NEW HAMPSHIRE HISTORIC PROPERTY DOCUMENTATION
CLAREMONT GAS WORKS COMPLEX
LOWER CUL DE SAC PLACE, CLAREMONT, NH

NH State No. 724

LOCATION:	Lower Cul de Sac Place Claremont, Sullivan County, NH USGS Springfield NH Quadrangle 805947.29 319487.38 feet (State Plane) UTM Zone 18 North 715716E, 480586N
BUILDER/ENGINEER	Unknown
FABRICATOR:	Unknown
DATE:	1859 Retort House and c. 1918 addition, 1859 Gasholder House, 1905 Gas Generator House, 1910-1930 Tar Separator Pits
PRESENT OWNER:	City of Claremont, NH and SG Propane of NH
PRESENT USE:	Vacant
SIGNIFICANCE:	The Claremont Gas Works, a contributing resource within the National Register-listed Monadnock Mills Historic District, is a small, rare, surviving pre-Civil War manufactured gas utility site. Although in poor, semi-ruinous condition and missing some later-phase, twentieth-century components, it remarkably still retains its two key original coal gas production and storage features: the 1859 Retort House and 1859 Gasholder House. It also includes the standing1905 Gas Generator House, associated with subsequent carbureted water gas production. Despite demolition of later, larger gas holders and minor outbuildings, these surviving buildings and structure reflect common, basic technological patterns in nineteenth- and twentieth-century manufactured gas technology. The Gasholder House is an unusual surviving example of this early industrial building type, particularly unusual for its surviving gas storage bell, and possibly internationally unique for its surviving center-column gas bell guide system.
PROJECT INFORMATION:	The complex is being demolished due both to its poor condition and the need to remediate the contamination on site. This recordation was undertaken in accordance with agreements between the New Hampshire Division of Historical Resources (NHDHR) and the U.S. Environmental Protection Agency. The report was completed by Nicole Benjamin-Ma and Rita Walsh of Vanasse Hangen Brustlin, Inc. (VHB) and Matt Kierstead of Milestone Heritage Consulting in 2015. The large format photographs were taken by Matt Kierstead. The measured drawings were produced by Existing Conditions Survey, Inc.

DESCRIPTION

Setting

The Claremont Gas Works property (Gas Works) is a 1.03-acre parcel in the city of Claremont, in Sullivan County in west-central New Hampshire, near the Connecticut River and Vermont state border. The parcel is on Rock Island in the Sugar River, on the north side of the city. Rock Island now appears to be part of the north river bank, as the former narrow mill raceway that originally separated the island from the north bank is overgrown with vegetation and has been filled in. Access to the site is via the north side of the river, where Lower Cul de Sac Place extends west from North Street (SR 120), culminating at a small cul-de-sac at the Gas Works property.

Although manufacturing buildings historically lined both sides of the Sugar River in Claremont, the north side surrounding the Gas Works complex was not as densely developed as the Monadnock Mill complex on the south side, and many of the industrial buildings on the north bank of the river have been removed. A former manufacturing building (Sunapee Mill 1843-1844) stands at the intersection of Lower Cul de Sac Place and North Street east of the Gas Works site. Northwest of the Gas Works, a recently-constructed visitors' center and park are located on a former mill site (Sullivan Machinery Company, ca. 1910), on a hill overlooking the Gas Works site, the river, and the city commercial core. The Gas Works overlooks one of three mill dams, Dam No. 3 (1927), which provided water power for the manufacturing industry of central Claremont west of the site. Dam No. 1 (1912) is located approximately 500 feet east of the Claremont Gas Works, past the intersection of Lower Cul de Sac Place and North Street. The site of Dam No. 2 is located southeast of the Claremont Gas Works; the dam was removed in 1927 but a rocky cataract still marks the site. The Gas Works, the former Sunapee Mill, and the two extant dams are part of the Monadnock Mills Historic District (NR # 7900027, listed 1979). Dam and mill numbers used in this report match those used in the National Register nomination for the Monadnock Mills Historic District and shown on Sanborn maps.

