [ ] statewide [ ] locally

Applicable National Register Criteria [ ] A [ ] B [ ] C [ ] D Applicable National Historic Landmark Criteria 1 2 4

Criteria Considerations (Exceptions) [ ] A [ ] B [ ] C [ ] D [ ] E [ ] F [ ] G

Areas of Significance (enter categories from instructions)	Period of Significance	Significant Dates
Industry	1852-present	1857 Fritz mill
Architecture		1857-62 Kelly
Engineering		experiments
Ethnic Heritage European		1867 Bessemer rails
	Cultural Affiliation	rolled
	N/A	

Significant Person
Fritz, John

Architect/Builder
Cambria Iron Company, Cambria Steel Company, Midvale Steel and Ordnance Company, Bethlehem Steel Company

State significance of property, and justify criteria, criteria considerations, and areas and periods of significance noted above.

Significance

Founded in 1852, the Cambria Iron Company was considered one of the greatest of the early modern iron and steel works. In the 1850s, 1860s, and 1870s, Johnstown attracted some of the best engineers, innovators, and managers in the industry and was the technological leader in the manufacture of iron and steel rail. Iron and steel technology was advanced through invention and industrial design at the Lower Works in Johnstown, innovations which were widely copied by other iron and steel companies throughout the country. These contributions included experimentation with the Kelly converter from 1857-1862; first use of the three high roll mill to produce iron railroad rails in 1857; development of the first blooming mill for breaking down ingots, the first hydraulic manipulator for turning over and moving ingots, and the first mechanical driving of rollers in the mill tables; early conversion to the Bessemer steel process in 1871; and first U. S. commercial production of steel railroad rails in 1867. Throughout the years of the steel industry's growth and dominance, Cambria remained a large independent company (third largest in 1904, fifth largest in 1916), becoming the Cambria Steel Company in 1898 during an age of steel consolidation. In 1916 it was purchased by the Midvale Steel and Ordnance Company. In 1923 the Bethlehem Steel Company purchased the entire Johnstown plant, thereby making it a component of the second largest steel company in the United States. Under Bethlehem's stewardship the plant was modernized, it participated in the World War mobilization of industry, it accepted organized labor, and it changed from war to peacetime operations to contribute to U. S. dominance in steel after 1945. Responses to postwar challenges to that dominance can be seen in the remaining machinery and the steelmaking and manufacturing processes presently occurring on site. The Johnstown plant's significance lies in its growth, from an integrated company specializing in iron and steel rail, to an expansive plant offering a diversity of steel products; a continuum reflecting the evolution of the industry nationwide.

The Cambria Iron Company's production of iron and steel rail helped end America's reliance on English-produced rails and allowed the momentous expansion of the nation's railroad network in the nineteenth century. Cambria trained a generation of iron and steel innovators and was the

[xx] See continuation sheet

9. Major Bibliographical References

[xx] See continuation sheet

Previous documentation on file (NPS):

- [ ] preliminary determination of individual listing (36 CFR 67) has been requested
- [ ] previously listed in the National Register
- [ ] previously determined eligible by the National Register
- [ ] designated a National Historic Landmark
- [ ] recorded by Historic American Buildings Survey # _____
- [xx] recorded by Historic American Engineering Record # PA-109

Primary location of additional data:

- [ ] State historic preservation office
- [ ] Other State agency
- [ ] Federal agency
- [ ] Local government
- [ ] University
- [x] Other

Specify repository:

Hagley Museum and Library, Wilmington, Delaware

10. Geographical Data

Acreage of property See continuation sheet

UTM References See continuation sheet

	Zone	Easting	Northing
A			
B			
C			
D			

[x] See continuation sheet

Verbal Boundary Description

[x] See continuation sheet

Boundary Justification

[x] See continuation sheet

11. Form Prepared By

name/title Sharon A. Brown Historian

organization Denver Service Center, National Park Service date January 26, 1989

street & number 12795 W. Alameda Parkway telephone (303) 969-2419

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Midvale Steel and Ordnance Company; Bethlehem Steel Corporation, Johnstown Plant

Number of Resources within Property

Contributing	Noncontributing	
LOWER WORKS		
32		buildings
1		sites
6		structures
39		Total
GAUTIER PLANT		
39		buildings
4		sites
43		Total
FRANKLIN PLANT		
52		buildings
2		sites
8		structures
62		Total
ROD AND WIRE PLANT		
15		buildings
3		structures
18		Total
WHEEL PLANT		
16		buildings
2		structures
18		Total

offering other services, being representative of changes occurring in the steel industry as a whole. Steel industry related buildings from the mid-twentieth century are included within the Lower Works site, but do not significantly detract from the overall look and association of the historic property. There are no active coal or iron ore mines in the west side of Prospect Hill facing the district as there were during the formative years of Cambria's history, yet the hill's size and mass has not been altered and provides the same physical backdrop to the works. The Stone Bridge crossing the Conemaugh River south of the historic works contributes to the historic scene.

Gautier Plant

The Gautier Plant, rebuilt after its destruction in the 1889 Johnstown Flood, is located on the south bank of the Little Conemaugh River, to the southeast of the Lower Works. It was built on the site of the former canal basin of the Pennsylvania Mainline Canal. The integrity of the Gautier Plant is high, as the buildings stand as built after the 1890s with few major alterations. The plant physically dominates sections of Johnstown, being visible at the end of several streets leading toward the river. Sections of the plant are in active use, although many large mill buildings stand empty or are used for storage. Buildings closely identified with steel manufacturing and fabrication processes stand intact. Much of the historic machinery has been demolished through the years as products and the marketplace changed; however, three bar mills are active inside the historic buildings, including the 12-inch Mill No. 1, 14-inch Mill, and 9-inch Mill No. 2.

Franklin Plant

The Franklin Plant is located about one-and-one-half miles east of Johnstown in the borough of Franklin, along the south side of the Little Conemaugh River. Franklin is an active works, containing primary mills, an intact steel car department dating from the 1890s, and modern steelmaking department with electric furnaces. It also contains numerous associated buildings, such as offices and shops offering support services. Much historic machinery and structures has been removed, including the open hearth furnaces, by-product coke plant, and the blast furnaces. These have been replaced with active, modern steelmaking equipment which is representative of the continuing evolution of industrial processes associated with the steel industry. The Rosedale Coke Plant, a site associated with the Franklin coke operation, but located near the Lower Works, was built in 1918 and contained batteries of by-product coke ovens. It has been demolished.

Rod and Wire Plant

The Rod and Wire Plant is located approximately three miles northwest of the Lower Works, on the south side of the Conemaugh River. It is an active site with rod and wire drawing occurring to meet current market demand. The buildings look essentially the same as they did when built in 1910-1911; machinery immediately connected to wire drawing has been replaced with 1950s vintage equipment, but other historic machinery remains.

Wheel Plant

The Wheel Plant is located on Main Street north of the Franklin Works, on the south side of the Conemaugh River. The facility was built in 1911 on farmland, and it produced forged railroad car wheels and other circular products. The wheel plant section of the operations closed in 1978, and the remainder of the operations closed in the early 1980s. The entire complex is currently abandoned, with trash and scrap storage strewn throughout. There is presently a scrap metal operation at the rear of the plant. Much historic machinery remains in place, although some has been scrapped.

Evidence of planning for efficiency and increased productivity can be seen in the general physical relationship of buildings to each other throughout the entire Johnstown Plant, as evolved from the Cambria Iron Works. The buildings are situated for easy access to transportation facilities, principally railroad tracks. The general character of the entire plant is industrial, and the building types were designed with function being the primary concern. Ease of hauling in raw resources, transporting products between buildings for processing, efficiency in processing, and ease in moving products to local and distant markets were all considerations in the building designs. Many remnants of the industrial process are visible on-site and add significantly to the look and feel of the historic scene, including tools, machinery, slag piles, waste, storage, grime, dirt, and other products generated by steelmaking. The general condition of the historic contributing buildings is good; there are currently no restoration or rehabilitation activities being conducted on site by the present owner, Bethlehem Steel Corporation. The historic Pennsylvania Mainline Canal, located between Prospect Hill and the plant alongside the Conemaugh and Little Conemaugh rivers, has been filled. The rivers are in a steep gorge with a narrow, 1,500 ft. wide floodplain. The river courses flow in essentially the same configuration as they did throughout the Cambria Iron Company's existence, but the riverbed has been substantially changed; natural earth banks have been channelized with concrete in an effort to control frequent flooding.

Cambria Iron Company's Development

Lower Works

The Cambria Iron Company built its first furnaces and mills in an area located close to the Allegheny Portage Railroad terminus and the Pennsylvania Mainline Canal. Transportation was readily available for the company's iron products, but more important was the abundance of nearby coal and iron ore deposits. Located at the junction of two rivers, Johnstown was in a natural amphitheater formed of hills containing iron ore and coal beds, which could be opened above water level and mined at minimal cost. Quantities of mineral resources were thus available for the production of iron and steel, the closest source being Prospect Hill, first mined in 1853. The large amounts of iron ore and coal owned by the Cambria Iron Company allowed it to control and regulate supplies, to manufacture its products cheaply, to combine varieties of ores and coal to produce different products, and offered the company some independence of the general iron and steel market's fluctuations.[1]

After the Cambria Iron Company was established in 1852 its owners purchased more than 25,000 acres of land and built four charcoal fuel furnaces. By December 1853 four coke blast furnaces were being built to smelt iron ore, and a large rolling mill, 600 ft. by 350 ft., was being finished. The rolling mill was of a cruciform shape and contained 60 puddling furnaces, 12 heating furnaces, and 4 scrap furnaces. Five engines were used to turn the machinery. A large machine shop, foundry, and blacksmith shop were finished and in operation. The company made all of its own brick in brickyards on-site.[2]

By the late 1860s Cambria's rail mill was one of the largest in the United States and produced 75,000 tons of rails each year. A second wing was added to the side of the main building for the boilers and a stack reached 150 feet high. Another addition was built, extending along the building's east side, 300 ft. long and 100 ft. wide. This wing contained a double set of three high rolls and 12 heating furnaces with squeezers, shears, saws, straightening hammers, and punches. A third mill was built, an extension shaped as another cross, the main building being 300 ft. long and 75 ft. across. This building included a set of three high bar rolls, 14 puddling furnaces, and a vertical engine. A fourth mill was soon built east of the second rolling mill, to

1. Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXV (June 21, 1878):485-487.

2. Peter Shoenberger, *Cambria Iron Company of Johnstown, Pa.* (New York: George F. Nesbitt and Co., Printers, 1853), pp. 3-54.

roll Bessemer steel rails. All of the mills were built of brick with slate roofs. The plant also contained a machine shop, foundry, smith shop, pattern making shop, boiler house, metal house, iron house, office building, grist mill, stables, wagon makers and carpenter shops, metal sheds, saddler shops, and other buildings. Approximately 40 rods from the works were four furnaces, connected by railroad, and above them was a coke yard. Around Prospect Hill was a railroad connecting the main ore drift mines.[3]

By 1878 the rolling mills expanded over seven acres in a complex covering 60 acres. At its height of technological influence and rail output, the Cambria Iron Works consisted of 77 buildings and structures. The coal washing and coking apparatus and stock houses for blast furnaces Nos. 1-4 were located on a high bank on Prospect Hill, while the rest of the works were located on level ground. Coking coal was drawn up an incline from the mines under the works. The arrangement of the different departments was convenient, the yard spaces were large, and railways, both standard gauge and narrow, wound throughout the works. With only a few exceptions all of the structures were brick. Most of the roofs covering the rolling mills had iron trusses and slate coverings. All of the roof trusses were rolled and put together at Cambria. By 1878 the company owned in fee simple, 51,962 acres of mineral lands in six Pennsylvania counties: Cambria County, 23,914 acres; Somerset County, 6,211 acres; Indiana County, 1,768 acres; Blair County, 7,392 acres; Bedford County, 10,577 acres; and Huntingdon County, 2,100 acres.[4]

By 1923 the Lower Works (so named because the company had grown to include other plants along the Little Conemaugh River) had expanded with new products being manufactured in addition to rail. The production of axles was undertaken, and the Lower Works still produced Bessemer and open hearth steel. There were six blast furnaces with capacities of 500 tons each. Near the furnaces were a pig casting plant, car dumper, and a sintering plant. The four Bessemer converters were accompanied by all the necessary support equipment, including seven cupolas and blowers, cranes, pumps, and hot metal receivers. The main open hearth building, of brick and

3. S. B. McCormick, *A Sketch of Johnstown and Suburbs, and the Cambria Iron Works* (Pittsburgh: Barr & Myers, 1868), pp. 11-15.

4. Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXV (June 21, 1878):485-487; Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company," London *Engineering* XXVI (July 12, 1878):21.

steel construction contained seven basic and one acid open hearth furnaces. A stock yard and refractory bins were nearby.[5]

In 1923 the Lower Works still contained a variety of mills: one 40-inch and one 48-inch two high mills with necessary support machinery produced blooms, blanks, and slabs. The beam, billet and slab mills produced slabs, billets, beams, channels, and tie plates. Billet mills produced billets and sheet bars. The rail mill contained two stands of 28-inch three high roughing and one stand of 28-inch three high finishing mills with two engines, five regenerative heating furnaces, two cooling beds, and saws. The rail mill building was supported by a continuous preheating furnace. The rail finishing department was in a steel building with drill presses, straighteners, saws, and other equipment. The rails produced ranged from 30 lbs. to 130 lbs. The No. 4 Mill produced angles, beams, channels, ship channels, crane rails, crane tees, and rounds.[6]

The axle plant and shop which eventually replaced the rail mills contained trolleys, six furnaces and cranes, four steam hammers of different sizes, axle and crank pin finishing machines, and tables. The plant produced railroad freight car axles, street car axles, crank pins, piston rods, forgings, armature shafts, and mine car axles.[7]

Shops consisted of the smith shop, pattern shop and carpenter shop, storage houses for the pattern shop, two foundry buildings, machine shop with storage yard and erecting shop, boiler shop, structural shop, and roll shop. Also on-site were an air compressor plant, electric power plant, electric repair shop, and two stations with six boilers, one for each blast furnace, and four more stations for the rail mill, Bessemer plant, blooming mills, and electric plant. A three-story brick warehouse was used for warehouse and emergency hospital needs; a six-story brick and steel office building contained the general mill offices and chemical and physical laboratories. A two-story brick general labor building was on-site along with stables, wagon and smith shops, lumber yard, saw mill, weight scales and mill offices.[8]

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5. George E. Thackray, "Brief History of Cambria Plant, Johnstown, Penna." In "History of Cambria and Coatesville Plants, B. S. Co.," typed manuscript, 1925, box: Plants-Danville-Johnstown, Acc. 1699, Bethlehem Steel Corporation Papers, Manuscripts and Archives Department, Hagley Museum and Library, Wilmington, Delaware, pp. 37-41.

6. Ibid., pp. 38-40.

7. Ibid., p. 40.

8. Ibid., pp. 40-43.

The Cambria Iron Company's earliest history is represented by buildings and structures surviving in the Lower Works from the 1860s-1880s. These ancillary buildings and structures were primarily involved with providing support services for the production of iron and steel rail on-site. No key buildings or structures used for iron and steelmaking and rail rolling have survived in their entirety, yet the extant buildings and structures are original to the site, contributed services as smithing, pattern-making and administrative support, and were critical to the overall iron and steelmaking operation. The Lower Works was built to supply rail; the evolution from railmaking to axle making in the 1920s can be seen in the extant axle plant and remaining machinery.

In the years after Bethlehem Steel Company's takeover, many changes occurred in the Lower Works. The company's "long range plan" sought the concentration of all steel ingot production and conversion to be located at the Franklin Plant. As a result several mills were demolished or moved, the open hearth furnaces were demolished and the last Bessemer steel was made in 1952. The Lower Works continued producing axles, manufactured mine cars briefly in the 1950s, and became home to the mechanical maintenance shops. An 11-inch Mill was added in 1959-1961, and axle manufacturing ended in 1982.[9]

Gautier Division

In 1877 the Gautier Mills of Jersey City, New Jersey, moved to Johnstown and became partners with the Cambria Iron Company, forming the Gautier Steel Company, Ltd. These mills were built on the site of the former Pennsylvania Mainline Canal basin and they manufactured plow steel and other merchant bar and wire products. In 1881 the company became a subsidiary of the Cambria Iron Company. After their destruction in the 1889 Johnstown Flood (in which rolls of barb wire entangled debris and victims in a huge mass lodged against the Stone Bridge) the mills were rebuilt after 1892 with the exception of wire facilities. Expansion occurred in several phases, dating from the initial rebuilding phase, followed by 1906-1911 mill additions and 1920s mill additions. Machinery in 1923, the year of Bethlehem Steel Company's takeover, included the 12-inch Mill No. 1, 9-inch Mill No. 1, 9-inch Mill No. 3, 8-inch Mill No. 1, 8-inch Mill No. 3, 14-inch Mill, 10-inch--18-inch mill, 10-inch Mill No. 1, 13-inch Mill, and 20-inch

9. Engineering Department, "History of the Evolution of the Johnstown Plant Bethlehem Steel Company 1852-1935 (Revised to 1958)," January 10, 1935, Revised August 1958, pp. 49-53.

Mill; all bar mills, in addition to the 36-inch Universal Plate Mill, rake shop, machine shop, disc shop, and cold rolling and drawing shop.[10]

Bethlehem installed four modern electric driven mills in 1924, and several mills were scrapped and others moved to make room. The four new mills included: a 14-inch structural mill, 13-inch bar mill, 10-inch bar mill, and the 9-inch No. 2 mill. Operations at Gautier have been greatly reduced within the last 10 years due to a decrease in demand for domestic steel, and the age of the facility. The 1977 Johnstown Flood did considerable damage at Gautier, and the losses included the 13-inch mill and the 36-inch plate mill.[11]

Franklin Plant

As the twentieth century approached, the demand for Cambria Iron Company products increased but there was no room for expansion at the Lower Works or Gautier because of physical limitations. Approximately 160 acres of land in Franklin borough was purchased and work began on a new integrated mill. As built, Franklin had coal mines, by-product coke ovens, blast furnaces for pig iron, open hearth furnaces for steel, rolling mills, and rail car shops. Coal mines were on either side of the river with tramways carrying coal into the plant, which was serviced by the captive Conemaugh & Black Lick Railroad. The mills supplied blooms and billets to the other Cambria plants in Johnstown for manufacturing into finished goods.[12]

In 1895 four batteries of Otto-Hoffman by-product ovens were built at Franklin--an industry first. Before this time, all of the company's coke was supplied by coke ovens located in Connellsville, Pennsylvania. In 1901 work began on the open hearth furnaces, consisting of six 75-ton furnaces. Additions to the furnaces were made in 1902, 1903, 1904, 1905, 1907, 1912, and 1916. By 1917, 22 open hearth furnaces were in operation. Mills by 1923 included a 40-inch Blooming Mill, 32-inch Round Mill, 34-inch Billet Mill, 34-inch Universal Slab Mill and 134-inch Plate Mill.[13]

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10. Engineering Department, "History of the Evolution," 1958, pp. 54-55.

11. U. S. Department of the Interior, National Park Service, Historic American Engineering Record, "Survey of Historic Structures in Blair and Cambria Counties Pennsylvania 1987," Draft, March 23, 1988, n.p.

12. Ibid.

13. Engineering Department, "History of the Evolution," 1958, pp. 31, 61-62.

Construction of two blast furnaces began at Franklin in 1903, and was completed in 1906 and 1907. The furnaces were served by hot stoves, stock handling systems, and an ore field with ore bridges and traveling car dumpers. The blowing equipment consisted of steam driven vertical blowing engines and tandem horizontal gas driven blowing engines. Two additional blast furnaces were built in 1917 due to increased wartime demands. The last of these furnaces was demolished in 1986.[14]

The Franklin Plant contributed to the production of steel during World War II, and women were first hired there in 1942. After the war Bethlehem Steel Corporation modernized the plant to expand its capacity. All of the open hearth furnaces were rebuilt, the last completed in 1953. During the 1970s construction began on a Basic Oxygen Furnace, but this effort was discontinued after questions were raised about the process' suitability at Franklin, and after the 1977 Johnstown Flood. A continuous caster, capable of producing bar, rod, and wire products, was 90 percent installed at Franklin, but the decision was made to forgo the project after a $10 million investment because of the plant's physical unsuitability. In 1981-1982 two electric furnaces were installed.[15]

Construction of the Franklin Car Shops began in 1898. By 1922 the facility was building 40 steel hopper railroad cars per day. In 1939 the two car assembly lines were revamped, and improvements over the next 10 years consisted of only relocation or addition of equipment. A third car line was added in 1954 to make welded car sides and sills. By 1958 the shop was equipped to produce hopper cars, gondola cars, ore cars, box cars, and mine cars. Adaptions have been made to the facility, but it remains largely intact and the historic function of making railroad cars continues to this day.[16]

Rod and Wire Division

The Cambria Steel Company did not manufacture wire after Gautier's destruction in 1889 until a new wire plant was built in 1910-1911. Built by the Morgan Construction Company of Worcester, Massachusetts, and completed in February 1911, the Rod and Wire Plant originally was composed of a rod mill, wire drawing department, nail machines, and a cooperage department.

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14. Ibid., p. 2.

15. HAER, "Survey, Blair and Cambria Counties," n.p.; John Strohmeyer, *Crisis in Bethlehem Big Steel's Struggle to Survive* (Bethesda, Maryland: Adler & Adler, Publishers, Inc., 1986), p. 61.

16. HAER, "Survey, Blair and Cambria Counties," n.p.; Engineering Department, "History of the Evolution," 1958, p. 95.

By 1958 the mill manufactured rods; hard drawn, annealed, bright, patented, spheroidized, normalized, galvanized, Bethanized wire and fine wire; barb wire and fence staples; woven wire fence; common, special and roofing nails; straight and cut wire rods; welding wire rods; twisted wire; clothesline and more. The making of nails, barb wire, and woven fence ceased in 1958. Current products include specialized wire and rod orders.[17]

Wheel Plant

The Wheel Plant was built in 1917-1918, and was composed of two units: No. 1 Mill and No. 2 Mill. Edwin E. Slick of Midvale Steel & Ordnance Company, directed the construction and development of the No. 1 Mill, which produced sections formed by circular rolling. The mill manufactured industrial wheels, gear blanks, motor flywheels, brake drums, shaft couplings, pipe flanges, turbine wheels, tire moulds, and other products. Midvale then transferred wheel rolling equipment from its Nicetown, Pennsylvania, plant to form most of No. 2 Mill, which produced railroad car wheels. The plant also contained finishing, shipping, storage and inspection facilities, as well as fuel, power, and hydraulic equipment.[18]

Description of Resources

Rating System for Historic Structures and Machinery Associated with the Nation's Historic Steel Works

Of the many historic steel mills in the United States, very few retain buildings and machinery dating from the 1850s through the 1880s, a period that witnessed the rise of the modern steelmaking and manufacturing complex. This lack of historic resources is not surprising in light of the modernization and expansion that occurred in the nation's steel works after the turn of the century and continues today. Of the few historic resources that survive from this early period, most are buildings or structures that housed steelmaking or manufacturing machinery; there is a marked paucity of surviving historic machinery. Most of the historic buildings that remain, have been, to varying degrees, physically altered. While many of the present guidelines developed by the National Park Service work extremely well for a wide range of architectural resources--

17. HAER, "Survey, Blair and Cambria Counties," n.p.; Engineering Department, "History of the Evolution," 1958, p. 67.

18. Engineering Department, "History of the Evolution," 1958, pp. 77-82.

residential, commercial, and institutional buildings--they are lacking in their applicability for resources relating to the nation's heavy industry.

It is with the idea that new parameters are needed to establish guidelines for evaluating America's historic iron and steel works that the Historic American Engineering Record and the Denver Service Center developed a rating system specifically for evaluating the rich historic resources of the Cambria Iron Works in Johnstown, Pennsylvania. It is hoped that this rating system will be the starting point from which other resources related to the nation's important iron and steel works may be evaluated. Clearly, other work is needed in this area.

Levels of Significance

Level I--Greatly Contributing, Historic (pre-1940)
Buildings
a. Early (pre-1890) buildings that are associated with the historic steel and rail production at Cambria. It was during the years from 1860 to 1890, that Cambria either led the nation or was one of the leaders in rail production and the technology of manufacturing iron and steel rail.

b. Buildings built prior to 1940 that exhibit outstanding architecture or structural engineering, or a high degree of craftsmanship in the use of building materials, and remain largely intact.

c. Buildings that meet the above (1b) criteria and housed an important steelmaking process or important machinery used in the manufacture of iron or steel products, or important support-service buildings associated with the iron and steel works.

Machinery
d. Pre-1940 machinery that was important in the technological advancement of steelmaking or in the manufacture of steel products.

e. Pre-1940 machinery that when installed was commonly found in the nation's steel works, but is now among the few remaining of its kind.

Level 2--Contributing, Historic (pre-1940)
Buildings
a. Buildings erected between 1890 and 1940 that exhibit outstanding architecture or structural engineering design, or are representative of steel mill building technology and design, and remain relatively intact.

b. Buildings that meet the above (2a) criteria and housed an important steelmaking process or important machinery for the manufacture of iron and steel products, or was an important support-service building associated with the steel mill.

Machinery
c. Pre-1940 machinery that is still commonly found in the nation's steel works but, over the next several decades, may become increasingly rare.

Level 3--Greatly Contributing, Nonhistoric (post-1940)
Buildings
a. Buildings built after 1940 that represent major technological innovations in structural engineering design or major works of architecture.

Machinery
b. Machinery manufactured after 1940 that when installed and in operation represented a major innovation in steelmaking or the manufacture of steel products.

Level 4--Contributing, Nonhistoric (post-1940)
Buildings
a. Buildings erected after 1940 that exhibit outstanding architecture or structural engineering design, or are representative of steel mill building technology and design, and remain relatively intact.

Machinery
b. Machinery representing minor improvements in materials and design, and is commonly found in the nation's steel mills.

Cambria Iron Company
Lower Works
Contributing Resources

1A. Blacksmith Shop, historic name; Blacksmith Shop, present name (ca. 1864). The shop is an octagonal brick structure topped by a wooden cupola and an iron and wood roof system which served the iron and steel works by producing a variety of metal works. Contained steam-powered hammers, coal-fired forges and many tools, including grinders, anvils, vises, and hammers. As many as 200 workers toiled in the blacksmith shop. (Level 1)

1B. During the 1870s a two-story addition was made to the west of the original octagon. (Level I)

1C. Around 1884-1885 a two-story annex with paired windows was built to the east of the shop. This addition held a ca. 1880s steam-powered five-ton Sellers hammer and an overhead crane, still in place. (Level I)

1D. About 1900 a one-story brick building, the chain shop, was built along the southwest side of the shop, containing forges and an overhead crane. A small office was built on the west side at the same time. (Level 1)

1E. In the 1920s a two-story brick structure was built as a locker room and lavatory. (Level 2) The Blacksmith Shop currently retains its original function. The main hammers, four Chambersburg hammers ca. 1920s, two of which are operational, are operated with compressed air. The hammers and gas-fired forges employ a handful of workers. (machinery Level 1) (PHOTO A)

2. Pattern Shop, historic name; Carpenters Shop, present name (ca. 1870). Two-story brick, wood post, and beam shop originally measured 51 ft. by 103 ft., and was topped by a mansard roof covered with slate. Inside machinery included saws, planers, and sanders. The patterns were used for foundry castings. Major additions to the pattern shop include a two-story, gable-roofed addition and a three-story brick fire-hose tower in 1890. The pattern shop is currently used for carpentry work and contains ca. 1950s, 1960s electric-powered machinery and one ca. 1900 pattern marker's lathe. (Level 1, machinery Levels 2, 4) (PHOTO B)

3. Rolling Mill Office, historic name; Mechanical Department Building, present name (ca. 1874). Two-and-one-half story building served as an office for the rolling mill operations. It originally featured an intersecting gable roof of slate, gothic brick arched windows, and a wrought-iron spiral staircase covered by a wooden cupola. The floor and ceilings are made of vaulted brick arches spanning wrought-iron rails. Several alterations have occurred, including a three-story addition to the south side in ca. 1900, and removal of the cupola. The building served as an office until recently, and contains no historic machinery. (Level 1) (PHOTO B)

4. Car Shop, historic name; Paint Shop, present name (ca. 1881). Two-story building with heavy timber-framing and infilled brick walls served as a car shop for railroad and possibly mining rolling stock. A foundry was located on the first floor and a carpenter shop on the second floor. Carpentry became the main function by the 1930s, with a paint shop and mechanical office in place by the 1950s. The building retains much of its original appearance, including a clipped gable roof, and serves as storage. It is possibly one of the few heavy timber-framed structures containing brick nogging and clipped gable roof existing in a steel mill setting. It contains no historic machinery. (Level 1) (PHOTO C)

5. Foundry and Foundry Addition, historic name; Foundry, present name (1865, 1880). One-and-one-half story brick building originally had a mansard, slate-covered roof, and housed foundry support services. In 1880 a two-and-a-half story wing was added, with stone foundation, brick pilasters and wrought-iron roof trusses. As recently as the 1930s much of the original 1870s machinery was intact, and the foundry was used until 1983. An overhead crane is in the foundry addition, and no machinery remains in the foundry. A sand shot tower and a 1950s sand conveyor are on the north side of the foundry addition. The foundry addition is almost unaltered except for covering the windows with translucent fiberglass. Ornate brick work remains in the foundry, but extensive changes were made to the original foundry roof. (Level 1)

Rolling Mill/Axle Plant Complex
6A. Merchant Mill, historic name; Axle Finishing Shop, present name (ca. 1872). Three-story brick structure had wrought-iron roof with Pratt trusses. The first rolling mill at Cambria was built in 1853-1854 and destroyed by fire in 1857. The rebuilt mill burned again in 1872, and the 1857 structure was reconstructed and expanded to the north and east. The expansion included building a merchant mill on the northeastern wing of the rolling mill. The merchant mill contained heating furnaces and a rolling train bar mill. Part of the original merchant mill is extant, forming part of

the axle plant finishing shop which was utilized until 1982. No machinery remains from the original merchant mill. (Level 1) (PHOTO D)

6B. Steel Rail Mill, historic name; Steel Car Truck Assembly Shop, present name (ca. 1867). Brick three-story building with a wrought-iron roof is a remnant of Cambria's original steel rail mill thought to have survived the 1872 mill fire. The mill contained presses, drills, heating furnaces, and a 21-inch three-high roll train, now all gone. This section of the complex was, by 1900, used for manufacturing structural shapes; by the 1930s it was a scarfing operation. After 1951 the steel rail mill remnants were used as a car truck assembly shop, and finally abandoned in 1982. Extant machinery is from the car truck assembly operation, and includes one 1920s Niles boring mill, one 1950s and one 1968 Snyder boring mill, a 1930s wheel press, and a 1977 bearing press. (Level 1, machinery Levels 2, 4)

6C. Axle Plant, historic name; Axle Plant, present name (ca. 1924). Three-and-a-half story steel frame, brick structure housed the manufacture of axles for railroad rolling stock. In the 1880s an axle plant expanded into the southwest section of the building, rendering the rolling mill almost unrecognizable. After Bethlehem Steel Company purchased Cambria the axle plant was expanded ca. 1924-1938, and improved through the takeover of the northern half of the old rolling mill. In 1938 an axle finishing shop was installed (See 6D), and in 1944-1945 the axle plant was modified when a rotating furnace was installed. The plant was upgraded again in the 1950s. Manufacture of axles ended in 1982, and remaining machinery includes a 1944 continuous rotary hearth furnace, a ca. 1890s 10,000 lb. Erie hammer, a ca. 1890s 15,000 lb. Erie steam hammer, and conveyors. Additional extant machinery includes axle cut-off machines, grinders, roughing lathes, straighteners, and two ca. 1960s West German GFF forging hammers. (Level 2, machinery Levels 2, 3)

6D. Axle Finishing Shop, historic name; Axle Finishing Shop, present name (1938). One-and-a-half story brick building was built to expand the axle manufacturing capabilities at Cambria. The finishing shop was built along the north side of the original merchant mill wing. Workers used grinders and boring mills to remove defects in the surface of steel axles. Axle manufacturing ceased in 1982. Surviving machinery includes an axle heating furnace, ca. 1950s Morey lathes, ca. 1950s Snyder journal lathes, and ca. 1950s-1960s shapers. (Level 2, machinery Level 4)

6E. Axle Finishing & Storage Building, historic name; Axle Finishing & Storage Building, present name (ca 1960). Two-story steel frame and corrugated metal structure was erected to finish and store axles produced in the axle plant. It extends from the south side of the original merchant

mill, and has been abandoned since 1982. Contains 1970s HEID finishing lathe from Austria. (Level 4, machinery Level 4)

7. Roll Shop, historic name; Roll Shop, present name (1895). Three-and-one-half story brick and steel frame building with steel and Pratt trusses roof system. Shop was used to service rolls for the various mills. New rolls were produced and old ones were reconditioned on large metal-cutting lathes. Building retains original function and much of its original appearance. An overhead crane remains in place, and a 1900 metal-cutting lathe is still used. A 1958 hydraulic lathe built by Youngstown Foundry & Machine Co. of Youngstown, Ohio, is still used. A crew of 8-10 men presently work in the shop. (Level 1, machinery Level 2, 3)

8. Blowing Engine House, historic name; Storage Building #509, present name (ca. 1890). Three and-one-half story steel frame, brick building housed blowing engines for the four coke-fired blast furnaces. The building contained Southwark vertical blowers which pushed air through the furnaces and hot-blast stoves. Three Mesta blowing engines were installed in 1914, and General Electric Company turbo blowers in 1918. After blast furnace functions ceased the building was converted into storage, and is still in use. (Level 2) (PHOTO E)

9. Boiler House (east), historic name; Pattern Storage Building #507, present name (ca. 1898). Two-and-one-half story brick and steel frame building originally housed sixteen small boilers, used in conjunction with a nearby powerhouse. After four blast furnaces were demolished in the 1920s the building was converted into a pattern storage facility. (Level 2)

10. Boiler House (west), historic name; Pattern Storage Building #506, present name (ca. 1898). Two-and-one-half story steel frame brick building housed twelve boilers for firing steam engines in the connecting engine house building. The building was converted to a pattern storage facility in the 1920s. (Level 2)

11. Compressor Engine House, historic name; Tin Shop, present name (ca. 1898). One-and-one-half story brick and steel frame building with a full basement. By the late 19th century compressed air served many functions in the steel mill. Compressed air lines extended into the blast furnace operation, various shops, and the rolling mills. This building served as an engine house, producing compressed air for more than 30 years. No original compressor machinery survives. Around 1935 the building was used as a tin shop, and recently as a plumbing shop. (Level 2) (PHOTO F)

12. Hot Blast Engine House, historic name; "E" & "F" Blast Furnace Engine House, present name (ca. 1873). Two-and-one-half story brick steel frame building housed the original blowing engines for the #5 and #6 blast furnaces. Equipment included three vertical blowing engines with blowing cylinders and steam cylinders. A northern addition was built in 1898; a southern one-story office addition was built in 1910. The machinery was upgraded in 1918 with the replacement of the original blowing engines with six Mesta horizontal engines. The southern half of the engine house is largely unaltered from its ca. 1873 appearance. The blowing engines have been removed. (Level 1) (PHOTO G)

Blast Furnace Complex
13A. Blast Furnace No. 5 and cast house, historic name; Manganese Blast Furnace "E" (1876, 1900, 1925). Blast Furnace construction began 1873, put into blast in 1876, and measured 75 feet in height with 20 feet diameter bosh and 8 foot hearth. The furnace was manually charged and produced 600 tons of Bessemer steel per week. In 1901-1903 steam driven skip hoists were installed, ending the manual charging. In 1924-1925 the skip house and blast furnace were demolished and rebuilt. The furnace was improved over the years with the addition of electrical skip hoists, new stock bins in 1930, gas cleaning plant in 1930-1931, and highly efficient hot blast stoves in 1930-1934. By the 1950s, blast furnace No. 5 was used for smelting manganese. Abandoned in the early 1970s, the blast furnace and cast house were torn down in 1986. The site contributes because the furnace foundation survives, in addition to associated structures. (Level 1-site)

13B. Skip House and Stock Bins, historic name; Skip House and Stock Bins, present name (ca. 1900). Brick-clad skip house added to blast furnaces, No. 5 and No. 6 along with steam driven hoist. Hoist was electrified in 1925, but skip house was unaltered. Stock bins were installed ca. 1931, and remain in place. (Level 1)

13C. Hot Blast Stoves, historic name; Hot Blast Stoves, present name (1930-1934). These stoves were improvements to the blast furnace. (Level 1)

13D. Gas Cooler and Washer Plant, historic name; Gas Cooler and Washer Plant, present name. (1930-1931). Gas cleaning facility at blast furnaces No. 5 and No. 6, abandoned in the late 1970s but remains in place. Consists of three primary spray towers and four disintegrators, used for cleaning blast furnace gas. (Level 2)

14. Brass Foundry, historic name; Brass Foundry, Building #514, present name (1896). Two-and-one-half story brick and steel frame building has a steel and Fink truss roof system. It housed a brass foundry which furnished brass fittings and parts for the company. Abandoned in 1983, the building retains much of its historical appearance, and machinery from the early 1900s foundry operation is still extant, including weighing scales, ovens, moulds, and overhead crane. (Level 1, machinery Level 2)

15. Foundry, historic name; Babbit Shop, present name (ca. 1898). One-and-one-half story brick and steel frame building has wrought-iron and Fink truss roof system. The building has been modified with various additions since 1900. The 1890s roof trusses contrast with the 1920s or 1930s brick walls. A one-story corrugated metal shed, ca. 1950 was added on the north end. The Babbit Shop is connected to the Brass Foundry, and was shut down in 1983. (Level 2)

16. Works Order Office, historic name; Works Order Office, present name (ca. 1897). Six-story brick and steel frame building with wood rafters contained a laboratory for testing grades of Cambria steel. Lower floors contained offices for the mill operations. The Bessemer and open hearth plants once nearby have been demolished. The building is currently abandoned. (Level 2) (PHOTO H)

17. Machine Shop, historic name; Machine Shop, present name (1906). Five-story brick and steel frame building built on site of original machine shop. From 1906 to 1970s, 400 men worked a single shift. Machinery still in place consists of ca. 1906 William Sellers 76" vertical boring stand, ca. 1950s American Pacemaker metal cutting lathes, and ca. 1960s Morton universal mills. Much of the machinery has been systematically removed in 1987-1988, including lathes, shapers, grinders, drills, and drill presses. Abandoned in 1984. (Level 2, machinery Levels 2, 4)

18. Erecting Shop, historic name; Structural Shop, present name (ca. 1900). Three-and-one-half story brick and steel frame building with steel and Fink truss roof system. Built as an erecting shop to provide structural steel products, it was linked in 1910 to a boiler shop to the north. The building was abandoned in the late 1970s and contains no machinery except for an overhead crane. (Level 2)

19. Boiler Shop, historic name; Structural Shop #511, present name (ca. 1910). Three-and-one-half story brick and steel frame building with steel and Fink truss roof system served as a boiler shop where pipe for the company's water system was manufactured. It replaced an earlier shop, built in 1880. A steel frame building was built next to the boiler shop as a dipping plant, housing

dipping tanks. After the 1920s the boiler shop was used to fabricate structural steel products, and a one-story welding shop was built alongside, adjacent to the dipping plant. Abandoned in the 1970s, no machinery remains except for overhead cranes. (Level 2)

20. Punching and Riveting Shop, historic name; Structural Shop, present name (ca. 1910). Two-and-one-half story brick and steel frame building with steel and Fink truss roof system was built as a punching and riveting shop connecting with the boiler shop to the south. Steel plate arrived in the shop by rail and went through several operations, including punching, countersinking, and scarfing. The plates were then formed into pipe for the plant's water system. Abandoned in the late 1970s, the building is currently leased. (Level 2)

20A. Crane historic and present name (ca. 1909). Open crane yard which serviced the punching and riveting shop yards. (Level 2)

21. Electric Light and Power Plant, historic name; No. 1 Power House, present name (1907-1908). Two-story brick building housed generators used for electricity in the Lower Works. The use of electricity eliminated need for overhead belts and line shafts needed for previous steam power. Used until all electricity was purchased from public utility by 1980, then converted to machine shop. No historic generating machinery remains. (Level 2)

22. 18-inch Billet Mill, historic name; Storage Building, present name (1908). Building originally housed 18-inch continuous billet mill and other mills until 1952. None of the original machinery survives, and building is currently made of corrugated metal. Only the steel frame of the 1908 billet mill remains. (Level 2)

23. Employee Entrance Gate and Footbridge, historic name; Gate #9 and Footbridge, present name (ca. 1930). A bridge spanning the Conemaugh River has existed at or near this location since the 1850s. By the 1870s an iron railroad bridge was located here, carrying a spur line across the river into the Lower Works. By the early 1890s a wagon bridge stood just south of the existing footbridge. Workers living in Cambria City and other towns north and west of the Lower Works used this bridge to enter the mills. By about 1930 a riveted steel Warren truss bridge, containing two spans, was built as a pedestrian bridge. The 1977 flood destroyed the westernmost span, however, the second ca. 1930 span remains in place. Bethlehem Steel also built a one-story brick building ca. 1930 which served as a gate house. This extant employee entrance gate was the scene of picketing during the Little Steel Strike of 1937. (Level 2)

24. Railroad Office, historic name; Blast Furnace Office, present name (ca. 1924). Two-story brick building with wood frame and wood rafters was used as offices for rail operations by Bethlehem Steel. By the 1960s the building was an office for the blast furnaces operations, and by the 1970s, an office for the car repair No. 4 shop. The office was vacated in 1980. (Level 2)

25. Water Treatment Building, historic and present name (late 1920s). Two-story brick building was built by Bethlehem Steel to treat water for use in the Lower Works and Gautier. The building is virtually unchanged. (Level 2)

26. 48-inch Mill Soaking Pits Building, historic name; Car Repair Shop, present name (ca. 1930). Four-and-one-half story, brick and corrugated metal, steel frame building contained six furnaces for a blooming mill operation. Each furnace contained four soaking pits, and blast furnace or coke gas fired the furnaces. Soaking pits have been filled in, and the overhead cranes survive. Building is currently used for repair shop and steel fabrication work. (Level 2)

27. Steam Station No. 3, historic name; No. 1 Steam Station, present name (1930). Six-story brick and steel frame building contained two Babcock & Wilcox Stirling boilers which produced steam for the power house, Lower Works, and nearby Gautier. The building, used only sporadically, remains largely unaltered from 1930s appearance, and original boilers remain. (Level 2, machinery Level 2)

28. Crane Runway, historic name; No. 9 Yard, present name (ca. 1930). This steel frame shed has no walls, and originally served as a scarfing building. It is currently used as a junk/storage yard. (Level 2)

29. Axle Heat Treating Building, historic name; Storage Building, present name (ca. 1950). One-and-one-half story corrugated metal, steel frame building with steel and Fink truss roof system was built as an axle heat treating facility. It stands on the original site of the wire mill, demolished in the 1930s. Currently used for storage, one 1950s heat treating furnace remains. (Level 4, machinery Level 4)

30. Manganese Shed, historic name; No. 4 Car Shop, present name (ca. 1960). Steel frame building housed manganese slabs brought from blast furnaces by rail. Workers in the shed broke the manganese with sledge hammers, and it was loaded onto metal pans, then onto rail cars and shipped. Manganese was produced until early 1970s, and building used as a car shop until recently. Building currently vacant. (Level 4)

31. Turbo-Blower Building, historic name; Steam Station #7, present name (1961). General Electric turbo-blowers installed in this four-story, steel-frame, brick veneer building in 1961. Used in conjunction with Blast Furnace "E" until 1977. Taken off line in 1977; in 1982 it was converted to a steam plant with gas-fired boilers. (Level 4)

32. Airco Buildings, present name (1960s). Steel and metal corrugated sided buildings built in the 1960s provide compressed air for the plant. (Level 4)

33. Oxygen Acetylene Building, present name (late 1950s). Two-story brick building was built by Bethlehem Steel in the late 1950s to provide the Lower Works with oxygen and acetylene. (Level 4)

34. 11-inch Mill & Shipping Building, historic name; 11-inch Mill & Shipping Building, present name (1959-1961). Five-story steel frame structure with metal siding built on site of original Bessemer steel plant and open hearth building contains series of automated rolls and shears. Steel bars from the 11-inch mill are processed through forging, machining, and cold drawing. Parallel to the mill is a steel-frame building used to ship mill products. The mill is still in operation with crew of 20-30 men and is center of activity in Lower Works, along with Blacksmith Shop, Carpenter Shop, Tin Shop, and Roll Shop. (Level 3, machinery Level 3)

35. Water Treatment Plant, present name (1960s). This plant was built solely to furnish water for the 11-inch Mill. (Level 4)

All spur rail lines within the Lower Works belong to the Conemaugh & Black Lick Railroad, a captive railroad belonging to Bethlehem Steel Corporation. The spur lines hook into the CSX system outside the works by the Penn Railroad Station, and into the Conrail system in Conemaugh by the Franklin Works.

A visual survey of Prospect Hill facing the works did not reveal any visible extant remains of historic coal or iron ore mines. Several rail or road beds cross the hill's face.