The portions of Claremont on both sides of the river are connected by a series of vehicular and pedestrian bridges, three of them in the immediate vicinity of the Gas Works. East of the intersection of Lower Cul de Sac Place and North Street, the latter forms another intersection with Washington Street (SR 11/ SR 103), which extends south across the Sugar River on a five-lane highway bridge. The Moseley Wrought Iron Arch Bridge (1870, part of the Monadnock Mills Historic District), connects the Gas Works to the Monadnock Mills Mill No. 6 on the south side of the river. This bridge was a pedestrian crossing for mill workers, and also supported pipes carrying illuminating gas for the mill buildings. Although the bridge deck is no longer extant, gas pipes still cross the bridge. This bridge, named for its designer and builder, Thomas William Moseley, is one of three of its type in the United States. It is the only one on its original site and was designated a Historic Civil Engineering Landmark in 1998. A recently-constructed steel truss pedestrian bridge is located west of Dam No. 3, connecting the visitor's center and park along North Street to the extant Monadnock Mills buildings on the south side of the river.

Gas Works Complex

The Gas Works complex currently includes two buildings and one structure: the remains of a Retort House (1859 with c.1918 addition), a Gasholder House (1859), and a Gas Generator House (1905). These are the only remaining standing aboveground resources in a complex that originally contained other buildings and structures including two large gasholders; the site includes at-grade and subsurface remains of these and other structures. This description focuses on the remaining aboveground resources.

It is important to note that as the Gas Works complex evolved, building functions changed and names shifted. The names of the current standing buildings are capitalized without quotation marks to reflect their original primary functions as shown on the earliest applicable Sanborn maps. Other functional names associated with those buildings are indicated in lower case letters. It is also important to understand that the small size of the buildings, possible restricted Sanborn survey access, and typical oversight or omission of minor elements from map to map resulted in discrepancies and the maps may not show actual conditions at the time they were made.

The Gas Works site slopes slightly downward from the rocky river bank to the foot of the steep hill to the north and is surrounded by a chain link fence. The buildings are tightly clustered toward the west end of the site on the steep eroded bank above the river, with a paved area on their east side. The perimeter and east portion of the lot are obscured by dense scrub vegetation. The east portion of the lot contains concrete footings that supported two early twentieth-century gasholders (no longer extant).

Lower Cul de Sac Place descends west along the south side of the complex. A driveway protected by a locked chain link fence gate leads north to the extant buildings The street continues past the driveway and ends in the cul-de-sac just south of the Gas Works buildings. The river bank south and southwest of the cul-de-sac incorporates a dry-laid stone retaining wall as well as concrete walls and foundation structures associated with former hydroelectric and steam power plants (no longer extant). The bank west of the Gas Works consists of eroded industrial fill, which extends northwest along the north bank into a low, filled swale, originally a watered bay at the end of the now-filled mill raceway that extended along the north edge of the site.

Gas Generator House (c. 1905)

The Gas Generator House is the newest and the largest remaining building in the complex. It is a rectangular, two-story brick building with a long north-south axis. It has a concrete foundation and a side gable, slate shingled roof. A shallow parapet extends above the roofline at each gable end. A metal gabled roof monitor projects above the north end of the main roof, and incorporates a row of moveable-sash windows on each side that provided ventilation directly above the gas manufacturing equipment. The north elevation includes an exterior modern cinderblock chimney.

<u>Exterior</u>

The brick walls are laid in a hybrid Common/Flemish bond pattern of six common bond rows and a seventh Flemish (alternating headers and stretchers) row. Quarry-faced granite is used for the window lintels and sills, some of which have been removed. Bricks at the vertical edges of original doorways are bull-nosed. A sheet metal canopy overhangs two doors on the east façade. A historic photograph shows a similar canopy over a door at the south end of the façade, but only the frame and metal brackets remain. A small one-story brick walled infill addition connects the north elevation to the Retort House to the north. Brick on the south elevation is discolored where an automobile garage and power house was constructed c. 1918. A modern diesel engine exhaust pipe and muffler extends from near the center of the west elevation.