Concerning archeology, no recording of prehistoric cultural resources has occurred at the Lower Works, although several prehistoric and one historic Indian site were recorded in

Johnstown. The Lower Works were not registered in the Pennsylvania state site inventory as of July 1987. The earliest structures on site, consisting of the Pennsylvania Mainline Canal and furnaces, can no longer be seen, and must be discovered archeologically. The discovery of prehistoric and historic cultural resources will be affected by the extent of historic and modern impacts to the site. There is high probability of discovering buried historic cultural resources at the Lower Works. Testing in archeological study units at approximate locations of former structures and features should provide data about such structures as housing, Pennsylvania Mainline Canal, inclined railway, early furnaces, brickyard, and railroad grades.[19]

Gautier Plant
Contributing Resources

1. Roll Shop, historic and present name (1924). Two-story, steel frame, brick curtain wall, steel roof-truss, with wood block floor, houses active roll shop. Extant machinery includes ca. 1920s Lewis Foundry and Machine Company (Pittsburgh) roll lathes used to cut rolls, and ca. 1970s Pangborn shot blaster. A one-story brick addition serves as a tool room. A roll storage yard and overhead craneway are adjacent. (Level 2) (Photos A, B)

2. 12-inch Mill No. 1, historic and present name (ca. 1893). Two-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor. Contains active mill machinery, including two-high and three-high, ca. 1920s, Blaw-Knox roll stands, 15-ton Cleveland overhead crane, 1903 gas fired furnace, and a straightener and shear. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 1, machinery 3)

3. 9-inch Mill No. 1, historic name; Storage, present name (ca. 1893). Two-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor. Once housed the 9-inch Mill No. 1; currently serves as roll storage for the 12-inch Mill No. 1. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 1)

4. 9-inch Mill No. 3, historic name; Storage, present name (ca. 1893). Two-and-one-half story, steel frame, brick nogging, stone foundation, steel roof-truss with full length monitor. Once

19. U. S. Department of the Interior, National Park Service, Applied Archeology Center, Rockville, Maryland, and American University, Washington, D. C. "An Archeological Planning Overview of the Cambria Iron Company, Lower Works Johnstown Pennsylvania," by Paula A. Zitzler, August 1987, pp. 10-11, 15-18.

housed the 9-inch Mill No. 3, currently used for storage. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 1)

5. Stock Yard Building, historic name; 12-inch Billet Yard, present name (ca. 1924). Two-and-one-half story, steel frame, brick nogging, stone foundation, steel roof-truss. Serves as billet storage for the 12-inch mill, and contains an overhead crane. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

6. Stock Yard Building, historic name; Storage Building, present name (ca. 1900). Two-and-one-half story, steel frame, brick nogging, stone foundation, steel roof-truss with full length monitor. Currently vacant, it contains overhead crane. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

7. Stock Yard Building, historic name; Storage Building, present name (ca. 1900). Two-and-one-half story, steel frame, brick nogging, steel roof-truss with full length monitor, stone foundation. Currently vacant, it contains overhead crane. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

8. Rail Anchor Shop, Fence Post Shop, Smith Shop, historic name; Storage Building, present name (ca. 1900). Two-story, steel frame, brick nogging, steel roof-truss with monitor, stone foundation. Currently vacant. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

9. Frog & Switch Plant and Machine Shop, historic name; Machine Shop, present name (ca. 1924). Two-story, steel frame, brick nogging, steel roof-truss with monitor. Currently contains small machine shop at western end of building, and remainder is used for storage. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

10. Shipping Warehouse, historic and present name (ca. 1924). Two-story brick nogging, steel frame, steel roof-truss, concrete foundation. Currently used for shipping. Four ca. 1956 annealing furnaces remain in the southern end of the building. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

11. Pickling Plant, historic and present name (ca. 1911). Two-story, corrugated metal, steel frame, steel roof-trusses; largely rebuilt ca. 1950s. Currently used for storage, and contains a Manning, Maxwell & Moore (Muskegon, Michigan) 10-ton overhead crane. (Level 4)

12. Warehouse Offices and Drawing Room, historic name; Office Building, present name (ca. 1924-1928). One-story brick, intersecting gable, roof steel frame, concrete foundation. Eastern end of the building contains a washroom; western end is currently vacant. (Level 2) (PHOTO C)

13. 8-inch Mill No. 1, historic name; Mechanical Storage, present name (ca. 1924). Two-story, steel frame, brick nogging, steel roof-truss with monitor, concrete foundation. The original 8-inch Mill No. 1 was relocated here in 1924. The building is currently used for mechanical storage. (Level 2)

14. 8-inch Mill No. 2, historic name; Mechanical Storage, present name (ca. 1924). Two-story, steel frame, brick nogging, steel roof-truss with nogging, concrete foundation. The original 8-inch Mill No. 2 was relocated here in 1924. The building currently used for mechanical storage. (Level 2)

15. Office, historic and present name (1928). Two-story, brick, steel frame, concrete foundation, with gable roof. Currently used as office. (Level 2) (PHOTO D)

16. Office and Laboratory, historic and present name (1928). One-story, brick, steel frame, concrete foundation, with hipped roof. Currently used as office. (Level 2)

17. Specialty Shops, historic name; Storage Building, present name (ca. 1930s). Two-story, brick veneer, steel frame, concrete foundation. (Level 4)

18. Car Bottom Furnace Building, historic and present name (ca. 1940s). Two-story, brick veneer, gable roof. (Level 4)

19. 22-inch and 20-inch Mills, historic name; Wire Goods, present name (ca. 1906). Two-story, steel frame, brick nogging, steel roof-truss with monitor, stone foundation. Currently used for storage. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

20. Finishing Shop, historic name; Storage Building, present name (ca. 1906). Two-story, steel frame, brick nogging, steel roof-truss with monitor, stone foundation. Currently houses a welding shop. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

21. Shear Shop, historic name; Storage Building, present name (ca. 1906). Two-and-one-half story, steel frame, brick nogging, steel roof-truss with full length monitor, concrete foundation. Building is vacant or used for storage. Contains a 36-inch x 36-inch three-cylinder, horizontal reversing engine, dating from 1905 and manufactured by Southwark Foundry and Machine Company (Philadelphia). It was used to power the 36-inch Universal Plate Mill. (Level 2, machinery Level 1)

22. 36-inch Plate Mill, historic name; Storage Building, present name (ca. 1906). Two-and-one-half story, steel frame, brick nogging, steel roof-truss with full length monitor, concrete foundation. Building is currently vacant with the exception of motor house containing an 1800 kva General Electric Induction Motor. (Level 2, machinery Level 2)

23. Storage Building, historic name; Stores, present name (ca. 1930s). Two-story, brick veneer, gable roof, concrete foundation. Used for storage. (Level 4) (PHOTO E)

24. Structural Warehouse, historic name; Structural Warehouse No. 3, present name (ca. 1893-1899). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, concrete foundation. Contains Morgan shear for the operating 14-inch Mill, truck and railroad car loading areas, and a Conemaugh & Black Lick Railroad spur which extends through the building. (Level 1, machinery Level 4)

25. Warehouse No. 1, historic name; Shipping Warehouse No. 1, present name (ca. 1893-1899). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Contains transfer beds for the operating 14-inch Mill, one 10-ton Morgan overhead crane, and truck and railroad car loading areas. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 1, machinery Level 4)

26. 13-inch Mill, historic name; Shipping Warehouse No. 2, present name (ca. 1893-1899). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Formerly contained 13-inch Mill; presently contains transfer beds for the operating 14-inch Mill, one 10-ton Morgan overhead crane, and truck and railroad car loading areas. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 1, machinery Level 4)

27. Shear Building, historic name; Finishing & Shipping, present name (ca. 1893-1899). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Contains 10-ton Morgan overhead crane, truck and railroad car loading areas, and hot bed for the operating 14-inch Mill. (Level 1, machinery Level 4)

28. 14-inch Mill Billet Yard, historic and present name (ca. 1924). Three-and-one-half story, steel frame, steel roof-truss with full-length monitor, brick nogging, and concrete foundation. Currently used as 14-inch Mill Billet Yard. (Level 2)

29. 14-inch Mill, historic and present name (ca. 1924). Three-and-one-half story, steel frame, steel roof-truss with full-length monitor and vent stacks, steel chimney stacks, brick nogging, and concrete foundation. Contains active 14-inch Mill with roll stands dating from ca. 1950s, manufactured by Continental Roll and Steel Foundry Company (Pittsburgh) and Blaw-Knox Company (Pittsburgh). (Level 2, machinery Level 4)

30. 13-inch Mill, historic name; Mechanical Storage, present name (ca. 1924). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Formerly contained 13-inch Mill, which stopped operation in 1977; currently vacant. (Level 2)

31. 10-inch and 12-inch Mill, historic name; Fuel Depot and Storage, present name (ca. 1924). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Currently used for storage. (Level 2)

32. 10-inch Mill Billet Yard, historic name; Storage Building, present name (ca. 1924-1928). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Currently used for storage. (Level 2)

33. Stock House, Bar Bending, historic name; Shipping Building, present name (ca. 1924-1928). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Currently used for storage. (Level 2) (PHOTO F)

34. 9-inch Mill No. 2, historic and present name (ca. 1924-1928). Three-and-one-half story, steel frame, steel truss-roof, brick nogging, with concrete foundation. Currently houses operating 9-inch No. 2 Mill with associated machinery, including a gas-fired furnace, 1950s Continental or Blaw-Knox roll stands, transfer bed, and shear. (Level 2, machinery Level 4) (PHOTOS G, H)

35. 9-inch Mill Billet Yard, historic and present name (ca. 1924-1928). Three-and-one-half story, steel frame, steel truss-roof, brick nogging, with concrete foundation. Billets for 9-inch Mill currently stored here. (Level 2)

Other contributing structures and buildings associated with the Gautier Plant operations:

36. Guard House, historic and present name (ca. 1920s). One-story, brick, flat roof. Currently in use. (Level 2)

37. Oil Storage, historic and present name (ca. 1920s). One-story, brick, concrete foundation. Currently in use. (Level 2)

38. Motor House, historic and present name (ca. 1920s). Two-and-one-half story, steel frame, brick veneer, glass-block masonry, concrete foundation. Currently in use. (Level 2) (PHOTO I)

39. Office, historic and present name (ca. 1940s). One-story, brick, concrete foundation. Currently in use. (Level 4)

40. Lavatory, historic and present name (ca. 1920s). One-story, brick, flat roof, concrete foundation. Currently used. (Level 2)

41. Pump House, historic and present name (ca. 1920s). One-story, steel frame, brick veneer, shed roof, concrete foundation. Contains three Ingersoll-Rand compressors, ca. 1920s. (Level 2)

42. Craneway, historic and present name (ca. 1940s). Used for open storage, with 10-ton Alliance crane. Currently used. (Level 4)

43. Lavatory, historic and present name (ca. 1940s). One-story, brick, flat roof, concrete foundation. Currently used. (Level 4)

Franklin Plant
Contributing Resources

The Steelmaking Department has several buildings and structures associated with steelmaking:

1. Open Hearth Furnace Shop, historic name; Electric Furnace Melting Shop Area, present name (ca. 1901-1950s). Steel frame, steel roof-trusses, Cambria-made structural steel, concrete foundation. Construction began in 1901, and by 1902 seven 75-ton open hearth furnaces were in operation. By 1916, the open hearth shop measured 131 ft. by 1730 ft., and 22 furnaces were in operation. Improvements to the boiler works were carried out in the 1930s, extensive improvements beginning in 1949 included the reconstruction of the operating 21 furnaces. In 1977 work on the installation of a continuous caster commenced, however, only the structural steel work was completed. In 1982 the open hearth shop was replaced with two electric furnaces. Remnants of the open hearth operation are located in the western half of the building and include some checkers, and the base of the furnaces and furnace pans, along with some panel boards and boiler work. The pit level is unchanged. Modern improvements include several structures associated with the electric furnace shop: a large steel-frame conveyor system, a two-story office building with corrugated metal siding, and a steel frame storage bin and hopper. (Level 1, machinery Level 3) (PHOTOS A, B, C, D, E)

2. Open Hearth Ingot Mold Storage Building, historic name; Ingot Storage Yard, present name (1901, 1950s). Partly covered and partly open shed area dating from the 1950s, steel frame, used for storing ingot molds, with 5-15-ton overhead crane. Currently in use. (Level 4) (PHOTO F)

3. Stripper, historic and present name (ca. 1960s). Open yard, steel frame, two overhead cranes. Used for removing ingots from ingot molds. Currently in use. (Level 4)

Other contributing buildings and structures associated with the former open hearth shop operation:

4. Gate House, historic and present name (ca. 1920s). One-story, brick, with flat roof. Currently in use. (Level 2) (PHOTO G)

5. No. 3 Power House, historic and present name (ca. 1930). Five-story, steel frame, brick veneer, flat roof, concrete foundation, with four-story brick addition (ca. 1942). Contains two 15

megawatt General Electric turbine-generator units (ca. 1930) and one Westinghouse 25 megawatt turbine-generator unit (ca. 1942). (Level 2, machinery Levels 2, 3) (PHOTO G)

6. Welfare Building, historic and present name (ca. 1940s). Westernmost section of building is one story, brick; easternmost section is two-story, brick, flat roof, concrete foundation. (Level 4)

7. No. 2 Power Station, historic name; No. 14 Substation, present name (ca. 1902). Steel frame, brick, gable roof. Contains ca. 1920s Allis-Chalmers Turbine generator units. Currently used as substation with frequency changer. (Level 1) (PHOTO H)

8. Blacksmith Shop, historic and present name (ca. 1920s). One-story, brick, flat roof with vent. Currently abandoned. (Level 2)

9. Steam Station, historic name; Brick Storage Building, present name (ca. 1902). One-and-one-half story, steel frame, brick nogging, steel roof-trusses with full-length monitor, concrete foundation. Currently abandoned. (Level 1) (PHOTO I)

Almost all of the former blast furnace operation at the Franklin Plant has been demolished. This area is considered a site. Remnants include:

10. Blowing Engine House, historic name; Storage Building, present name (ca. 1900). Four-story, steel frame, brick nogging, steel roof-trusses, concrete foundation. Blowing engines have been removed. Two overhead cranes remain in place. Currently used for storage. (Level 1) (PHOTO J)

11. Ore Yard, historic and present name (ca. 1900). Yard measures 250 ft. by 1500 ft. Traveling ore crane removed; concrete retaining wall remains. (Level 1) (PHOTO K)

12. Blast Office Stock Bins, historic and present name (ca. 1900). Only remnants are left of this concrete viaduct, which contained hopper bins for transport of ore to skip hoist. (Level 1)

13. Skip House, historic and present name (ca. 1920s). One-story, steel frame, brick veneer, gable roof. The skip house is elevated on a steel frame, now abandoned. (Level 2)

Almost all of the former coke operation at the Franklin Plant has been demolished. This area is considered a site. Remnants of coke batteries remain, as well as the following:

14. Sulphate Storage Building, historic and present name (ca. 1900). Two-and-one-half story structure containing steel frame, brick veneer, steel truss roof, concrete foundation, and parts of the by-product coke ovens, almost completely demolished. (Level 1) (PHOTO L)

15. Coke Plant Repair Shop, historic name; Mechanical Department, present name (ca. 1900). Two-and-one-half story, steel frame, brick nogging, steel Fink roof-trusses, concrete foundation. Currently used as a rigger shop. (Level 1)

16. Electric Substation, historic and present name (ca. 1920s). Two-story, steel frame, brick veneer, steel Pratt roof-trusses, concrete foundation. Currently in operation. (Level 2) (PHOTO M)

The Primary Mills have several buildings and structures associated with steelmaking:

1. 40-inch Mill Soaking Pits, historic and present name (ca. 1900). Steel frame, corrugated metal siding, steel roof-trusses, concrete foundation. The soaking pits were filled in 1976. Currently used for storage. (Level 1)

2. 40-inch Blooming Mill (ca. 1900). Two-and-one-half story, steel frame, corrugated metal siding, steel roof-trusses, concrete foundation. Currently houses electric generators for 34-inch Billet Mill. (Level 1)

3. 46-inch Blooming Mill and Soaking Pits Building, historic and present name (ca. 1950-1951). Two-and-one-half story, steel frame, corrugated metal siding, steel roof-trusses, concrete foundation. Contains soaking pits and active machinery, including ca. 1950-1951 46-inch high lift mill with manipulators. (Level 3, machinery Level 3) (PHOTO N)

4. Motor Room, historic and present name (ca. 1950-1951). Two-story, steel frame, steel roof-trusses, brick, concrete foundation. Contains Worthington & Aldrich pumps, used for hydraulic shears for 46-inch bloom mill. (Level 3, machinery Level 3)

5. Engine House, historic name; Storage Building, present name (ca. 1902). Two-story, steel frame, brick nogging, steel roof-trusses, concrete foundation. Although slightly altered, several original arched windows survive. Presently used for storage. (Level 1) (PHOTO O)

6. No. 1 Stock House and No. 2 Stock House, historic name; 46-inch Mill Transfers, present name (ca. 1900). Two-and-one-half story, steel frame, brick nogging, steel roof-trusses, concrete foundation. The two buildings were joined together in 1950-1951. Contains active slab shear and bloom shear ca. 1950-1951, and 30-ton overhead crane. (Level 1, machinery Level 3) (PHOTO P)

7. No. 1 Furnace House and No. 2 Furnace House, historic name; Storage Building, present name (ca. 1902). Two-story, steel frame, steel roof-trusses with monitor, brick and corrugated metal. Currently used for storage. (Level 1)

8. 134-inch Plate Mill, historic and present name (1917). Two-story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with monitor; original arched windows bricked in. The plate mill was removed in 1976. (Level 2) (PHOTO Q)

9. Shear Building, historic name; Storage Building, present name (ca. 1920s). One-and-one-half story, steel frame, brick cladding, gable roof, concrete foundation. Contains hand-operated crane. (Level 2)

10. Shipping Building, historic and present name (ca. 1950s). Two-and-one-half story, steel frame, steel roof-trusses with monitor, brick cladding and corrugated metal siding, concrete foundation. Currently used for billet storage and shipping. (Level 4) (PHOTO R)

11. Wheel Assembly & Axle Finishing Mill, historic name; Steel Preparation Building, present name (ca. 1920s). Steel frame, steel roof-trusses with monitor, brick, concrete foundation. Currently active as grinder line for steel preparation. (Level 2) (PHOTO S)

12. Shearing Shed No. 1, historic name; Scarfing and Shipping Building, present name (ca. 1902). Two-and-one-half story, steel frame, steel roof-trusses with monitor, brick cladding, concrete foundation. Currently used for scarfing and shipping. (Level 1) (PHOTO S)

13. Shearing Shed No. 2, historic name; 21-inch Billet Mill, present name (ca. 1920s). Two-and-one-half story, steel frame, brick-cladding, steel roof-trusses with monitor, concrete foundation. Presently houses 21-inch Billet Mill roll stands. (Level 2, machinery Level 3)

14. 34-inch Billet Mill, historic and present name (1923). Two-and-one-half story, steel frame, steel roof-trusses with monitor, concrete foundation. Attached to north is active No. 2 Shear Shed; attached to south is scarfing and steel preparation facility. The 34-inch Billet Mill is still active. (Level 2, machinery Level 3)

Other contributing buildings and structures associated with the primary mills include:

15. Ingot Stripper, present name (1960s). Steel frame, steel roof-trusses, corrugated roofing, open on all sides. Active facility. (Level 3)

16. Ingot Storage Yard, present name (1960s). Steel frame, steel roof-trusses, corrugated roofing, open on all sides. Active facility. (Level 4)

17. Stores, historic and present name (ca. 1930s). Three-story, steel frame, corrugated metal siding, concrete foundation. (Level 2) (PHOTO T)

18. Water Treating Station, present name (ca. 1970s). One-story, brick, currently used for maintenance. (Level 4)

19. Water Treatment Plant, present name (ca. 1970s). Two steel water tanks, open steel frame, water treatment area. Currently used. (Level 4)

20. Office and Welfare Building, present name (ca. 1950). Two-story, steel frame, brick cladding, concrete foundation. Currently used. (Level 4)

21. Office, present name (ca. 1950). Two-story, steel frame, brick cladding, flat roof, concrete foundation. Currently used. (Level 4)

The Steel Car Department contains several buildings and structures where steel freight cars are fabricated, assembled, and painted:

1. Works Office, historic and present name (ca. 1900). Two-story, brick, flat roof, stone foundation. Currently in use. (Level 1) (PHOTO U)

2. Machine Shop, historic and present name (ca. 1900). One-and-one-half story, steel frame, brick curtain walls, steel roof-trusses with full-length monitor. Contains lathes, milling machine, and drill presses. Currently in use. Attached is the former oxygen storage building, now a clock station. (Level 1) (PHOTO V)

3. Acetylene Building, historic and present name (ca. 1910s). One-story brick building with flat roof, now serves as labor office. (Level 2)

4. Office Building, historic and present name (ca. 1940s). Two-story, brick with flat roof, concrete foundation. Currently serves as welfare building. (Level 4)

5. Storage Yard, historic and present name (ca. 1910). Open stockyard containing craneways, with 10-ton crane and 20-ton Alliance crane. (Level 2)

6. Forge Shop Extension, historic and present name (ca. 1920s). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor, concrete foundation. Contains overhead crane, presses and shears, including two hydraulically operated Verson Presses ca. 1950s. (Level 2)

7. Forge Shop, historic and present name (ca. 1910). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor, concrete foundation. Contains overhead crane, a ca. 1951-1952 800-ton Verson Press, two ca. 1890s steam drop hammers, a continuous gas-fired Rust furnace, a Bethlehem steam press, three small Acme presses, and a Williams & White press. (Level 2, machinery Levels 2, 4) (PHOTO W)

8. Forge Shop Stock Yard, historic and present name (ca. 1920s). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor, concrete foundation. Contains machinery associated with steel car fabrication, including overhead crane, shears, and ca. 1970s Bliss press. (Level 2, machinery Level 4)

9. Car Shop No. 2, historic and present name (1901-1906). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor, concrete

foundation. Used for assembly of rail cars and contains ca. 1920s hand-operated riveting machines termed Bull riveters. (Level 1, machinery Level 2)

10. Car Shop No. 1, historic and present name (1901-1906). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor, concrete foundation. Used for assembly line for steel cars with associated machinery including ca. 1970s automated cold riveters and overhead cranes. (Level 1, machinery Level 4)

11. Car Shop No. 3, historic and present name (1901-1906). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with gable roof, concrete foundation. Contains associated machinery for steel car assembly, including angle punch. Also serves as piece storage for steel car assembly. (Level 1, machinery Level 4)

12. Car Shop Storage, historic name; Car Preparation Shop, present name (ca. 1902). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor and steel vent stacks, concrete foundation. Contains piece storage and associated fabrication machinery, including a 1960s Beatty punch and angle punch. (Level 1, machinery Level 4)

13. Stockyards, historic and present name (ca. 1900). Active, open stockyards with traveling cranes and runways serve the Steel Car Department. Overhead cranes include two Morgan 20-ton, an Alliance 20-ton, Bethlehem 20-ton, and Sellars 20-ton cranes. (Level 1)

14. Welding Shop, present name (1960). Two-story, steel frame, corrugated metal siding, steel roof-trusses, concrete foundation. Corrugated tin building used for welding shop, shipping, and storage. (Level 4)

15. Structural Shop, historic name; Tank Car Shop, present name (ca. 1898, 1922, ca. 1940s). One-and-one-half story, steel frame, brick nogging, riveted Warren steel roof-trusses, concrete foundation. A structural fabricating shop which was used until 1922; the adjoining Steel Tank Car shop was built in 1922. Another addition was made in the 1940s. Active shop contains overhead cranes, welding machinery, 250-ton press, and other smaller machinery used to fabricate steel hopper cars. (Levels 1, 2, machinery Level 4) (PHOTO X)

16. Car Paint Shop, present name (1960s). Two-story, steel frame, corrugated metal siding, concrete foundation. Building burned and was rebuilt in the 1960s. Contains Conemaugh & Black Lick Railroad track and equipment used for painting steel cars. (Level 4)

17. Car Paint Shop, historic and present name (ca. 1920s). Steel frame building. Contains east and west car transfer for transporting assembled steel cars into shot blasting facility, a part of the car painting process. (Level 2)

Other contributing buildings associated with the Steel Car Department include:

18. Compressor Building and Electric Substation, historic and present name (ca. 1910). Two-story, steel frame, brick cladding, concrete foundation. The substation contains four Westinghouse generators. Attached are a Pump House (ca. 1920s), one-story brick building, and a Pipe Shop (ca. 1920s), one-story, brick. (Level 2)

19. Woodworking Shop, historic and present name (ca. 1920s). Two-story, steel frame, brick veneer, concrete foundation. Attached is one-story brick pipe shop. (Level 2) (PHOTO Y)

20. Pipe Shop and Air Brake Material Building, historic name; Bolt Repair and Chain Shop, present name (ca. 1920s). One-story, brick, contains weld test area, hydraulic repair, electric reamer, and basic tool repair. Attached is a one-story office. (Level 2)

21. Power Transformers and Accumulator, historic and present name (ca. 1920s). Five-story, steel frame, brick cladding, concrete foundation. Houses pressure vessel for hydraulically operated machinery. (Level 2) (PHOTO Z)

22. Storage and Lavatory Building, historic and present name (ca. 1910s). Two-story and two-and-one-half story, steel frame, brick cladding lavatory building extends off the north facade of the storage building which contains a gable roof. The lavatory building has a flat roof. (Level 2)

23. Guard House, historic and present name (ca. 1920s). One-story, brick, flat roof. Currently in use. (Level 2)

Rod and Wire Plant
Contributing Resources

The Rod and Wire Plant contains several buildings and structures associated with the current manufacture of rods and wire:

1. Cooperage, historic name; Office, present name (ca. 1911). Two-story, brick with concrete foundation. Formerly used as cooperage, presently used as offices for the mill, having moved there in 1957. (Level 1) (PHOTO A)

2. Rod Storage, historic and present name (ca. 1911, ca. 1940s). Two-and-one-half story brick, steel frame, steel roof-trusses with monitors, and concrete foundation. A "Loopro Line," consisting of ca. 1950s machinery for drawing, cleaning, coating, and heat-treating steel wire, stands in the 1940s addition, and is still in use. The eastern half of the building is presently used as storage area. (Level 1, machinery Level 4)

3. Rod Mill, historic and present name (ca. 1911). Two-and-one-half story, brick curtain walls, steel frame, steel roof-trusses with monitors, concrete foundation. The original continuous Rod Mill was installed in 1911, and completely removed and replaced in 1955 by a 23 stand Morgan Rod Mill, still in use. Other machinery includes an Olson Furnace (ca. 1950s), and a hook conveyor (1951), used to cool rod coils. (Level 1, machinery Level 4) (PHOTOS B, C, D)

4A. Cleaning, Baking, Drawing, and Annealing Department, historic name; Wire Drawing Mill, present name (ca. 1911). Two-and-one-half story, brick curtain walls, steel frame, steel roof-trusses with monitor, concrete foundation. Ten Vaughn wire drawing machines (ca. 1950s) still stand. Brick infill-offices are adjacent. 4B. Cleaning House, historic and present name; (ca. 1911, 1933). Original cleaning house was rebuilt in 1933. Acid wash and lime tubs are arranged in two parallel sections. 4C. Annealing Room, historic and present name; (ca. 1911). Contains two parallel lines of annealing pots. (Level 1, machinery Level 4) (PHOTOS E, F, G)

5. Wire Drawing Room, historic and present name (ca. 1940s). Two-and-one-half story, brick curtain walls, steel frame, steel roof trusses with sawtooth monitors, concrete foundation. Contains

wire-drawing equipment (ca. 1950s) and a Patent Furnace, which heat-treats the wire with salt. Part of the building is used for storage. (Level 3, machinery Level 4)

6. Heated Warehouse, historic and present name (ca. 1920s). Two-and-one-half story, brick curtain walls, steel frame, steel roof trusses with sawtooth monitor, concrete foundation. Currently used for storage. (Level 2)

7. Several departments in one building: Two-and-one-half story, brick curtain walls, steel frame, steel roof trusses with monitors, and concrete foundation. 7A. Nail Department, historic name, Bundling Room, present name (ca. 1911). There is no remaining nail making machinery, and the building currently serves as wire storage. (Level 1) 7B. Fence and Barb Wire Department, historic name; Surface Furnace, present name (ca. 1911). No fence or barb wire machinery remains; the building now contains a ca. 1970s Surface Combustion Co., Toledo, Ohio, annealing furnace and wire storage. (Level 1, machinery Level 4) (PHOTO H) 7C. Galvanizing Department, historic name; Galvanizing Plant and Bethanizing Plant, present name (ca. 1911). The original mill, in 1911, included two galvanizing lines, a process consisting of coating steel wire with zinc; a smaller line was added in 1924. In 1935 the No. 2 galvanizing line, coating steel wire with zinc, was removed to make room for Bethanizing units No. 1 and No. 2. Bethanizing was an electric-plating process for zinc-coating on steel wire, and was based on patents by Dr. V. C. Tainton. The active plant contains aluminizing and Bethanizing heat treatments. (Level 1, machinery Level 3) 7D. Experimental Bethanizing Plant, Electroplating, historic name; No. 3 and No. 4 Bethanizing, present name (1944). An experimental work was established in 1944, and placed into commercial production in 1951, having two parallel lines each treating six strands of wires. Extant machinery is still operating with GE spoolers. (Level 3, machinery Level 3) (PHOTO I)

8. Warehouse, historic and present name (ca. 1911). Two-and-one-half story, brick curtain walls, steel frame, steel roof-trusses with monitors, and concrete foundation. Building is still used for wire storage and contains two brick-infill sections. The northernmost section contains Ajax-Hough (Cleveland) straightening and shearing machines, and bar straighteners; and three Lewis Machine Company (Cleveland), No. 8F, Travel-Cut machines, along with other spooling and shearing machinery, all dating from 1910s-1930s. (Level 1, machinery Level 2) (PHOTOS J, K)

9. Warehouse Extension, historic and present name (1936-1937). Two-and-one-half story, brick curtain walls with corrugated metal, steel frame, steel roof-trusses with monitors, and concrete foundation. Windows are covered with translucent fiberglass. A Conemaugh & Black Lick

Railroad track enters the north end of the building. A one-story brick lavatory is located inside; the building is used for storage. (Level 2)

Contributing associated buildings and structures attached or adjacent to the Rod and Wire Plant include:

10. Motor House, present name (ca. 1950s). Two-story, brick. (Level 4)

11. Leach Plant, present name (ca. 1960s). Three-story, brick building, with translucent fiberglass over the windows. (Level 4)

12. Filter House, present name (ca. 1970s). Three-story, clad with corrugated metal. (Level 4)

13. Water Treatment plant, present name (ca. 1970s). Two steel water tanks. (Level 4)

14. Two-story brick building, present name (ca. 1940s). Concrete foundation, containing pipe storage, electric repair shop, and machine shop with several ca. 1960s lathes and shapers. (Level 4, machinery Level 4)

15. Compressor House, present name (ca. 1940s). One-and-one-half story, brick, with extant Ingersoll-Rand compressors. (Level 4)

16. Water Treatment Plant, present name (ca. 1970s). Pond and water tank. (Level 4)

17. Billet Yard, historic and present name (1930s). Contains two overhead cranes. (Level 2) (PHOTO L)

18. Guard House, historic and present name (ca. 1920s). One-story, brick, flat-roof. (Level 2) (PHOTO M)

Wheel Plant
Contributing Resources

The Wheel Plant, mostly abandoned or used for storage, contains the following buildings and structures:

1. Steel Receiving and Preparation Building, historic and present name (1917-18). Two-and-one-half story, steel frame with brick curtain walls, concrete foundation, steel roof-trusses with monitors, corrugated metal roofing. Interior includes railroad spur line for receiving round blooms and wheel blocks, charging machine (ca. 1950s), parts of three Heller saws (ca. 1950s), billet breaker plate (ca. 1950s), forging press No. 1 (ca. 1918), and overhead crane (ca. 1918). This building, now used for storage, also contains coiled rods and pieces of scrapped machinery from the wheel plant. (Level 2, machinery Level 4) (PHOTOS A, B)

2. Circular Products Rolling Mill No. 1, historic and present name (1917-18). Two-and-one-half story, steel frame with brick curtain walls, concrete foundation, steel roof-trusses with monitors, corrugated metal roofing. Interior includes piercing press (ca. 1950), finish shear, and hub punch (ca. 1950). This building, part of which is now used for coal storage, contains miscellaneous scrap and debris. The original No. 1 mill was developed by Edwin E. Slick to produce sections formed by circular rolling to manufacture railroad car wheels. A combined rolling and pressing action occurred between two revolving dies which formed the wheel. The tread was rolled in a tread rolling mill to produce a harder wearing surface. These wheels were found to be structurally weak and wheel manufacture was afterwards carried out on the No. 2 mill. (Level 2, machinery Level 3)

3. Circular Products Rolling Mill No. 2, historic and present name (1917-18). Two-and-one-half story, steel frame, brick curtain walls, concrete foundation, steel roof-trusses with monitors, corrugated metal roofing. Interior includes rotary reheating furnace (ca. 1918) and parts of Morgan wheel rolling mill (ca. 1918). This building is now used for roll storage and miscellaneous scrap storage. (Level 2, machinery Level 2)

4. Heat Treating Buildings, historic and present name (1917-18). Two buildings, the first is a one-and-one-half story, steel frame with brick curtain walls, concrete foundation, steel Fink roof-trusses, gable roof with one-story monitor, corrugated metal roofing. Interior includes rotary furnace (ca. 1932). The second building is two-and-one-half story, steel frame, brick curtain walls, concrete foundation, steel Fink roof-trusses, gable roof with full-length monitor, corrugated metal roofing. Interior includes charging machine (ca. 1950s), rotary-type drawing furnace (ca. 1932, now partially demolished), pusher-type drawing furnace, pusher-type heating furnace, and a Treadwell quenching tank. (Level 2, machinery Level 3) (PHOTOS C, D)

5. Wheel Finishing Shop and Shipping Building, historic and present name (1917-18). Two-and-one-half story, steel frame with brick curtain walls, concrete foundation, steel roof-trusses with monitors, corrugated metal roofing. Interior of the Finishing Shop includes six King tracer lathes (ca. 1950s), two 50" Niles-Bement (ca. 1918) vertical-car wheel machines, one Bullard tracer lathe (ca. 1950s), Snyder boring mill (ca. 1950s), Wheelabrator and inspection station (ca. 1960s). Interior of the Shipping Area includes two lines of railroad tracks. Miscellaneous scrap is now stored in this building. Two-and-one-half-story addition, ca. 1960s, containing a steel frame, corrugated metal siding, steel roof-trusses, and concrete foundation, extends off the north facade. (Level 2, Machinery Levels 3, 4) (PHOTOS E, F, G)

6. Die Machine Shop, historic and present name (ca. 1920s). Two-and-one-half story, steel frame with brick curtain walls, concrete foundation, steel roof-trusses, gable roof covered with corrugated metal and containing metal vent stacks. Interior includes overhead crane (ca. 1920s) and miscellaneous debris. (Level 2)

Contributing associated buildings and structures attached or adjacent to the Wheel Plant include:

7. Accumulator Building, historic and present name (ca. 1918). Partially demolished, brick, houses two ca. 1918 accumulators for operating hydraulic machinery. (Level 2)

8. Electrical Substation Building, historic and present name (ca. 1918 with later additions). Four-story, brick and corrugated metal, glass windows and translucent fiberglass. Still an active substation. (Level 2)

9. and 10. Two lavatory and office buildings, historic and present name (ca. 1920s, 1950s). Brick lavatories, currently abandoned. (Levels 2, 4)

11. Office and Welfare Building, present name (ca. 1950s). One-story, brick, flat roof, glass windows. Currently abandoned. (Level 4)

12. Locomotive Repair Shop, historic and present name (ca. 1920s). One-and-one-half story, brick, flat roof, glass windows. A small repair facility, now abandoned. (Level 2)

13. Warehouse Building, historic and present name (ca. 1920). One-and-one-half story, brick veneer, steel frame building with concrete foundation. Storage facility served by the Conemaugh & Black Lick Railroad. (Level 2)

14. Craneways, historic and present name (ca. 1918 and ca. 1960s). Two cranes on steel frames located north of the Wheel Plant are still in service.
(Levels 2, 4)

15. Heat Treating Building, present name (ca. 1960s). Two-story, steel frame, corrugated metal. Addition to the south facade of Wheel Mill No. 1, contains ca. 1960s rotary furnace. (Level 4, machinery Level 4)

16. Wheel Plant Office, present name (1955). One-story, brick, with flat roof. Currently abandoned.

History and Prehistory in the National Park System and the National Historic Landmarks Program 1987 Themes and Subthemes

XII. Business
A. Extractive or Mining Industries
1. Iron and Ferro Alloys
3. Other Metal and Minerals (Coal)

B. Manufacturing Organizations
4. Fabricated Metal and Glass Products

XVI. Architecture
X. Vernacular Architecture (Industrial)

XVIII. Technology (Engineering and Invention)
D. Tools and Machines
F. Extraction and Conversion of Industrial Raw Materials
G. Industrial Production Processes

XXXI. Social and Humanitarian Movements
H. Labor Organizations

Significant Dates

1852 Cambria Iron Company founded
1871 First blow from Bessemer furnace; Cambria Iron Works sixth Bessemer plant in United States
1876 Cambria Iron Works largest U. S. rail producer
1878 Open hearth furnace installed in Lower Works
1881 Gautier becomes subsidiary of Cambria
1889 Johnstown Flood
1890s Gautier Plant rebuilt
1895 Otto-Hoffman coke by-product plant built
1898-1902 Franklin Plant built
1910-1911 Rod and Wire Plant built
1916-1917 Wheel Plant built
1916 Takeover by Midvale Steel and Ordnance Company
1919 Great Steel Strike
1923 Takeover by Bethlehem Steel Company
1937 Little Steel Strike
1941 Labor organized in Johnstown Plant
1952 Bessemer process discontinued and machinery demolished
1982 Electric furnaces installed at Franklin

Significant Person

Morrell, Daniel Johnson
Holley, Alexander Lyman
Kelly, William
Fritz, George
Hunt, Robert Woolston
Jones, William Richard

most productive iron and steel company of the mid- to late-nineteenth century. It represents the evolution of the iron and steel industry, from scattered furnaces, forges, and rolling mills, to fully integrated plants. The earliest surviving buildings reflect a vernacular style of industrial construction, including heavy timber and iron framing and ornate brickwork. Iron ore, coke, and coal supplying the mills came first from local and regional sources; Cambria being one of the larger coal and coke producers in the area. Raw materials came from Prospect Hill and the Rolling Mill Mine locally, as well as from mines in Fayette, Cambria, Blair, and Bedford, and Westmoreland counties. Iron ore was later obtained from the Great Lakes region, a trend reflective of the industry as a whole. This control of raw resources was crucial to the iron and steelmaking operation. Much of the labor in the Cambria mills was supplied initially by American-born workers and subsequently by western and southern European workers. This diversified workforce accounted for Johnstown's rich ethnic heritage. Through the decades, the expanding plant in Johnstown diversified its product line to offer steel needed for an industrializing America. In addition to steel trackwork for mine and industrial railroads, at various times in its history, the plant manufactured structural steel products, wheels, axles and forgings, merchant bar and agricultural steels, spring steels, concrete bars, wire rods and wire products, steel freight and mine cars, coke and by-products, and Bessemer and open hearth plates.

The Lower Works convey a sense of historic and architectural cohesiveness through its design, setting, materials, and association. The buildings are made of brick, timber, iron and steel, and were functional for specific industrial processes. The plant's evolution was dictated by changing technology and the need to upgrade facilities for cheaper and more efficient steel production. The plant's layout was based on the most efficient use of space within an area defined by natural features--the river and looming hillside. The spacing of older brick buildings among newer corrugated tin ones shows the relationship between the historic iron and steelmaking processes and newer ones. The uses and functions of older facilities changed, yet they continued to contribute to the on-going process of steel fabrication.

By 1900 the Cambria Steel Company consisted of the original plant, the Lower Works, as well as two other plants, Gautier and Franklin. The company also owned various support and supply operations such as water works, coal mines, and coke ovens. The Gautier Plant's significance lies in the integrity of its buildings and in the visible evolution of mill machinery. Constructed by the Cambria Steel Company in the late 1890s and after, the buildings remain virtually unchanged. The remaining active mills reflect both modern milling practices, and the evolution of mill industry. The 12-inch Mill is a direct descendant of the type of three high mill invented by John Fritz at Cambria.

The building of the Franklin Plant was a result of the Cambria Steel Company's decision to expand in Johnstown rather than move the entire operation to an interior port. The building of this plant allowed Cambria to diversify, expand in the steel market, stay competitive, and remain one of the largest steel producers in the nation. The most intact parts of the Franklin Plant include the Steel Car Department, followed by the Primary Mills and the Steelmaking Department. Railroad cars are still made in buildings built for that purpose, and remaining machinery reflects the evolution of car building from hand methods to modern automation. The buildings at the Primary Mills are largely unchanged and still house the same functions (production has been reduced, a reflection of the current steel market). Remaining mill machinery dating from the post-war modernization of the plant, ca. 1950s, is still active. The shell of the open hearth building is a remnant of the Cambria Steel Company's capacity for steelmaking which enabled the company to be a national leader in steel production. The modern electric furnaces located within this building are the latest in steelmaking technology.

The Rod and Wire Plant's significance lies in its integrity, both of the buildings and the evolution of its machinery. The Cambria Steel Company decided to reenter the wire trade and built the plant in 1910-1911. Some functions have changed; the plant no longer produces nails or barb wire. The drawing of wire does still occur in buildings constructed for that purpose on machinery dating from the 1950s. Experimentation with the Bethanizing treatment of wire began here in the 1930s, followed by general acceptance of this type of electric plating process.

Midvale Steel and Ordnance Company built the Wheel Plant in 1917-1918 to manufacture steel wheels. Vice-president and General Manager Edwin E. Slick invented the Slick Wheel Mill which produced stronger wheels capable of handling increased wheel loads and speeds. Remnants of this significant mill remain in the Wheel Plant buildings.

The Cambria Iron Company's significance can be placed in the context of both the late nineteenth and the twentieth century industrialism of the United States. Domestic production of iron and steel changed the look of America, contributed to western expansion and the growth of modern cities, fostered the growth of transportation systems, and was a factor in America's becoming a world power. The iron and steel industry also radically affected human lives. The discipline of the mills imposed long work days and work weeks, intensive labor and, for many mill jobs, low pay. American born and immigrant workers alike were often powerless to control their lives and working conditions, and became the most vocal in demanding reforms and a higher standard of living. Several eventful strikes failed before labor was organized in the mills.

The Cambria Iron Works was an early producer of iron rail, the sixth plant to produce Bessemer steel, the first to roll steel rail on commercial order, and an early producer of steel rail. In 1876 the plant rolled the largest aggregate of rails rolled in one year by one mill in the country. Thus, the Cambria Iron Company's story is more than an examination of the nationally significant technological advances made there in the conversion from iron to steelmaking. The continuing history of the steel business in America can also be seen in Cambria's continuing physical evolution up to the present day. The plant's history is a contextual look at the human, social, economic and political responses to industrialism, in which Cambria played a significant, yet representative role.

The Cambria Iron Works' physical location in western Pennsylvania was a crucial factor in its success during its early years. During colonial times Pennsylvania was the most important iron manufacturing colony. It had abundant resources of raw materials and water. Philadelphia merchants financed the ironmaking establishments, and by the end of the colonial era the industry was located west of the Susquehanna River in York County, the Cumberland Valley, and in the Juniata Valley. By the time of the Revolutionary War iron production commenced in the western part of Pennsylvania. Eastern manufacturers had great difficulty sending heavy iron goods over the Allegheny mountains, thus providing western ironmasters with some protection from competition. Blast furnaces and forges were established close to ore, charcoal and water sources, and the wrought iron and pig iron was shipped by animal or boat to Pittsburgh, where they were finished. Pittsburgh was an iron processor, but not yet an iron manufacturer.[20]

The high cost of British rails eased competition and spurred American production. By the mid-1850s new American rail mills were built, primarily west of the Allegheny Mountains, including the Cambria Iron Company. Western Pennsylvania became a leader in the production of iron and steel rails. This was due in part to the liberal supply of raw materials, but also because of protective legislation. Liberal grants of public lands to railroad companies, protective tariff policy, and the homestead policy all spurred the construction of thousands of miles of railroads. With the building of these roads, the consumption of iron increased along with the population.

20. David Lewis, *Iron and Steel in America* (Greenville, Delaware: The Hagley Museum, 1976), pp. 20, 29.

The opening of farms and ranches in the Midwest and West expanded the market for iron products.[21]

Railroads were important to American growth from 1850 to 1890. Railroads were the first dominant business, and railroad expansion sparked many changes in the nation's social and technological fabric. The railroads created the demand for iron, then steel rail, and the railroaders were the biggest supporters of the fledgling Bessemer industry. Of the first 11 Bessemer plants, all but one were organized for the rail business. Steel plants were established across the United States, and from 1870 to 1907, Bessemer steel comprised half of national production. Almost all of this steel went to the production of rails. American production of Bessemer steel rails surpassed that of Great Britain in 1879; by 1886 the United States was the largest steel maker in the world, with an output of more than 2,500,000 tons.[22]

The Bessemer process consisted of forcing cold air under pressure into a converter partially filled with melted cast iron. The air's oxygen combined with the iron's carbon and silicon and eliminated it through combustion. The silicon, manganese, and carbon joined with the oxygen to form combustible gases which burned off, leaving pure iron. However, some carbon was needed to make steel, so it was added back to the iron in the form of manganiferous pig iron (spiegeleisen), composed of carbon, manganese, and iron. The product was liquid Bessemer steel, produced in large quantities, which could then be poured into ingots. The commercial success of Bessemer steel laid in the control of the recarburization step of the process.[23]

In a Bessemer steel plant the pig iron was brought in by railroad cars. A ton was dumped into the cupola where it was melted and run off into ladles. The melted iron was tipped into spouts which filled the converters. Fans were started to blow air into the tuyeres and through the metal. This began the blow, after which the molten steel was tipped into ingot molds. After

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21. Peter Temin, *Iron and Steel in Nineteenth-Century America An Economic Inquiry* (Cambridge: The M. I. T. Press, 1964), pp. 21-22; James M. Swank, "The Manufacture of Iron and Steel Rails in Western Pennsylvania," *The Pennsylvania Magazine of History and Biography* XXVIII, no. 1 (1904):1-2.

22. Elting E. Morison, *Men, Machines, and Modern Times* (Cambridge: The M. I. T. Press, 1966), pp. 170-171; James M. Swank, *Notes and Comments on Industrial, Economic, Political, and Historical Subjects* (Philadelphia: The American Iron and Steel Association, 1897), pp. 155-156.

23. James M. Swank, *History of the Manufacture of Iron in All Ages, and Particularly in the United States from Colonial Times to 1891* (Philadelphia: The American Iron and Steel Association, 1892), p. 395; Morison, *Men, Machines*, pp. 126-127.

cooling, the ingots were reheated in furnaces, and moved to the blooming mill where they were hammered or rolled into blooms. These were then passed through the rail mills.[24]

The expansion of the railroad system was a commercial boon to the American iron and steel industry. At the end of 1860 there were 30,626 miles of steam railroad in use, but by 1895 this figure grew to 181,021 miles. The first steel rails were rolled at the North Chicago Rolling Mill in May 1864, from Bessemer steel ingots forged at a small experimental works at Wyandotte, Michigan. The first steel rails rolled in America on commercial order were run at the Cambria Iron Works in August 1867, for the Pennsylvania Railroad Company. After 1867 American Bessemer steel rails began replacing iron rails. The highest tonnage of iron rails made was 808,866 tons in 1872, but by 1877 iron rails fell behind steel rails in the amount produced. In 1876 Cambria's rail production exceeded that of any other plant; totalling 10 percent of all American rail output. In that year 103,743 net tons of rail were rolled; 47,643 tons were iron rails and 56,100 tons were steel rails. In 1880 iron rails totaled 70.9 percent of the nation's railroad track; by 1895, 87.8 percent of track was laid with steel rail. In 1902 the nation produced 2,935,392 tons of Bessemer steel rails. Western Pennsylvania contributed 950,266 tons of this amount, or one-third of the total. This tonnage came almost entirely from the Edgar Thomson Steel Works at Braddock, Pennsylvania, operated by Andrew Carnegie, and the Cambria Iron Works. Steel rails had replaced iron rails by 1907.[25]

The site for the Cambria Iron Company was chosen because of the abundant coal and iron ore deposits, and available water in and around Johnstown. Early iron forges in the area used these local resources, and relied on Johnstown's geographic location to ship goods to far markets. Johnstown was the western terminus of the Allegheny Portage Railroad where passengers and freight were transferred onto canal boats for transport west on the Pennsylvania Mainline Canal, part of which flowed through the eastern section of the iron works. Location and raw resources dictated the early success of iron producing ventures.[26]

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24. Morison, *Men, Machines*, pp. 166-167.

25. Swank, *Notes*, p. 147; James M. Swank, "The Manufacture of Iron and Steel Rails in Western Pennsylvania," *The Pennsylvania Magazine of History and Biography* XXVIII, no. 1 (1904):7; G. T. Raidabaugh, "History of the Rolling of Rails," *The Blast Furnace and Steel Plant* (April 1927):183; Shappee, "History of Johnstown," p. 93; Richard A. Burkert, "Iron and Steelmaking in the Conemaugh Valley," in *Johnstown: The Story of a Unique Valley*, ed. Karl Berger (Johnstown: Johnstown Flood Museum, 1984) p. 281.

26. J. J. McLaurin, *The Story of Johnstown: Its Early Settlement, Rise and Progress, Industrial Growth, and Appalling Flood on May 31st, 1889* (Harrisburg: James M. Place, Publisher, 1890), p. 41.

The Cambria Iron Company had several predecessors, dating to early local efforts at producing iron. Local iron forges took advantage of the ore deposits and water transportation, and in the 1840s George Shryock King and a partner, Dr. Peter Shoenberger, operated four iron furnaces in the area. The two associates owned more than 25,000 acres of land in Cambria and Somerset counties, including the ore in Prospect Hill overlooking Johnstown, which was mined from the 1840s until the 1880s. When the Pennsylvania Railroad entered the Conemaugh Valley, George King recognized the potential of producing iron railroad rails. Construction of a rolling mill and four coke furnaces began in March 1853, after articles of association establishing the Cambria Iron Company were signed August 21, 1852. The location chosen for the new plant was the Millville bottom, bounded by the railroad, canal, Prospect Hill, and the Conemaugh River.[27]

Monetary problems resulted in the company's transfer from local and New York hands to those of Philadelphia businessmen. Wood, Morrell and Company leased the Cambria Iron Company for five years, starting May 21, 1855. In 1862 the company took over the plant through default.[28]

Technical innovation was Cambria's early claim to fame. All of the significant persons associated with the Cambria Iron Company contributed to the nation's development through their contributions to the American iron and steel industry. John Fritz was considered the most innovative engineer of his day, a mechanical genius, and many iron and steel employees who worked with him were called "Uncle John's boys." He arrived at Cambria in 1854, and designed the three high roll mill and other machinery. On July 29, 1857, iron railroad rails were first rolled on John Fritz's mill which economized on both labor and heat by allowing hot rails to be passed alternately through the rollers in both directions without removal. He left Cambria in 1860 after honing a competent labor force, and after influencing the commercial success of the iron rail industry. Fritz subsequently became closely associated with the Bethlehem Iron Company, in Bethlehem, Pennsylvania. He was one of a group of men who applied the process

27. Henry Wilson Storey, *History of Cambria County Pennsylvania* (New York: The Lewis Publishing Company, 1907) 1:400-405; James M. Swank, *Cambria County Pioneers* (Philadelphia: Allen, Lane & Scott, 1910), pp. 66-68; Thackray, "Brief History," pp. 1-2.