Fenestration is irregular, with windows and doors of various sizes and asymmetrical groupings on multiple levels, expressing the original entrances and floor levels associated with the building's industrial function. The fenestration also does not align with the interior division of stories, and windows that appear to indicate the second floor level on the exterior are actually split between the first and second floors on the interior. Sanborn maps indicate that the south section of the building originally had two floors or a raised interior floor, and that the north section was open to accommodate the gas equipment. Many of the windows retain their painted wood frames but are missing sash, and some of the openings have been partially or completely infilled with brick.

The south half of the north elevation contains two doorways on the first floor and three windows on the second floor; the middle window set lower than the outer ones. The south door is raised above a short flight of concrete steps, part of a concrete loading dock platform that extends past the door to the south end of the building, where the auto garage stood. The wood door to the south has a recessed panel on the bottom half and framed single-pane glazing on the top half. The doorway to the north is partially infilled with brick. It appears that this door was originally level with the ground, but the bottom and left side were filled for a raised entrance or window. Hinges are still attached to the wood frame. In the windows, remnant sash indicates the outer two windows contained 6/6 sash while the lower, center window contained paired 4/4 sash. The north side of the north elevation incorporates a set of two windows and two doors on the first floor, and one window on the second floor. The windows on the first floor have been infilled on the top and are missing their sash, but their original outlines are similar to the 6/6 wood sash windows in other parts of the building. The two wood doors, which are protected by a metal canopy, have window openings on the top, and the north door has a transom. The south door has an opening for a single pane window, and the north door contained six panes. The window on the second floor is covered in plywood, but is similar in size and shape to the building's 6/6 wood sash windows. Fenestration on the west elevation is more regular. The south end contains two raised doors on the first floor, and two 6/6 wood sash windows on the second floor. The north end includes one first floor window, smaller than others and with a concrete lintel, suggesting it postdates original construction. Another similar window on the second floor may also be a later feature. Neither window has extant sash. A second window located on the second story at the north end of this elevation is covered by plywood, but has the same size and proportions as other 6/6 windows.

The Gas Generator House north elevation has a first floor window partially obscured by the addition linking it to the Retort House. The south elevation does not appear to have fenestration, but two brick arches visible on the interior suggest that there were originally two doors on this elevation that were filled when the addition was constructed (by 1918). The connector to the Retort House on the north end of the building has a shed roof with asphalt shingles and open eaves. It includes one window with no remaining sash, but the wood frame and quarry-faced sill and lintel are similar to the Retort House windows.

<u>Interior</u>

The Gas Generator House interior has been stripped of all machinery and fixtures associated with its original gas manufacturing function. Minor elements associated with its modern natural gas utility function such as electrical panels, a heating furnace, etc. remain but are generic equipment not specifically related to the building's historic function.

The first floor is divided into two main north and south rooms with poured concrete slab floors separated by a transverse brick wall. Two filled segmental arch openings in the wall indicate the rooms were previously connected. The floor in the south room is higher than the floor of the north room, a feature typically associated with manufactured gas plants housing carbureted water gas (CWG) equipment. The floor surface is a few inches higher than the door sills in the south room, indicating that a second, shallow concrete floor slab may have been added after construction. The north end of the north room is subdivided by cinderblock walls. The subdivided rooms are blocked by debris, and their structural stability is unknown. They were not entered for photography or laser scanning, however, their layout and general measurements were estimated and are included on the plan drawings. Only one of these subdivided rooms opened into the main room; the rest were accessed by an exterior door at the north end of the north elevation. The room accessible from the interior has a five-paneled wood door, with the largest panel glazed. A second door on the opposite wall leads to a hallway in the adjacent coal house.

The upper floor level of both sections is supported by sawn wood joist construction, sheathed on the underside with insulation and sheetrock. The upper floors were not accessed as they are structurally unsound, evidenced by large holes in the floor exposing the joists. There is no evidence of an interior staircase, and it appears that the second floor was accessed by a metal ladder in the north section of the first floor.