28. Storey, *History of Cambria*, 1:413-414, 416-417; Nathan Daniel Shappee, "A History of Johnstown and The Great Flood of 1889: A Study of Disaster and Rehabilitation," Ph.D. dissertation, University of Pittsburgh, 1940, pp. 65-66.

of making Bessemer steel to the American industry, together with his brother George Fritz, Robert W. Hunt, William R. Jones, and Alexander L. Holley.[29]

George Fritz was a mechanical genius like his brother. He participated in the trials of the three high mill, helping with its development, and served as general superintendent of the plant. He invented the first blooming mill for breaking down ingots, adopted by steel works at Troy, North Chicago, Joliet, and Bethlehem; in addition to a hydraulic manipulator for turning and moving ingots, and the mechanical driving of rollers in mill tables. George Fritz's mechanical skill was evident in the design and efficiency of the mill machinery, furnaces, and supporting services. George Fritz also worked with Alexander Holley to roll the first steel rails at Cambria, using ingots from the Pennsylvania Steel Company plant in Steelton.[30]

Other early experiments centered on the work of William Kelly. Cambria's general manager, Daniel J. Morrell, brought Kelly to Johnstown in 1857 where he experimented with the pneumatic process at the same time that Henry Bessemer was perfecting the hot blast in England. Kelly had worked with small converters since 1851, and he produced enough steel to ask for a U. S. patent, which he obtained in 1857. At Cambria, Kelly invented a tiltable converter and experimented with it before leaving Johnstown in 1862.[31]

William R. Jones began work at Johnstown in 1859 as a machinist. He served in the Civil War and returned to Cambria, where he became assistant to George Fritz. He arrived in Cambria just in time to become part of the circle of iron and steel experts who were combining their knowledge to promote the making of Bessemer steel. He left Cambria after 16 years to become a master mechanic for Andrew Carnegie at the Edgar Thomson Steel Company, where he patented many processes and machinery to improve the making of steel.[32]

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29. Jeanne McHugh, *Alexander Holley and the Makers of Steel* (Baltimore: The Johns Hopkins University Press, 1980), pp. 234-239; John Fritz, *The Autobiography of John Fritz* (New York: John Wiley & Sons, 1912), pp. 91, 108-115.

30. McHugh, *Alexander Holley*, pp. 213-214, 217-218, 228; Engineering Department, "History of the Evolution," 1958, p. 4.

31. John Newton Boucher, *William Kelly: A True History of the So-called Bessemer Process* (Greensburg, Pennsylvania: By the Author, 1924), pp. 80-82; Swank, *History of the Manufacture*, pp. 396-400.

32. McHugh, *Alexander Holley*, pp. 220, 251.

Daniel Morrell hired Robert W. Hunt to establish the first chemical laboratory as part of an iron company at Cambria in 1860. After the Civil War he took part in early testing of the Bessemer process, took charge of rolling the first steel rails on commercial order at Cambria, and assisted John Fritz and Alexander L. Holley in designing and building Cambria's Bessemer plant. He took charge of this plant upon its completion in 1871. He left Johnstown in 1873 to work at the Troy Iron & Steel Company, and later established an engineering consulting firm.[33]

Alexander L. Holley's career was closely associated with establishing the Bessemer steel process in America. He rebuilt, designed, or served as a consultant in starting most of the early Bessemer steel plants, including consulting on Cambria's Bessemer plant in 1871, and supervising the first Bessemer blow in 1873. He was the most renowned steel plant designer and engineer in America. He worked with George Fritz and Robert W. Hunt to roll the first steel rails at Cambria.[34]

By the early 1860s the process for steelmaking was understood chemically, but its commercial use was still hindered because of inadequate machinery, inadequate control over the process, and because suitable pig iron was hard to find. Lake Superior ores eventually became the source of supply. Ten years passed between Kelly's and Bessemer's discoveries and the full commercial use of steel because of the legal, technical, and financial problems involved.[35]

Daniel Morrell, with others, obtained control of the Kelly patents, organizing the Kelly Pneumatic Process Company. In October 1864 the Kelly process was combined with Robert F. Mushet's patent for recarburizing pneumatic steel. In England Henry Bessemer patented his process and sold his American control to Alexander Holley and Associates of Troy, New York. Thus, the Kelly Company controlled the pneumatic principle and the Mushet patent while the Troy Company controlled the Bessemer patent. Alexander Holley brought together the two groups and formed the Pneumatic Steel Association. The U.S. patent office recognized the Bessemer patent in 1866, and all the patents for the process and required machinery were consolidated. The combination of these patents, bringing together the various technological, mechanical, and chemical aspects of the process, resulted in the establishment of the American steel industry. Members of

33. Ibid., pp. 214-215, 252, 376-377.

34. Ibid., pp. 213-214, 228-229.

35. Temin, *Iron and Steel*, p. 127; Morison, *Men, Machines*, p. 141.

the association designed and built a plant in 1867 at Steelton, outside Harrisburg, Pennsylvania, followed by continued influence on the development of American steel plants until 1875.[36]

In 1867 the Cambria rolling mill produced the first Bessemer rails on commercial order in the United States, made from ingots forged at the Steelton plant. At the time Cambria was the largest iron rail producer in the country. By 1871 Alexander Holley had designed and installed Bessemer converters at Cambria. This was the sixth Bessemer furnace in America, and by 1876 commercial rail production at Johnstown reached 103,743 tons; 47,643 tons of iron rail and 56,100 tons of steel rail. Beginning with 10,000 tons of iron rails produced in 1855, the Cambria Iron Company's capacity in 1878 was 100,000 tons of iron and steel rails, bar iron, steel wire, bolts, nuts, and other products. This production exceeded that of any other steel plant and totaled 10 percent of all American rail manufacturing. The company produced iron and steel rail for more than 50 years.[37]

Cambria continued to contribute to the American steel industry well past the formative years of the industry. Technological innovation was advanced through the introduction of the Otto-Hoffman by-product coke ovens in 1895-1896 at Franklin, the first by-product oven plant in the United States to be operated in conjunction with a blast furnace. Cambria employee John Coffin invented the Coffin heat treating process used in the manufacture of car axles; the first use in the industry of heat treatment for axles. Not only did Robert W. Hunt set up the first analytical laboratory, but he and John E. Fry patented the principle of filling an ingot mold from the bottom. In 1902 the first Steel Plant Metallurgical Department in the country was established at Cambria. In 1917-1918 the Slick Wheel mill was developed by Edwin E. Slick.[38]

The Cambria Iron Company owned several subsidiary industries, principally the Gautier Works, established in 1878 and specializing in wire, specialty steel, and agricultural implements. The Johnstown Mechanical Works specialized in fancy iron work and wood-turned products. The Johnstown Manufacturing Company in Woodvale made bricks. Also affiliated were the Woodvale

36. Swank, *History*, pp. 409-412; Morison, *Men, Machines*, pp. 139-144; McHugh, *Alexander Holley*, pp. 199-200, 211-212; Robert W. Hunt, "A History of the Bessemer Manufacture in America," *Transactions of the American Institute of Mining Engineers* V (May 1876 to February 1877):15.

37. Burkert, "Iron and Steelmaking," pp. 281; Swank, *History of the Manufacture*, pp. 413; Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company," London *Engineering* XXVI (September 20, 1878):233.

38. Engineering Department, "History of the Evolution," 1958, pp. 5, 77.

Flouring Mill and Woodvale Woolen Mills. The company possessed coal and iron ore veins in the adjacent hills and counties, and operated its own mines. The local iron ore was used until the 1870s, when purer iron ore from the Lake Superior region was needed for making steel but regional coal mining has continued to the present day. Efficient rail communication running east and west helped transform both Cambria into a major iron and steel producer and Johnstown into a thriving city.[39]

The Cambria Iron Company and its subsidiaries were the principal employers and the reason for the area's extraordinary growth. The company was the major factor in Johnstown's development for more than 100 years. Johnstown grew from a single borough of 1,300 people in 1850 to the focus for boroughs inhabited by 15,000 people in 1880. Conemaugh Borough was the location of Cambria's Gautier Works. Most of Prospect Hill's residents rented houses from the company. The main rolling mills, foundries, machine shops, and blast furnaces were located in Millville. The majority of Cambria City's population was employed by Cambria. Woodvale had a Cambria Iron Company chemical works, woolen mill, tannery, flouring mill, and brick works. East Conemaugh was built around the railroad yards. Other boroughs and villages, Kernville, Morrellville, Franklin, Coopersdale, and Moxham, were all connected economically to the Cambria Iron Company.[40]

Continuing growth of the company's production was reflected in the expansion of the plant along the Little Conemaugh River. Increased competition and costs forced many independent steel companies to merge or reorganize, and in 1898 the Cambria Iron Company leased its properties to the Cambria Steel Company. Thought was given to moving the plant from Johnstown to nearer the Great Lakes, but the decision was made to extend the facilities. The Franklin Plant was built, and the construction of new waterworks assured the plant's growth. Johnstown's proximity to the Connellsville, Pennsylvania coal region and the good railroad access also factored in the decision. In later years Johnstown's industrial advantage was reduced as increasing competition in transportation put the steel plant at a disadvantage. Isolated to an extent from the Great Lakes and the eastern seaboard, Johnstown's traditional role as a supplier to distant markets was diminished. The steel industry grew only slowly after World War I, and Cambria was not spared.

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39. Alexander L. Holley and Lenox Smith, "American Iron and Steel Works The Cambria Iron and Steel Works," London *Engineering* XXV (May 31, 1878):422-423.

40. McLaurin, *The Story of Johnstown*, pp. 39-40; Paula Degan and Carl Degan, *The Johnstown Flood of 1889 The Tragedy of the Conemaugh* (n.p.: Eastern Acorn Press, 1984), p. 8.

In 1916 Cambria became a subsidiary of the Midvale Steel and Ordnance Company of Philadelphia and was taken over again in 1923 by the Bethlehem Steel Company.[41]

The American steel industry underwent dramatic changes in the second half of the twentieth century. Dominant worldwide during World War I, and surviving the Great Depression to become even larger during World War II, the industry produced more than 90 million tons of steel ingots in 1946, an amount far above any other nation in the world. In America approximately 85 percent of all manufactured goods contained steel, and 40 percent of employed workers were tied to the steel industry directly or indirectly. By the early 1950s the Johnstown plant employed approximately 18,000 workers, and produced 2.28 million tons of steel ingots annually.[42]

By the mid-1980s the steel industry's economic health had deteriorated. More than 250,000 jobs were lost, entire steel facilities were closed and are currently being scrapped, and 30 million tons of capacity disappeared. Foreign steel suppliers gained one-fourth of the domestic steel market, and the American industry lost $7.25 billion between 1981 and 1986. This fall has signalled drastic changes in several areas, including the evident scale-down of large integrated plants, the emergence of mini-mills, and the use of concessionary bargaining as a union attempt to save jobs by keeping plants open.[43] The continuing evolution of steelmaking regarding machinery and products is visible when the Johnstown Plant of the Bethlehem Steel Corporation is viewed in the context of its continuing history. The extant buildings, structures, and machinery either abandoned or still in use on the site are the result of decisions made in the interest of economics, competitiveness, and capacity in the reality of a modern world steel market. The Johnstown Plant, heir to the Cambria Iron Company, still survives and remains open with reduced operations, even though other plants have closed. This is due to several factors, the primary ones being the cooperation and sacrifices of the workforce and the support of the community.[44]

The social history of the Cambria Iron Works is intertwined with the surrounding community regarding ethnicity and the growth of labor unions. Labor for the Cambria mills came from

41. Burkert, "Iron and Steelmaking," pp. 296, 303-304.

42. John Strohmeyer, *Crisis in Bethlehem Big Steel's Struggle to Survive* (Bethesda, Maryland: Adler & Adler, 1986), pp. 11-12, 196.

43. Ibid., pp. 12-15.

44. Ibid., p. 195.

several different sources. Farm labor and German and Welsh migrations in the 1830s, 1840s, and 1850s supplied the initial manpower. South European and Slavic immigration came in waves after the 1870s. Southern black migrants arrived after World War I. More than 70 percent of the male blue-collar force in Johnstown was employed at Cambria mills and coal mines, and there were very few opportunities for women's employment in Johnstown. The Cambria Iron Company was the main attraction for this immigration into Johnstown, and thus shaped the city's cultural and ethnic heritage.[45]

The Cambria Iron Company engaged in a paternalistic form of welfare capitalism, assuming responsibility for worker welfare and civic improvements. In 1887 the company built the first industrial hospital in America. After 1870 it funded and then built a public library; after 1889 it funded the public library built by Andrew Carnegie after the 1889 Johnstown Flood. The company built an opera house and club house, operated a company store, and ran a night school offering free classes for employees. The Cambria Iron Company was also the largest landlord in Johnstown, owning houses which it either rented or offered for sale to workers.[46]

According to historian Ewa Morawska, the Cambria Iron Company's influence affected not only Johnstown's economic sphere, but its social, political, and cultural worlds as well. The major newspaper "traditionally" supported company policy, and company managers held high public offices in town, forming "a tightly knit sociopolitical elite in the city." From the very beginning the company's managers actively opposed labor organizations and successfully suppressed several strikes by miners and mill workers between 1866 and 1919. Organizational efforts by various trade unions and the Knights of Labor through the years were either short-lived or failed altogether. Workers at the Johnstown Plant participated in the Great Steel Strike of September 1919, and thousands were rewarded by the Midvale Steel and Ordnance Company management with outright dismissal. This strike crippled the iron and steel industry when industry leadership fought against craft unions affiliated with the American Federation of Labor. The strike was a total defeat for the unions. John L. Lewis formed the Committee for Industrial Organization with other labor leaders in 1935. In 1937 discussions between Lewis and U. S. Steel ended in a collective bargaining agreement between the company and a CIO local. Efforts

45. Shappee, "History of Johnstown," p. 72; Ewa Morawska, *For Bread with Butter The Life-worlds of East Central Europeans in Johnstown, Pennsylvania, 1890-1940* (Cambridge: Cambridge University Press, 1985), p. 85; Richard B. Sherman, "Johnstown v. The Negro: Southern Migrants and the Exodus of 1923," *Pennsylvania History* 30 (October 1930):454-455.

46. Shappee, "History of Johnstown," p. 97; Holley and Smith, "Cambria Iron and Steel Works," XXV:422; Morawska, *Bread With Butter*, p. 87; "Helping the Workingmen to Help Themselves," *The Iron Trade Review*, June 6, 1912, pp. 1213-1219.

by the Steel Workers Organizing Committee to sign contracts with other steel companies led to the Little Steel Strike of 1937. Johnstown was Bethlehem Steel Corporation's only plant to strike. Pickets rallied for days in front of plant gates, and some violence occurred at Franklin. This strike failed, and not until after World War II brought government controls would steel management accept the SWOC as a bargaining agent. The Johnstown Plant was soon organized by the United Steelworkers of America, in 1941.[47]

The possibility for survival of the American steel industry is currently debated, and the ramifications of its loss in terms of American strength is not known. Seen in a continuum of history, the significance of the Cambria Iron Company and its successive managements remains in its contributing and representative role not only in the development of an industry, but in the larger context of American world dominance and strength as well.

Comparable Properties

In 1988, the Historic American Engineering Record (HAER) conducted a nationwide survey of important iron and steel works, specifically those that were established in the 1840s through the 1860s, and rose to prominence in the mid- to late-nineteenth century. The purpose of the survey was to determine the extent to which these important iron and steel works retained historic buildings, structures, and machinery. Through a literature search, followed by the research of primary and secondary sources, HAER developed a list of significant iron and steel works founded in the three decades between 1840 and 1870.

During the course of the fieldwork HAER determined that no single site exists that can be considered a complete and unaltered "showpiece" of mid- to late-nineteenth century steelmaking and manufacturing technology. Simply put, there does not exist in the steel industry any site which is perfectly preserved. This finding is not surprising in light of the periodic modernization that the nation's major steel works experienced over the course of their history. Nonetheless, HAER found that certain steel works contained a greater number of extant historic structures than others; however, in each case these historic structures had undergone at least some structural or

47. Morawska, *Bread With Butter*, p. 87; Shappee, "History of Johnstown, pp. 73-82; Irving Bernstein, *Turbulent Years A History of the American Worker 1933-1941* (Boston: Houghton Mifflin Company, 1971), pp. 490-494; Bruce Y. Williams and Michael D. Yates, *Upward Struggle A Bicentennial Tribute to Labor in Cambria and Somerset Counties* (n. p.:n. p.), n. p.; Colston E. Warne, ed., *The Steel Strike of 1919* (Lexington, Massachusetts: D. C. Heath and Company, 1963), pp. v, ix; Donald S. McPherson, "The "Little Steel" Strike of 1937 in Johnstown, Pennsylvania," *Pennsylvania History* 39 (April 1972):219, 237.

architectural alterations. As for historic machinery and equipment dating from the mid- to late-nineteenth century, HAER found that very few of these resources survive in situ.

Thus, with these findings serving as a framework, HAER concluded that among the historically important iron and steel works identified in the research, there are three sites that contain a relatively large number of historic structures and thereby provide the best physical evidence of an early prominent iron and steel works. The three include: the Cambria Iron Company in Johnstown, Pennsylvania; the Trenton Iron Company in Trenton, New Jersey; and the Bethlehem Iron Company in South Bethlehem, Pennsylvania. In each case several structures survive from the mid-nineteenth century. Importantly, the Bethlehem Steel Corporation presently operates the works in Johnstown and South Bethlehem, whereas the works in Trenton, last operated by the American Steel and Wire Company, are now abandoned.

Bethlehem Iron Company was organized in 1857 as the Saucon Valley Iron Company. Its name was changed in 1859 to the Bethlehem Rolling Mills and Iron Company and then in 1861 to Bethlehem Iron Company. The company was a major producer of iron and then steel rails throughout the latter part of the 19th century. Several buildings associated with this period remain at Bethlehem, now the Bethlehem Steel Corporation, including structures built by John Fritz. Extant resources include: (1) ca. 1860 Iron Rail Mill and Puddling Furnace Building, now threatened with demolition; (2) ca. 1870-1872 Bessemer Building and Rail Mill, greatly altered; (3) ca. 1862 Pattern Shop; (4) five blast furnaces, ca. 1860-1870s, all rebuilt; (5) ca. 1870s Blowing Engine House; (6) ca. 1888 "High House"; (7) ca. 1888 Machine Shop; and (8) ca. 1888 Press Forge Shop.

The Trenton Iron Company was formed in 1845 by Peter Cooper and Abram Hewitt as the Smith Trenton Iron Company, and in 1847 its name was changed to the Trenton Iron Company. The original works consisted of a rod and wire mill and facilities for rolling iron rails. The company adapted to meet changes in the iron market and in the early 1850s began rolling iron structural beams when rail prices began decreasing. In 1865 Trenton Iron completed one of the earliest open hearth facilities in America. However, the process did not prove commercially viable at this time and the process was abandoned in 1869. In 1866, Trenton began rolling a combination iron and steel rail ("steel-topped") which served as a transition from iron to the all-steel rails that followed in the 1870s. Structures remaining from this period include: (1) the Trenton Iron Company Office, ca. 1879; (2) an 1872 Boiler House; (3) an 1880 Engine House; (4) the 1871 Wire Mill No. 1; (5) the ca. 1850s Wire Mill No. 3; (6) and the 1885 Blacksmith Shop. Adjacent to these buildings is the site of the Trenton Locomotive and Machine

Manufacturing Company built by Abram Hewitt. Remaining historical structures include: (7) the 1853 machine shop, (8) 1853 foundry, and (9) the 1853 pattern shop.

Besides these important sites, there are several other companies that were important 19th century rail producers. The rolling mill operations of the Renssalaer Iron Works was begun in 1853, and a rail mill built in 1866 rolled steel rails from the newly completed Bessemer steel converter. Unfortunately, it burned in October 1969. During the summer of 1969 this brick rail mill was documented by HAER.

The Joliet Iron and Steel Company was formed in 1873 to roll steel rails using Bessemer steel. It was part of the 1889 merger which created Illinois Steel, the first of the major steel company mergers. The mill was dismantled in 1905, but several significant structures remain, including (1) an impressive 1873 limestone office building, (2) a ca. 1872 machine shop, (3) a ca. 1872 boiler house, (4) a ca. 1872 pattern shop, (5) a ca. 1886 storage building and (6) an 1888 roll shop.

The Pennsylvania Steel Company, in Steelton, Pennsylvania, was started in 1866, and rolled rails for the Pennsylvania Railroad Company. The steel came from a Bessemer steel converter which began operations in May 1867. The rail mill was completed in May 1868. The first Bessemer plant was built in 1867 and housed two five-ton converters. In 1881, the second Bessemer plant was built, containing three eight-ton converters. Structures remaining from this early period include (1) a three-story, stone Bessemer building, probably ca. 1881, (2) an 1892 roll shop, and (3) an 1899 machine shop. Many other buildings remain at this site although they date from the early 20th century.

The Cleveland Rolling Mill, Newburgh, Ohio, was built in 1858 for rerolling iron rails. The company began rolling steel rails in 1868 after the installation of a Bessemer converter, and in 1889, was part of the merger which formed Illinois Steel. There do not appear to be any remaining structures at this site.

The Union Rolling Mill was built in 1863 at South Chicago, or Bridgeport, Illinois, and was owned by Cleveland Rolling Mill. It first rolled iron rails and then in 1871, steel rails after the installation of a Bessemer converter. In 1889 it became part of the Illinois Steel Company. The works were dismantled in 1902, and there are no remaining structures.

The North Chicago Rolling Mill was built in 1857 on the North Branch of the Chicago River. The original rail mill was for rerolling iron rails. Another rail mill was built in 1864, and, by 1878, it was used to roll steel rail after a Bessemer converter was built in 1871. There are no surviving structures at the North Chicago Works.

In 1880, the South Chicago works were built on Lake Michigan and became the nucleus of the operations. In fact, the North Chicago works were later abandoned. In 1889, North Chicago (including the South Chicago Works), combined with Joliet Iron and Steel, Cleveland Rolling Mill, and Union Rolling Mill to form Illinois Steel. North Chicago held 54 percent of the stock and was the dominating interest in this merger. Illinois Steel later became part of Federal Steel, and then, in 1901, was part of the United States Steel Corporation merger. South Chicago does have remaining machinery.

The Johnstown Plant can also be compared with remaining iron and steel works in nearby Pittsburgh, Pennsylvania, also known for its iron and steel heritage. In 1987 the Pittsburgh History & Landmarks Foundation rated six mills to have potential for listing on the National Register of Historic Places. These are: (1) USX Corporation's Clairton Works, founded in 1900, occupying 238 acres, is partially demolished and was at one time the world's largest coke-producing operation; (2) USX Corporation's Duquesne Works, dating from 1886 and occupying 200 acres, were part of Carnegie mills. They are threatened with demolition. Older buildings are intact and modified blast furnaces date from the 1880s; (3) USX Corporation's Homestead Works date from 1881, occupy 410 acres and are threatened with demolition. This plant was the site of the famous 1892 strike; (4) USX Corporation's Edgar Thomson Works, dating from 1875 and located on 176 acres, is currently in use. This was Andrew Carnegie's first steel mill, and contains much old equipment; and (5) Jones & Laughlin Steel's South Side plant dating from 1852, is on 230 acres. It is partially used and partially demolished. It is a large diversified steel mill, and was an impetus for Pittsburgh's growth and attracted East European immigration into the city. It has no remaining furnaces, but has an open hearth furnace shed and an old Bessemer building. A sixth plant was identified by Pittsburgh History & Landmarks Foundation, the CCX Braeburn Alloy Plant in Lower Burrell, Westmoreland County, but it is a specialty steel plant and is of a much smaller scale than the Johnstown Plant.

Only the Jones & Laughlin plant in Pittsburgh is as old as the Cambria Iron Company's Lower Works. It contains historic buildings which have been significantly altered, and contains no remnants of Bessemer furnaces, open hearth furnaces, or blast furnaces, although it does have remnants of a Bessemer building. It does contain electric arc furnaces, as does Bethlehem Steel

at the Franklin Plant in Johnstown. Jones & Laughlin had a rail mill, dated later than Cambria's. The Jones & Laughlin plant was also an independent mill, as was Cambria, and had raw materials, furnaces, and production facilities all on one site. It is the only plant which has a similar history to Cambria's, although it is not as historically significant in terms of industrial and engineering achievements occurring there.

Other early Bessemer plants (1864-1876) need to be compared against the resources at Cambria. All of these plants were affected in some way by the Pneumatic Steel Association, owners of the American Bessemer steel patents, and were influential in establishing an American steel industry. They are listed here in order of their establishment.[48]

1. Kelly Pneumatic Process Company, Wyandotte, Wayne County, Michigan. This company began experiments on a Bessemer-like process in 1862 and the first blow on the two-and-one-half-ton experimental converter was in the fall of 1864. However, the experiments were not commercially successful and the operations were abandoned in 1869. There had been a rolling mill at this site since 1855, and a second mill was built in 1872. This company eventually became the Eureka Iron and Steel Company. The only indicator of the importance of this site to the development of America's steel industry is a historical marker; there are no remaining structures.

2. Albany and Rensselaer Iron and Steel Company, Troy, New York. This experimental Bessemer plant had one two-and-one-half-ton converter which first blew on February 15, 1865. The Bessemer plant was added to an iron rail mill. There are no remaining structures.

3. Pennsylvania Steel Works, Pennsylvania Steel Company, Steelton, Dauphin County, Pennsylvania. This was an entirely new works with two seven-ton converters. The first blow was in June 1867. Remains include only a three-story stone Bessemer building, probably dating from 1881.

4. Freedom Iron and Steel Works, Lewistown, Mifflin County, Pennsylvania. Two five-ton converters were added to the works of the Freedom Iron Company, and the first blow was on May 1, 1868. These works failed in 1869 and most of the Bessemer machinery was moved to Joliet, Illinois. Although there are probably no remains, HAER will investigate this site.

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48. Swank, *History*, pp. 411-412.

5. Cleveland Rolling Mill Company, Cleveland, Ohio. Two six-and-one-fourth-ton converters were added to an iron rail mill. The first blow was on October 15, 1868. There are no remaining structures at this site.

6. Cambria Iron Works, Cambria Iron Company, Johnstown Pennsylvania. Two six-ton converters were added to an iron mill, and the first blow was on July 10, 1871.

7. Union Steel Company, Chicago, Illinois. Two six-ton converters were added to an iron rail mill, and the first blow was on July 26, 1871. There are no remaining structures.

8. North Chicago Rolling Mill Company, Chicago, Illinois. Two six-ton converters were added to an iron rail mill. The first blow was on April 10, 1872. There are no remaining structures.

9. Joliet Steel Works, Joliet Steel Company, Joliet, Illinois. This was an entirely new plant, with two eight-ton converters. The first blow was on January 26, 1873, and the first steel rail rolled on March 15, 1873. There are several buildings remaining from the time period, but none directly relating to the steelmaking process.

10. Bethlehem Iron Company, Bethlehem, Pennsylvania. Two seven-ton converters were added to an iron rail mill. The first blow was on October 4, 1873, and the first steel rail rolled on October 18, 1873. Buildings built by John Fritz in 1862 remain, and are threatened with demolition.

11. Edgar Thomson Steel Works, Carnegie Brothers & Co., Limited, Bessemer Station, Braddock, Pennsylvania. These were entirely new works with two seven-ton converters. The first blow was on August 25, 1875, and the first steel rail rolled September 1, 1875. USX Corporation has not yet granted permission to pursue any field survey at this plant, thus the extent of any remaining structures is not known.

12. Lackawanna Iron and Steel Works, Lackawanna Iron and Coal Company, Scranton, Lackawanna County, Pennsylvania. Two five-ton converters were added to an iron rail mill. The first blow was on October 23, 1875, and the first steel rail made December 29, 1875. These works were dismantled and the machinery moved to Lackawanna, New York, in the 1890s. At this time it appears that the only remaining structures at Scranton may be some remnants of stone iron furnaces and blast furnaces.

13. St. Louis Ore and Steel Company, St. Louis, Missouri. Two seven-ton converters were added to an iron rail mill, and the first blow was on September 1, 1876. There do not appear to be any remaining structures.

Properties comparable to the Cambria Steel Company after the turn of the century, with the expansion into Gautier, Franklin, the Wheel Plant, and the Rod and Wire Plant; and with the entire complex after it was absorbed by the Midvale Steel and Ordnance Company and the Bethlehem Steel Company, need to be considered. Such a study is beyond the scope of this nomination, but the companies are listed here for further consideration. In the early 1950s, at the height of the American steel industry's strength, the 12 largest companies were: United States Steel Corporation, Bethlehem Steel Corporation, Republic Steel Corporation, Jones and Laughlin Steel Corporation, National Steel Corporation, Youngstown Sheet and Tube Company, Inland Steel Company, Armco Steel Corporation, Wheeling Steel Corporation, Crucible Steel Company of America, Pittsburgh Steel Company, and Sharon Steel Corporation. Each of these companies operated more than one plant.

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10. Geographical Data

Acreage
Lower Works approximately 165 acres
Gautier Plant approximately 41 acres
Franklin Plant approximately 211 acres
Rod and Wire Plant approximately 26 acres
Wheel Plant approximately 39 acres

UTM References

Lower Works
A Zone 17 Easting 676 370 Northing 4467 540
B Zone 17 Easting 676 710 Northing 4467 440
C Zone 17 Easting 676 990 Northing 4466 710
D Zone 17 Easting 676 560 Northing 4466 260
E Zone 17 Easting 676 260 Northing 4466 500
F Zone 17 Easting 676 300 Northing 4466 880
G Zone 17 Easting 676 180 Northing 4466 980
H Zone 17 Easting 676 280 Northing 4466 960
I Zone 17 Easting 676 240 Northing 4467 420

Gautier Plant
A Zone 17 Easting 676 820 Northing 4466 000
B Zone 17 Easting 677 780 Northing 4466 300
C Zone 17 Easting 677 580 Northing 4466 060
D Zone 17 Easting 677 100 Northing 4465 840

Franklin Plant
A Zone 17 Easting 678 620 Northing 4466 700
B Zone 17 Easting 679 000 Northing 4467 420
C Zone 17 Easting 679 520 Northing 4467 790
D Zone 17 Easting 679 830 Northing 4466 780

Rod and Wire Plant
A Zone 17 Easting 674 920 Northing 4469 060
B Zone 17 Easting 674 930 Northing 4468 350
C Zone 17 Easting 674 685 Northing 4468 420

Wheel Plant
A Zone 17 Easting 680 140 Northing 4468 300
B Zone 17 Easting 680 020 Northing 4468 460
C Zone 17 Easting 680 100 Northing 4468 860
D Zone 17 Easting 680 360 Northing 4468 880
E Zone 17 Easting 680 240 Northing 4468 380

Verbal Boundary Description

Lower Works

Starting at the downstream headwall of a concrete headwall with a 1947 keystone, the boundary follows Hinckston Run to the southwest, intersecting with the Conemaugh & Black Lick Railroad line and the Conemaugh River. The boundary proceeds south along the river and tracks, taking in the pedestrian bridge, turning southeast at a railroad switch, turning northeast past another railroad switch, to the summit of Prospect Hill. It then proceeds north to the summit of another hill to the north, before returning northwest to the point of origin.

Gautier Plant

The nominated boundary begins at the western end of the plant at the railroad switch of the Conemaugh & Black Lick Railroad. It follows the railroad line and the Little Conemaugh River to the eastern end of the plant at the eastern end of the roll shop. It then proceeds southwest along Clinton Street, to the corner of Clinton and Washington Street. The boundary then proceeds northwest along Washington and the Conemaugh & Black Lick Railroad line to the point of origin.

Franklin Plant

The nominated boundary begins at the southwestern corner of the plant near the power transformers and the Conemaugh River, at the Franklin Borough Line, and follows the Conemaugh River northeast to Locust Street. It follows Locust Street south to Main Street, then west to Bridge Street. It follows Bridge Street southeast, turning west along the Franklin Borough Line, taking in the face of the hill formerly containing the coke operation. At the western end of the plant the boundary cuts northwest, taking in the power transformers, to the point of origin.

Rod and Wire Plant

The nominated boundary begins at the northern end of the plant, moving south along the Conemaugh River and Conemaugh & Black Lick Railroad to the Coopersdale Bridge. Moving southwest, it follows Laurel Avenue to the Pennsylvania Railroad right-of-way, then follows the right-of-way north to the point of origin.

Wheel Plant

The nominated boundary starts at the southwest corner of the wheel finishing shop and shipping building, following the Conemaugh & Black Lick Railroad and the Little Conemaugh River north, around the north end of the site, to the northern end of Pershing Avenue where it meets the tracks. It then proceeds south along Pershing, detouring to include the warehouse building, before following gravel entrance roads around and including the wheel plant office, to the point of origin.

Boundary Justification

Lower Works

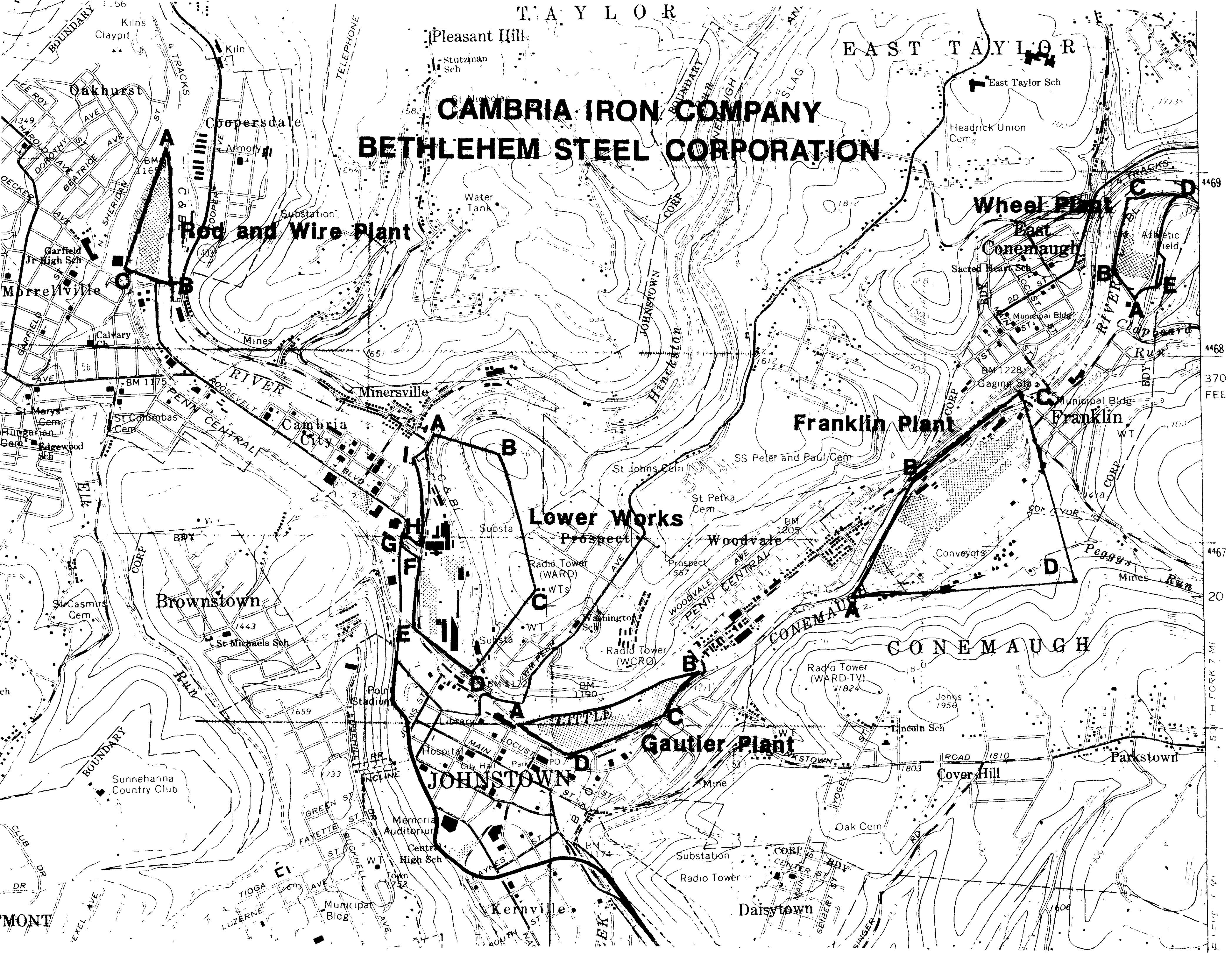
The Lower Works of the Cambria Iron Company are included in the boundary because of its association with advancements in iron and steelmaking technology, and because it was the site where iron and steel rails were manufactured in the mid-nineteenth century to early twentieth century, and where axles were produced until recently. Prospect Hill facing the Lower Works was included because of the historic relationship between the iron ore and coal mining operations conducted there by the Cambria Iron Company and the production of iron and steel. The employee entrance gate and pedestrian bridge were included because of the historic relationship between the works and the neighboring communities, home to employees of the Cambria Iron Company.

The Gautier Plant is included within the boundary because of its associations with historic and present-day steel product manufacturing. The buildings are a physical manifestation of the Cambria Steel Company's decision to reenter these trades immediately after the 1889 Johnstown Flood. Included are the intact buildings, built together to be a single unit, and supporting services buildings and structures.

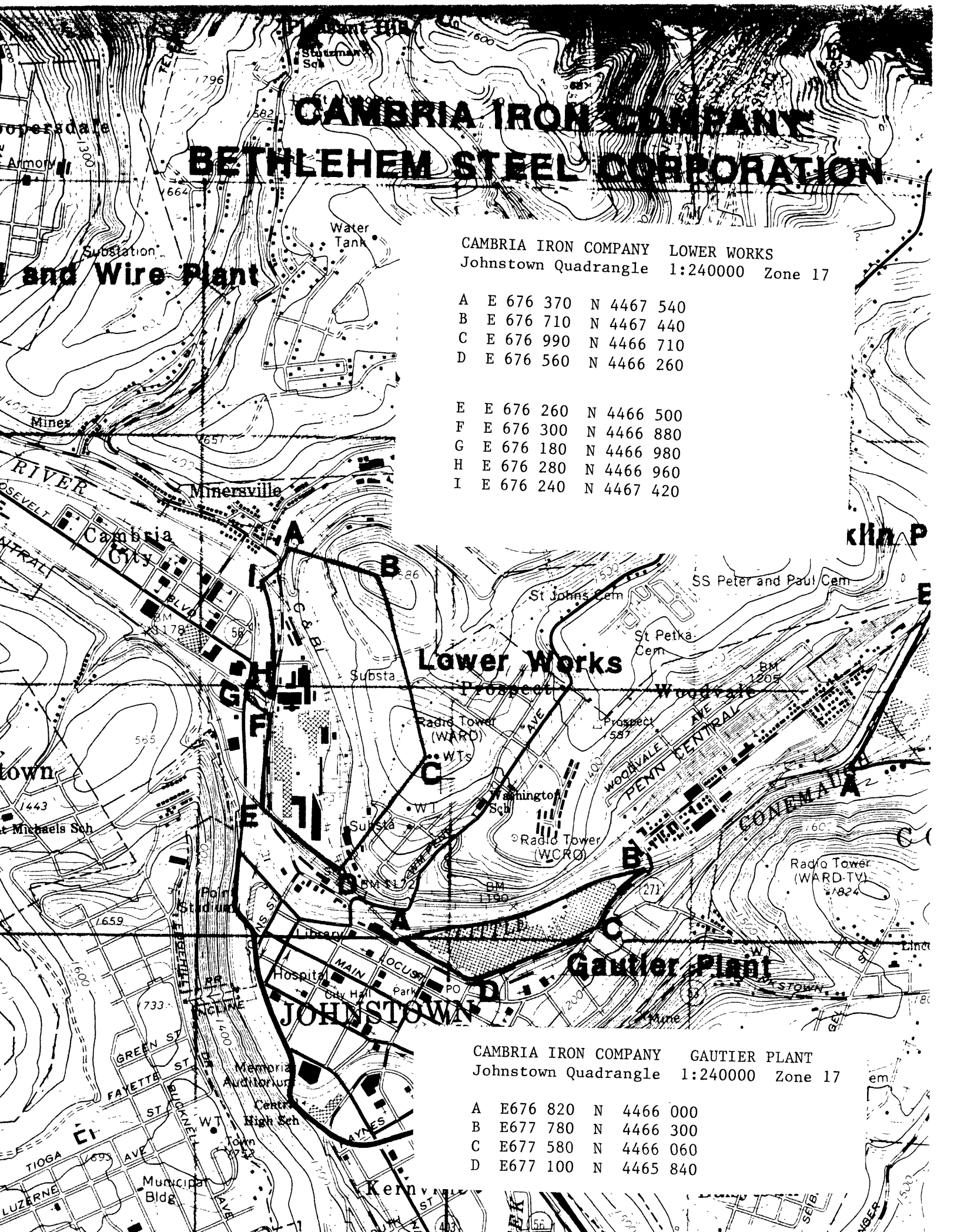
The Franklin Plant is included within the boundary because of its associations with historic and present-day steel car manufacturing, and steelmaking. This plant was built as a result of the Cambria Steel Company's decision to expand their operation in Johnstown, rather than move the entire complex. The site of the former coke and by-product operation and the blast furnace operation are included for their potential archeological value.

The Rod and Wire Plant is included within the boundary due to its historic and present-day associations with wire drawing. The boundary includes the entire complex, including intact buildings, and support services buildings and structures.

The Wheel Plant is included within the boundary because of its historic association with the manufacture of wheels and circular products. The entire complex is included, with intact buildings, and support services buildings and structures.


CAMBRIA IRON COMPANY
BETHLEHEM STEEL CORPORATION
Rod and Wire Plant
Wheel Plant
Franklin Plant
Lower Works
Gautler Plant
TAYLOR
EAST TAYLOR
CONEMAUGH
JOHNSTOWN
Pleasant Hill
Oakhurst
Coopersdale
Morrellville
Minersville
Cambria City
East Conemaugh
Franklin
Woodvale
Prospect
Brownstown
Kernville
Daisytown
Cover Hill
Parkstown
Sunnehanna Country Club

CAMBRIA IRON COMPANY
BETHLEHEM STEEL CORPORATION

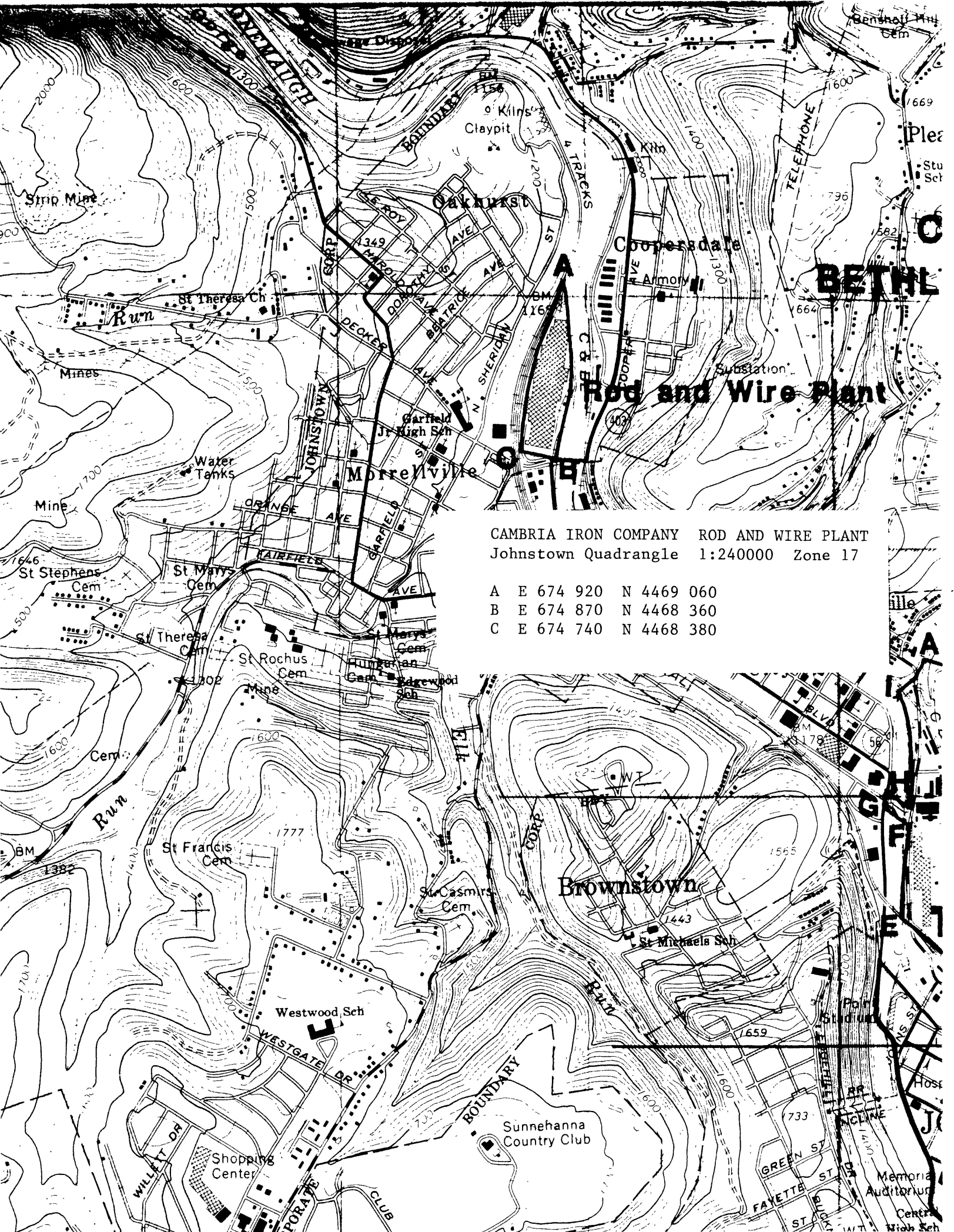


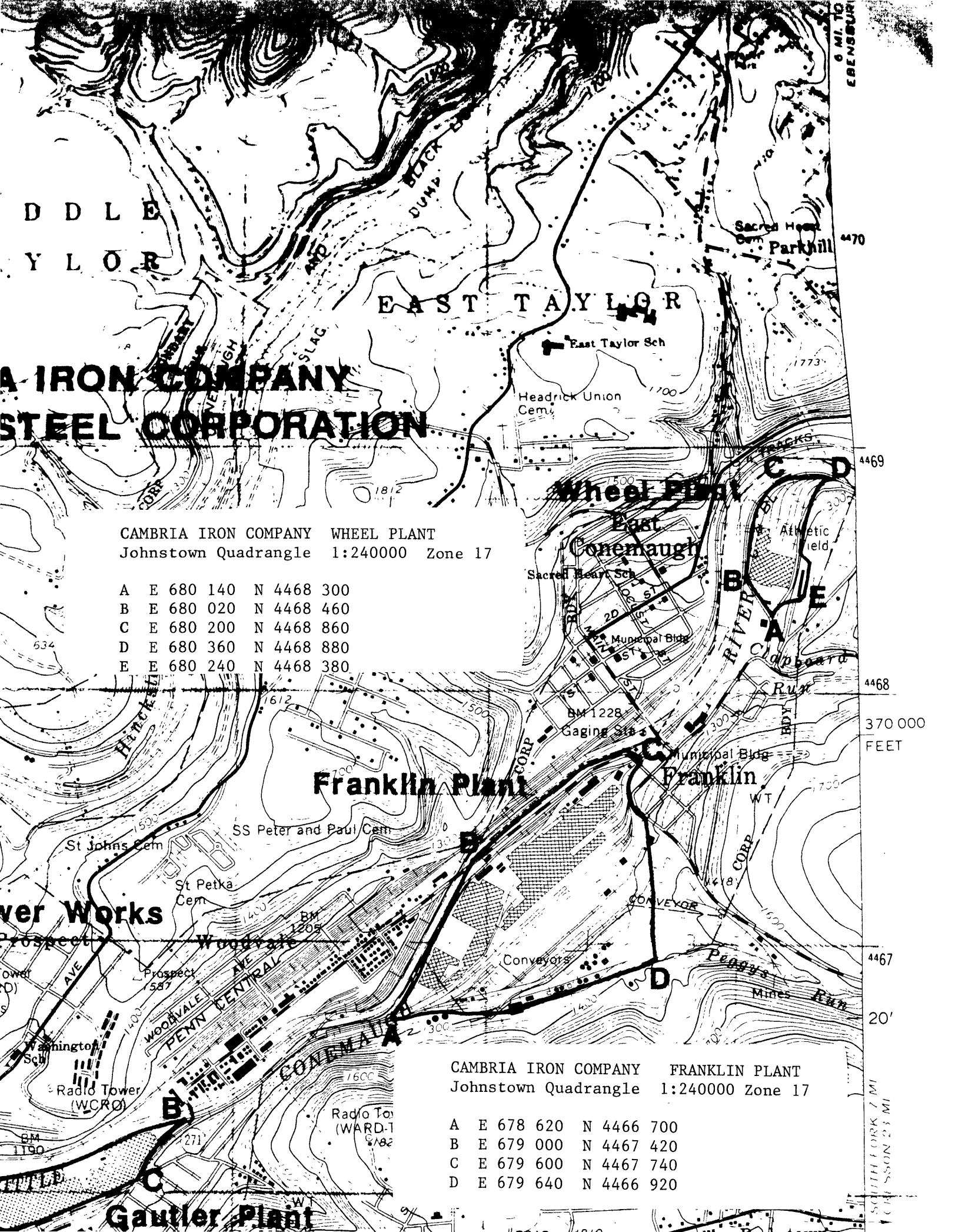
CAMBRIA IRON COMPANY LOWER WORKS
Johnstown Quadrangle 1:240000 Zone 17

A	E 676 370	N 4467 540
B	E 676 710	N 4467 440
C	E 676 990	N 4466 710
D	E 676 560	N 4466 260
E	E 676 260	N 4466 500
F	E 676 300	N 4466 880
G	E 676 180	N 4466 980
H	E 676 280	N 4466 960
I	E 676 240	N 4467 420

CAMBRIA IRON COMPANY GAUTIER PLANT
Johnstown Quadrangle 1:240000 Zone 17

A	E676 820	N 4466 000
B	E677 780	N 4466 300
C	E677 580	N 4466 060
D	E677 100	N 4465 840


Oakhurst
Claypit
Coopersdale
Armory
Rod and Wire Plant
Substation
Morrellville
Garfield Jr High Sch
Water Tanks
Mine
Strip Mine
Mines
St Theresa Ch
St Stephens Cem
St Marys Cem
St Theresa Cem
St Rochus Cem
Hungarian Cem
Edgewood Sch
St Francis Cem
St Casmirs Cem
Brownstown
St Michaels Sch
Westwood Sch
Sunnehanna Country Club
Shopping Center
Memorial Auditorium
Run
BOUNDARY
TELEPHONE
4 TRACKS
C & B
JOHNSTOWN
CORP
DECKER
ORANGE AVE
FAIRFIELD
GARFIELD AVE
WESTGATE DR
WILLETT DR
CLUB
FAYETTE
GREEN ST
BETTELEY
BLVD
N. SHERIDAN
DOROTHY AVE
BEATRICE AVE
LE ROY AVE
MARION
CAMBRIA IRON COMPANY ROD AND WIRE PLANT
Johnstown Quadrangle 1:240000 Zone 17
A E 674 920 N 4469 060
B E 674 870 N 4468 360
C E 674 740 N 4468 380

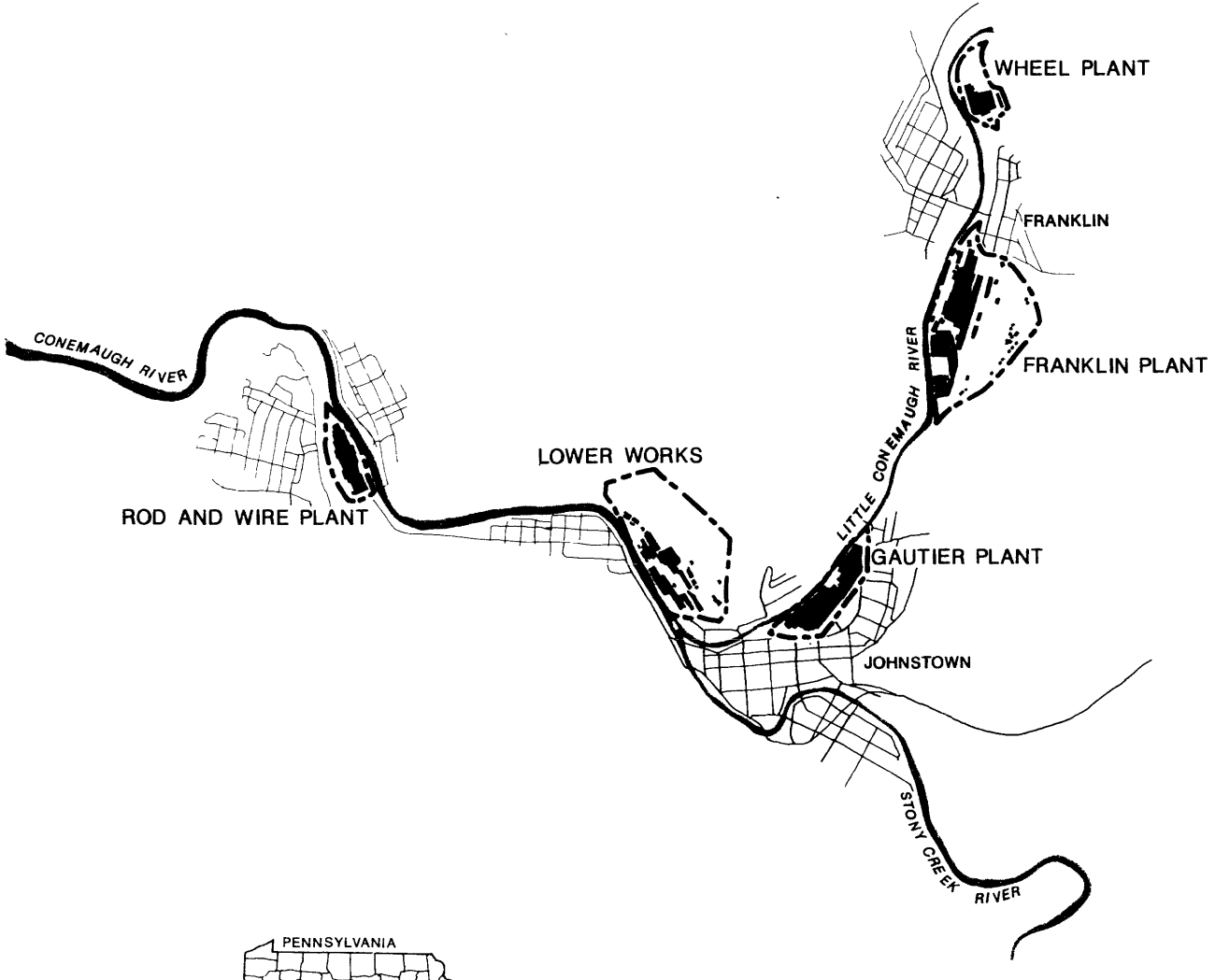


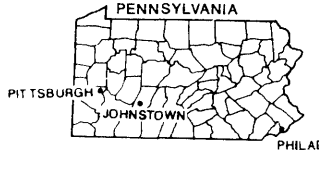
CAMBRIA IRON COMPANY WHEEL PLANT
Johnstown Quadrangle 1:240000 Zone 17

A	E	680 140	N	4468 300
B	E	680 020	N	4468 460
C	E	680 200	N	4468 860
D	E	680 360	N	4468 880
E	E	680 240	N	4468 380

CAMBRIA IRON COMPANY FRANKLIN PLANT
Johnstown Quadrangle 1:240000 Zone 17

A	E	678 620	N	4466 700
B	E	679 000	N	4467 420
C	E	679 600	N	4467 740
D	E	679 640	N	4466 920



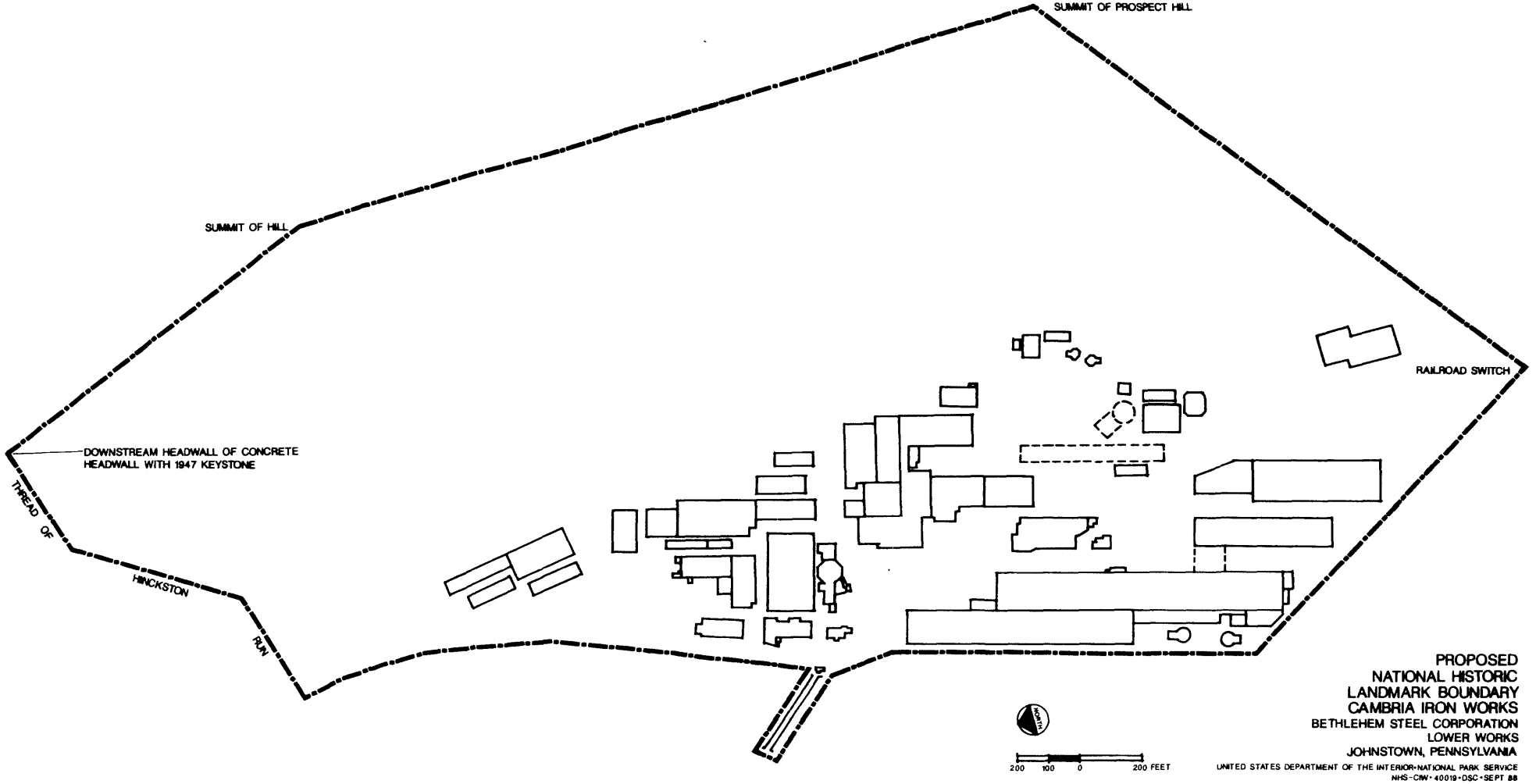


PROPOSED NATIONAL HISTORIC LANDMARK

NORTH

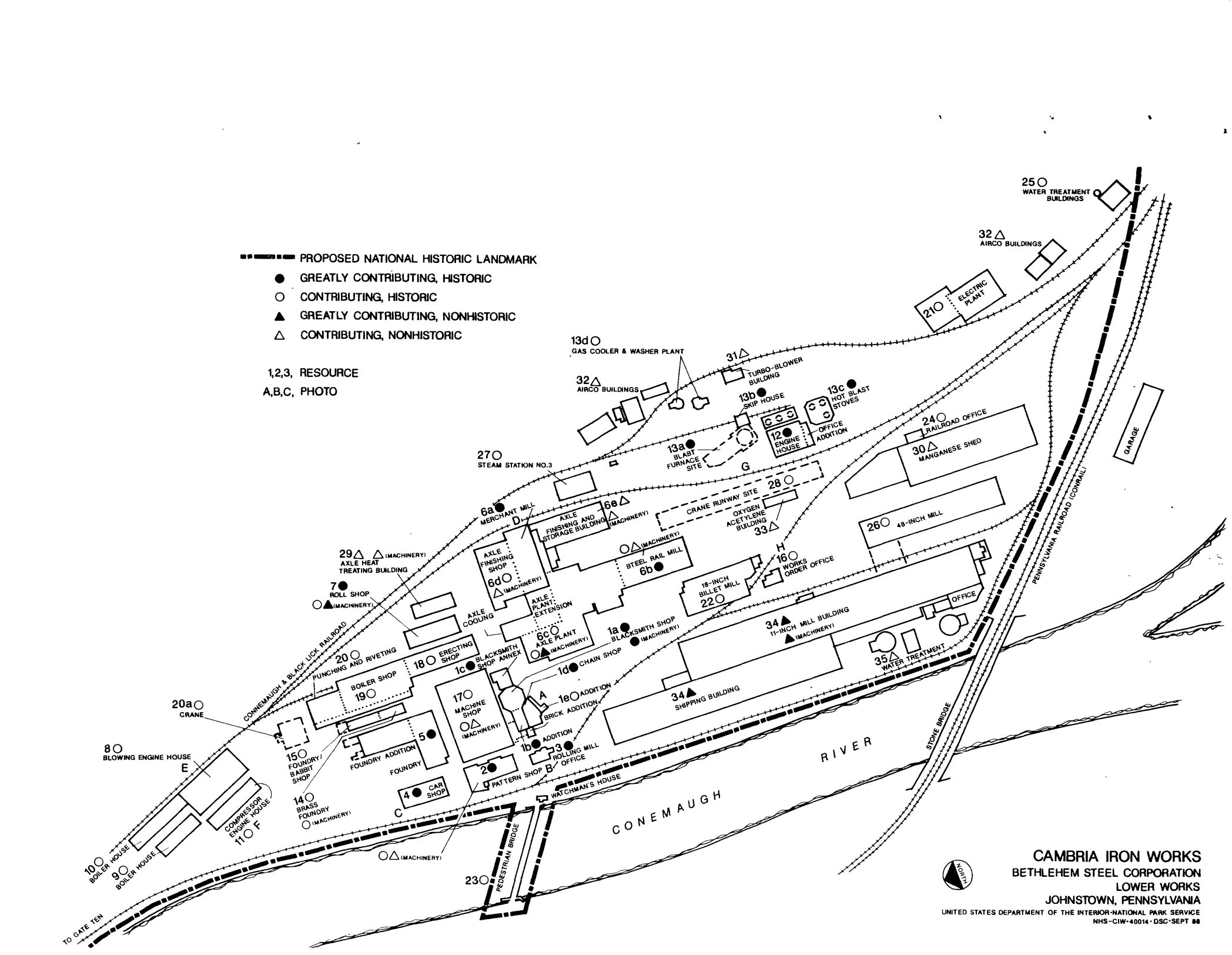
VICINITY
CAMBRIA IRON WORKS
BETHLEHEM STEEL CORPORATION

UNITED STATES DEPARTMENT OF THE INTERIOR·NATIONAL PARK SERVICE
NHS-CIW·40020·DSC·SEPT 88



PROPOSED
NATIONAL HISTORIC
LANDMARK BOUNDARY
CAMBRIA IRON WORKS
BETHLEHEM STEEL CORPORATION
LOWER WORKS
JOHNSTOWN, PENNSYLVANIA

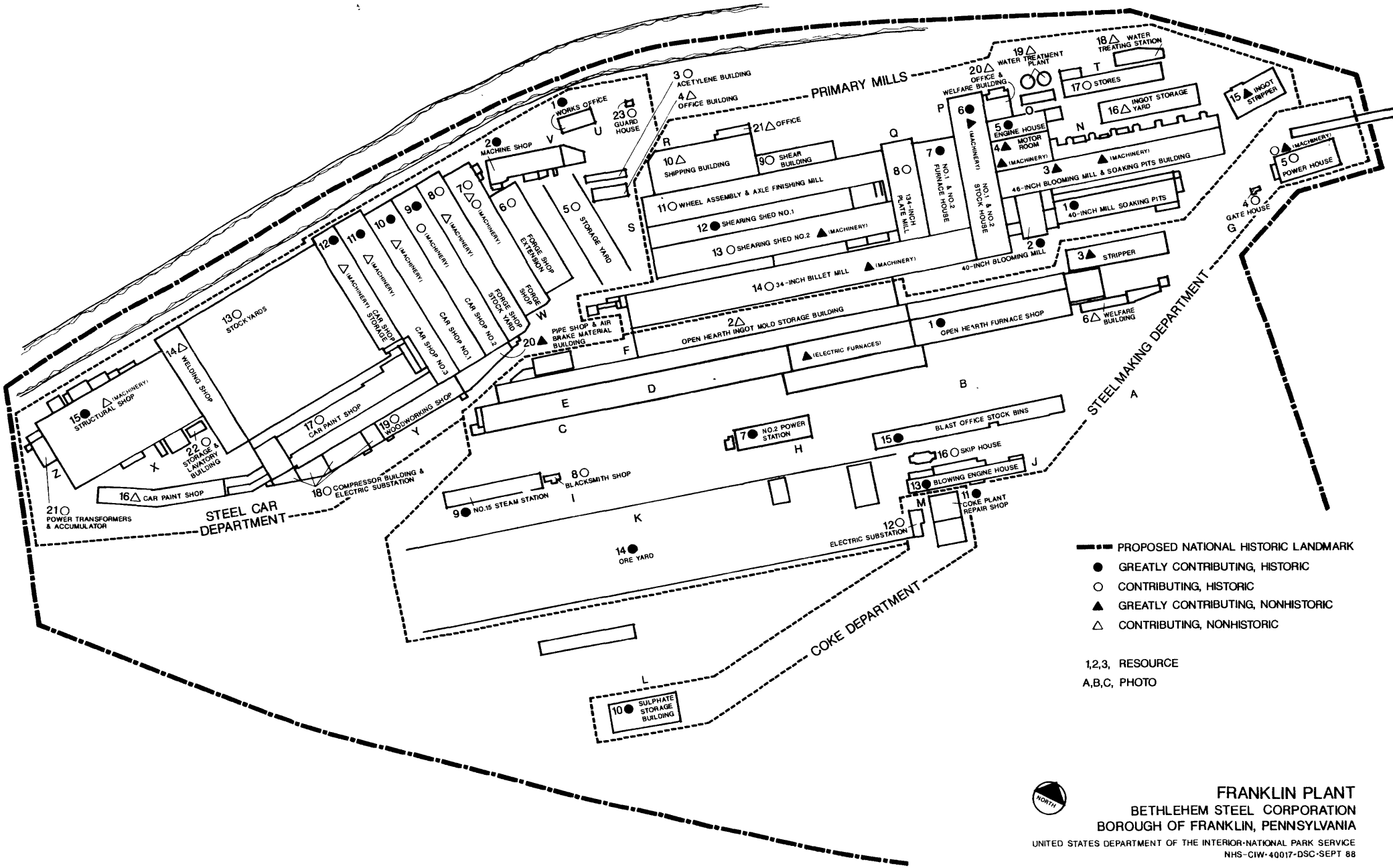
UNITED STATES DEPARTMENT OF THE INTERIOR•NATIONAL PARK SERVICE
NHS-CIW•40019•DSC•SEPT 88



CAMBRIA IRON WORKS

BETHLEHEM STEEL CORPORATION
LOWER WORKS
JOHNSTOWN, PENNSYLVANIA

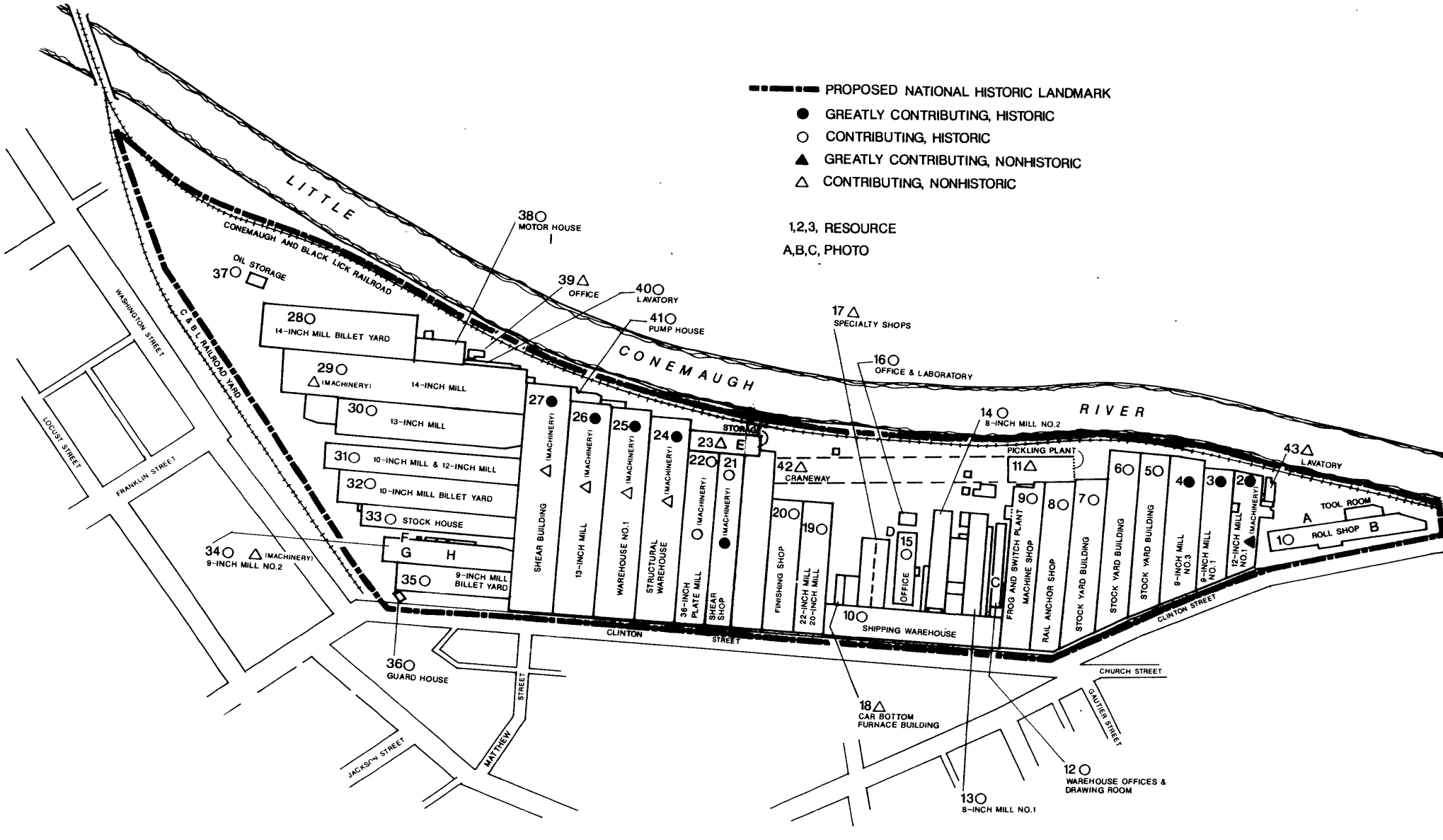
UNITED STATES DEPARTMENT OF THE INTERIOR·NATIONAL PARK SERVICE
NHS-CIW-40014·DSC·SEPT 88



FRANKLIN PLANT

BETHLEHEM STEEL CORPORATION
BOROUGH OF FRANKLIN, PENNSYLVANIA

UNITED STATES DEPARTMENT OF THE INTERIOR·NATIONAL PARK SERVICE
NHS-CIW-40017-DSC-SEPT 88

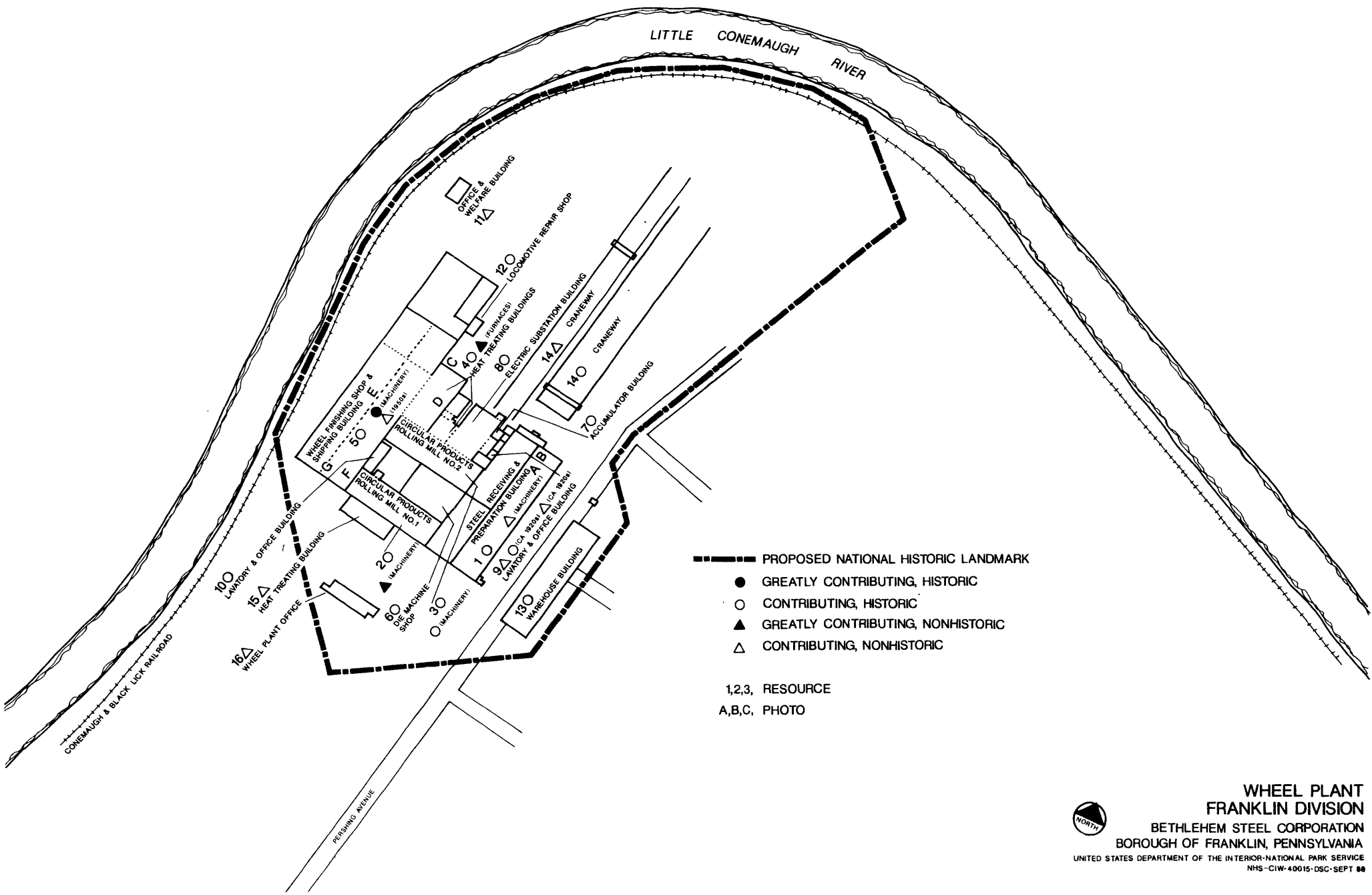


NORTH

GAUTIER PLANT

BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PENNSYLVANIA

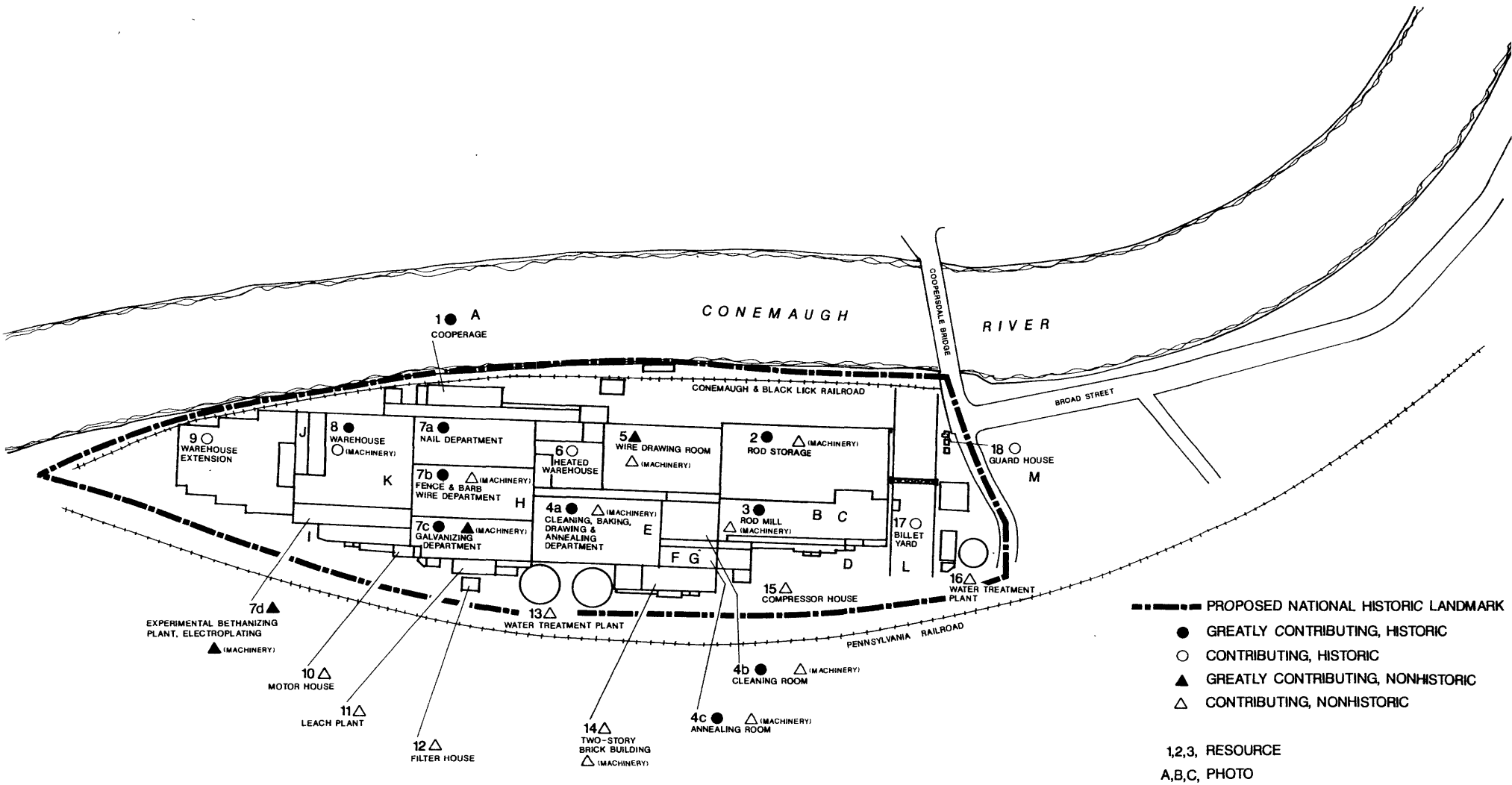
UNITED STATES DEPARTMENT OF THE INTERIOR-NATIONAL PARK SERVICE
NHS-CIW-40016-DSC-SEPT 86



WHEEL PLANT
FRANKLIN DIVISION

BETHLEHEM STEEL CORPORATION
BOROUGH OF FRANKLIN, PENNSYLVANIA

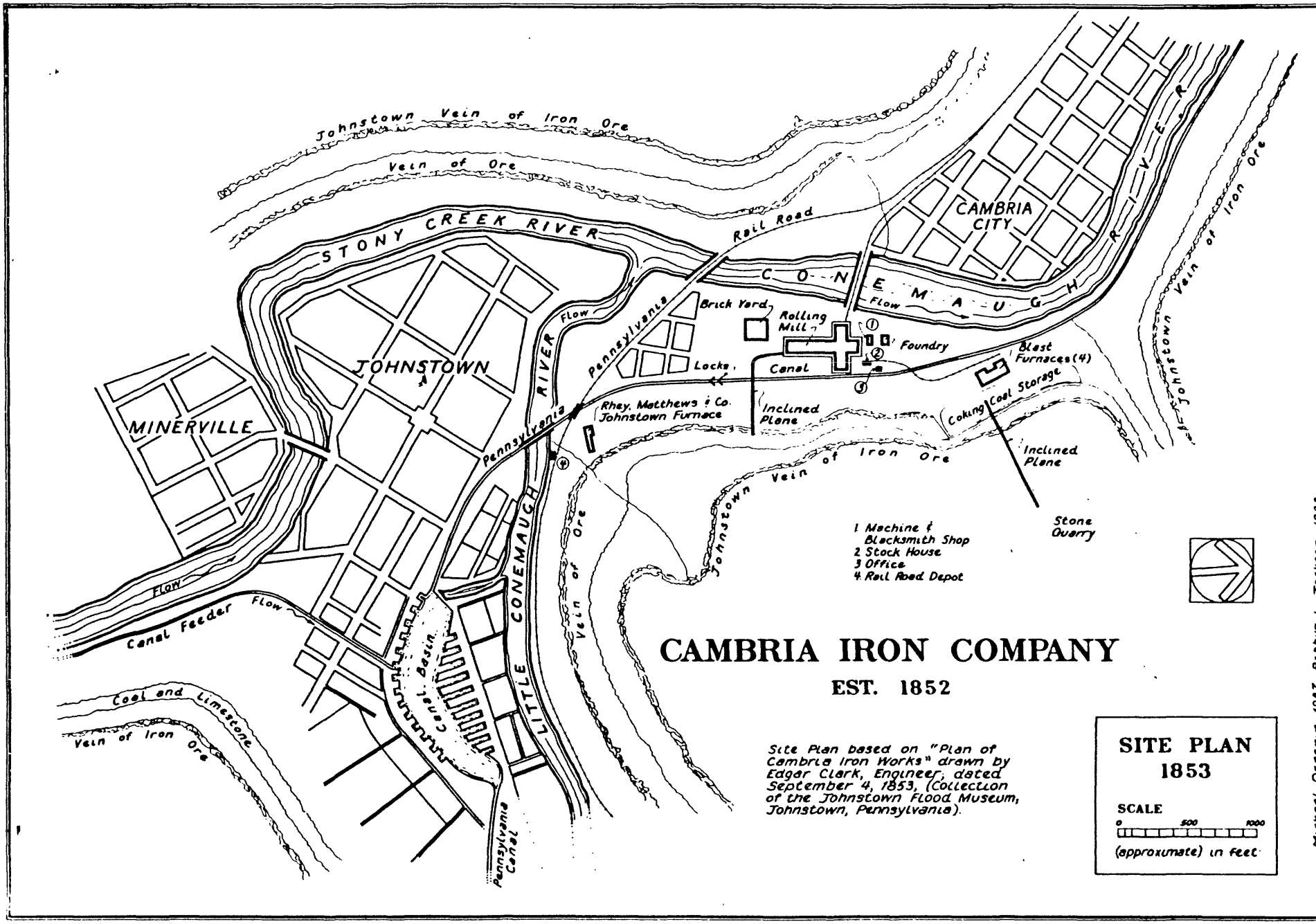
UNITED STATES DEPARTMENT OF THE INTERIOR-NATIONAL PARK SERVICE
NHS-CIW-40015-DSC-SEPT 88



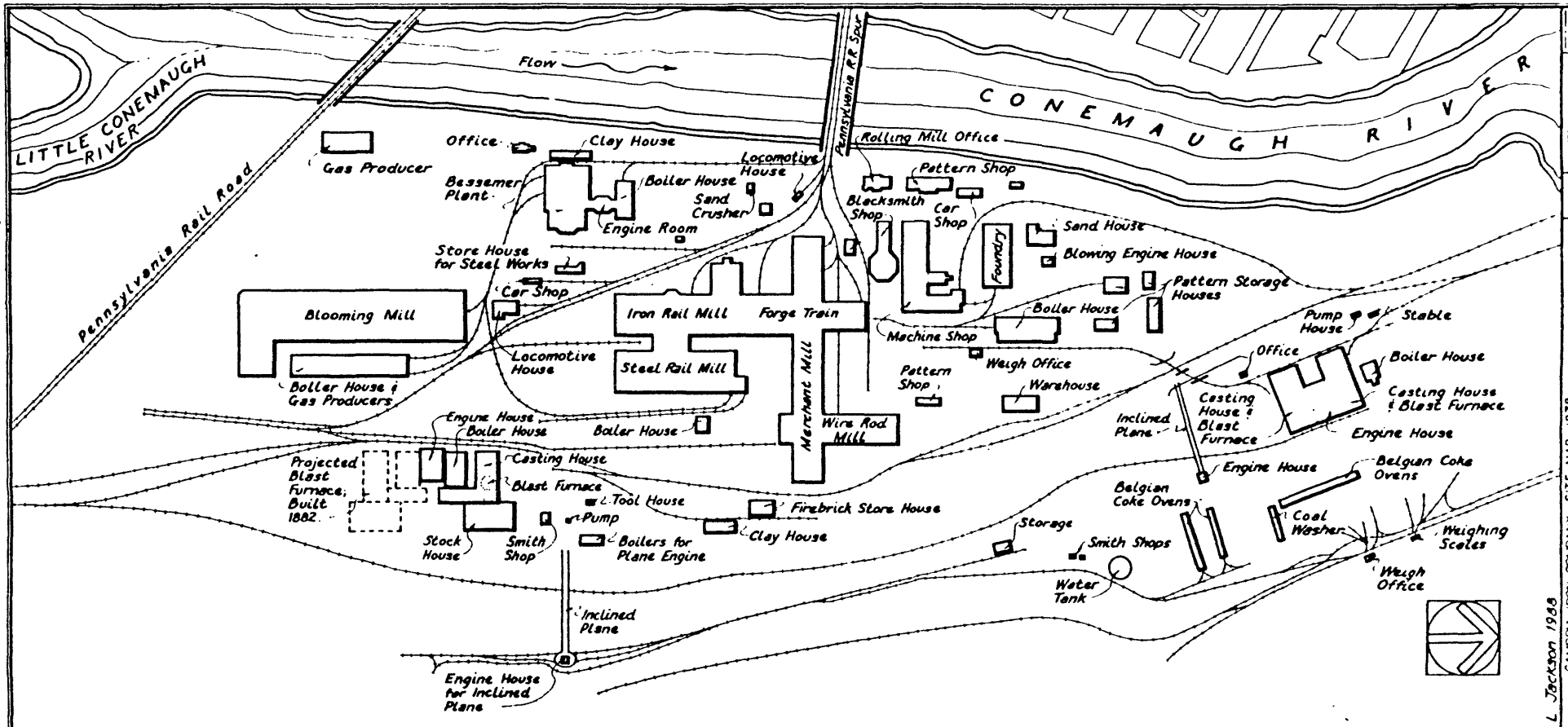
ROD AND WIRE PLANT

BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PENNSYLVANIA

UNITED STATES DEPARTMENT OF THE INTERIOR•NATIONAL PARK SERVICE
NHS-CIW•40018•DSC•SEPT 88



HISTORIC AMERICAN ENGINEERING RECORD
PA-109
SHEET 2 - 2
PENNSYLVANIA
CAMBRIA IRON COMPANY, SITE MAP - 1853
EAST BANK OF CONEMAUGH RIVER, 1 MILE NORTH OF STONYCREEK CONFLUENCE
CAMBRIA COUNTY
SOUTHWESTERN PENNSYLVANIA HERITAGE PRESERVATION PROJECT
JOHNSTOWN
MICHAEL ORSINO, 1987, ROBBYN L. JACKSON, 1988



CAMBRIA IRON COMPANY

1852 - 1898

OWNERS OF IRON WORKS

Cambria Iron Company
1852 - 1898

Cambria Steel Company
1898 - 1916

Midvale Steel & Ordnance Company: Cambria Plant
1916 - 1923

Bethlehem Steel Company: Cambria Plant
1923 - Present

SITE PLAN 1878

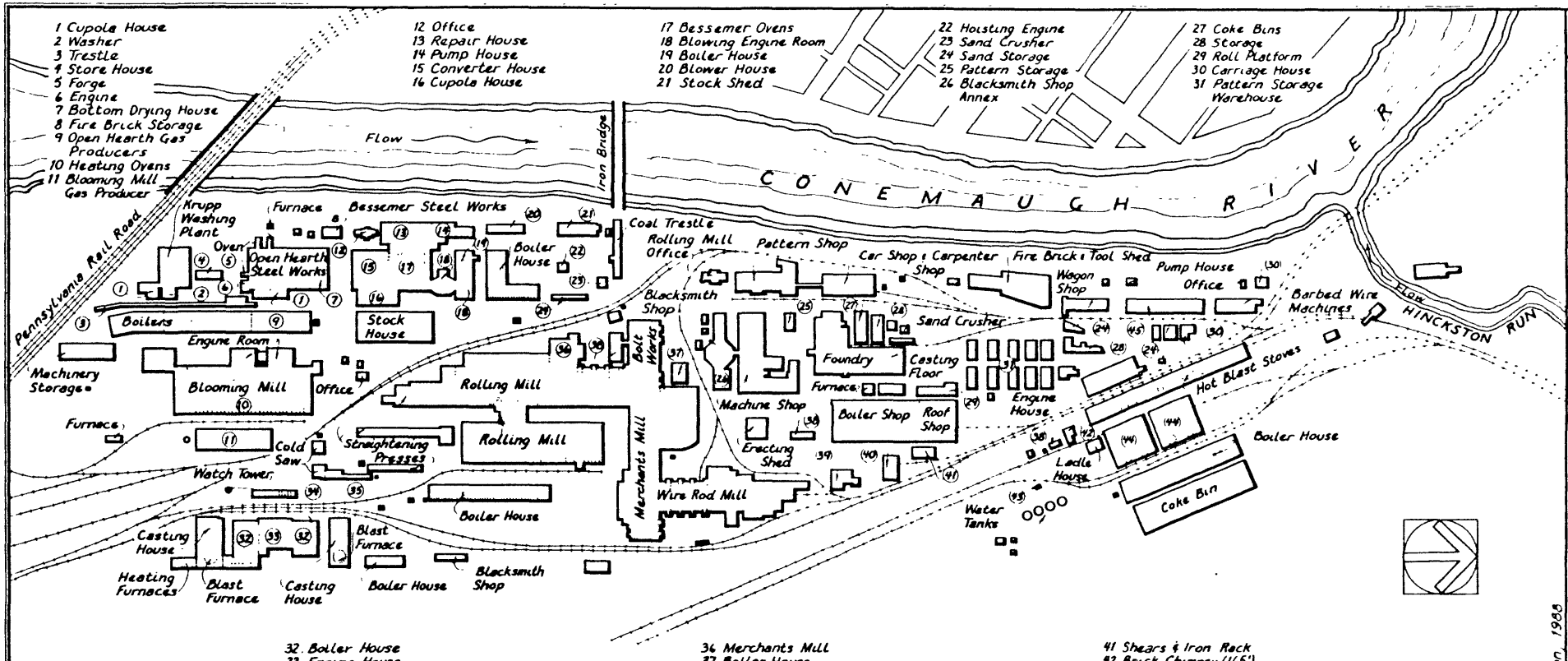
SCALE (approximate) in feet:

0 100 200 300 400

Based on a map by A. L. Holley and Lenox Smith, "American Iron and Steel Works: Works of the Cambria Iron Company," in Engineering: An Illustrated Weekly Journal, Vol. 26, (London: 12 July, 1878) pp 21-22.

EAST HALF OF CAMBRIA IRON COMPANY SITE MAP, 1878.

Michael Drasnin, 1987 Robbyn L Jackson 1988



OWNERS OF IRON WORKS

Cambria Iron Company
1852 - 1898

Cambria Steel Company
1898 - 1916

Midvale Steel & Ordnance Company: Cambria Plant
1916 - 1923

Bethlehem Steel Company: Cambria Plant
1923 - Present

CAMBRIA IRON COMPANY

1852 - 1898

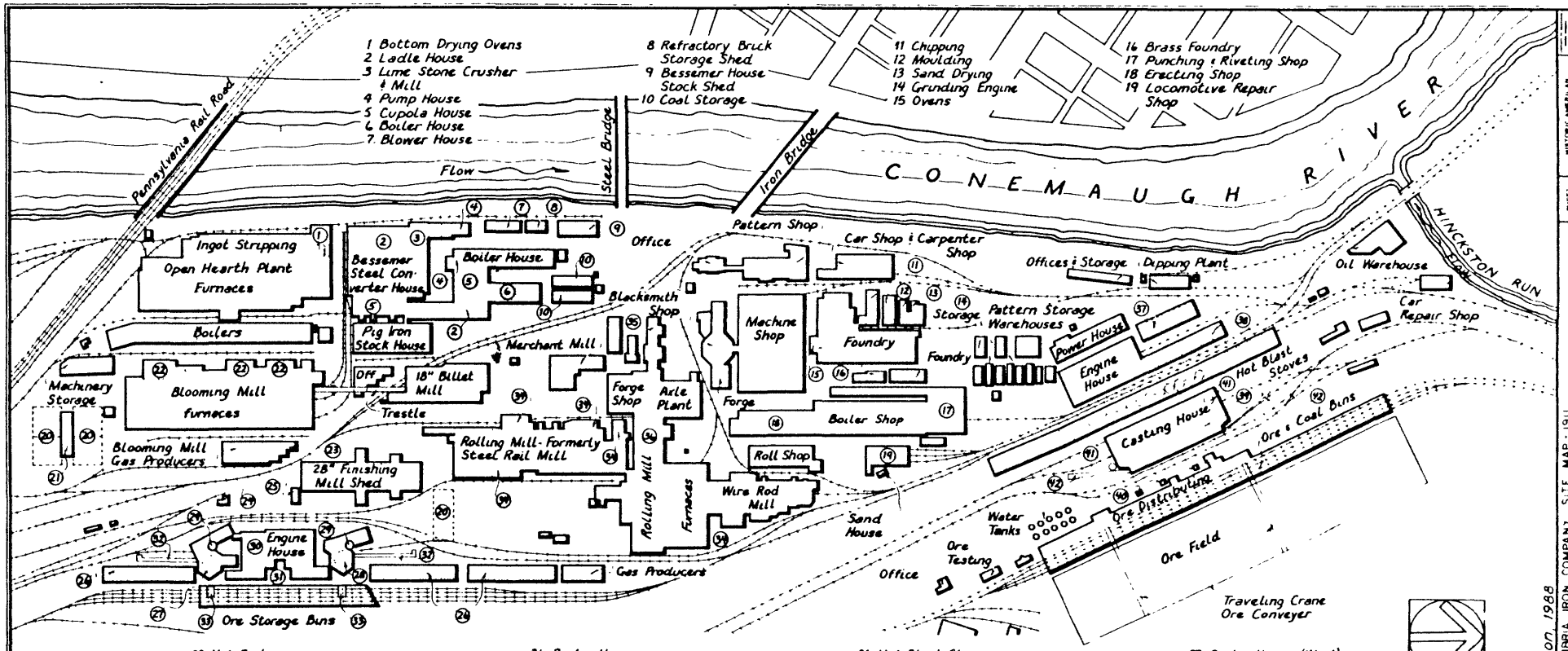
SITE PLAN 1891

SCALE (approximate) in feet
0 100 200 300 400

Based on map by Sanborn-Perris Map Company, Ltd; "Johnstown, Pennsylvania, New York, 1891.

CAMBRIA IRON COMPANY SITE MAP - 1891
EAST BANK OF CONEMAUGH RIVER, 2 MILES NORTH OF STONYCREEK CONFLUENCE
CAMBRIA COUNTY
PENNSYLVANIA
JOHNSTOWN

DELINEATED: Michael Drasnin, 1987 Robbyn L Jackson, 1988



CAMBRIA STEEL COMPANY

1898 - 1916

OWNERS OF IRON WORKS

Cambria Iron Company
1852 - 1898

Cambria Steel Company
1898 - 1916

Midvale Steel & Ordnance Company: Cambria Plant
1916 - 1923

Bethlehem Steel Company: Cambria Plant
1923 - Present

SITE PLAN 1911

SCALE (approximate) in feet
0 100 200 300 400

Based on map by Sanborn Map Company, "Johnstown & Environs, Pennsylvania," New York, 1911

CAMBRIA IRON COMPANY SITE MAP - 1911
EAST BANK OF CONEMAUGH RIVER 5 MILES NORTH OF STONY CREEK CONFLUENCE
CAMBRIA COUNTY
JOHNSTOWN
PENNSYLVANIA
HISTORIC AMERICAN ENGINEERING RECORD PA-109
SHEET 6 - 2

Michael Drassin, 1987, Roddyn L. Jackson, 1988