Retort House (1859, c. 1918 addition)

The Retort House is located adjacent to the north elevation of the Gas Generator House. It is a rectangular one-story building consisting of two attached sections, a brick walled one-story front (east) section (original 1859 retort house), and a wood-framed two-story west addition that has collapsed. Both sections have concrete slab floors. The building was extended west to form its current configuration between 1918 and 1925. The bricks of the front section are laid in Flemish/common bond, like the Gas Generator House. A vertical strip of rough brickwork on the north elevation marks the location of the retort draft stack (chimney) as shown in historic photographs. The shallow pitch, asphalt shingle-clad gable roof of the front section is supported by five timber trusses that extend through the cornice to form chamfered brackets. A large, later garage door opening was inserted in the east elevation; collapsed remains of the wood garage door lie just inside the entrance. The wall above the doorway is reinforced with iron tie bolts and diamond-shaped washers.

Only the north elevation of the west section is still partially intact, and is covered with asphalt roll siding. This section includes two wood frame windows on each story of the north elevation. A six-paned, wood sash window is located on the second floor. A one-story appendage on the west side has collapsed with the rest of the building. A wood frame on the north side indicates the former location of a door. The interior of both sections of the Retort House have no remaining machinery and contain debris. At the time of survey a long painted wood sign with the legend "CLAREMONT GAS LIGHT CO." was found lying on the floor and set aside for salvage as a historical artifact.

Gasholder House (1859)

The remains of the Gasholder House are located immediately west of the Gas Generator House, separated from it by a narrow alley approximately five feet wide where the buildings are closest together. This structure consists of a standing portion of the cylindrical brick outer enclosure ("house"), its internal wrought sheet iron gas container or "bell," the water-filled brick water seal pit ("tank") the bell sat in, and the central vertical column that supports the remaining roof timbers and also guided the bell's vertical travel. Two rectangular wood-lined tar separator pits are located immediately outside of gasholder house, on its northwest and south sides.

The Gasholder House is approximately 36 feet in diameter with brick walls between 16 and 17 feet high above grade. Approximately two-thirds of the structure is extant; the western third closest to the river has collapsed or been demolished. Most brick is Flemish bond with paired stretchers between paired headers. Coursing varies, possibly due to later masonry repairs. The walls are two courses thick, and buttressed by widely-spaced internal vertical piers three courses thick. A corbelled brick cornice caps the wall, which still includes a few wrought iron tie rod ends with iron strap washers. The extant portion of the gasholder house contains two windows and a wood door. The windows have wood frames and narrow quarry-faced granite lintels, but no remaining sash. The bricks around both windows have been heavily repointed. Sanborn maps and a 1927 photograph of the complex show the missing portion of the gasholder house contained two additional windows, and a small door on the west side.

The cylindrical tank (water seal pit), a brick-lined pit which also serves as the Gasholder House subgrade foundation, is intact. The tank is three brick courses thick. The depth of the tank is unknown, but based on rough calculations for a below-ground "single-lift" (single-section, non-telescoping bell) tank, the depth would appear to be between 10 and 15 feet. The floor material is unknown but likely brick made watertight with layers of clay puddling or cement mortar. Some tanks incorporated a central shallow truncated conical floor called a "dumpling," the presence of which at Claremont is unknown (Thomas 2014:11-12, 17, 19).

The gas bell is in place within the tank, but is deteriorated and has shifted off center. The bell is a hollow, covered, flat-topped cylinder constructed of riveted rolled wrought iron plates. It was originally concentric to the inside of the gasholder house, with approximately 2 feet of clearance between the bell and brick tank wall. Based on estimated diameter and height, the bell appears to have had approximately 12,000 cubic feet of storage capacity. The vertical sides of the bell rising from the water are intact, but the horizontal top plates are caved in or missing. A copper or tin sheet metal apron surrounds the center column where it meets the central column. Several wrought iron eye bolts (function unknown, possibly associated with installation) are located around the upper perimeter of the bell. The top of the bell has collapsed and is covered with debris including loose structural roof support timbers, iron binder rods, and iron pipes of 1 inch to 3 inch diameter incorporating valves and cast iron T and elbow fittings. The pipes rise from the water in the tank and pass through the broken sections of the top of the bell. One approximately 3- inch diameter horizontal pipe crosses over the west lip of the bell and turns 90 degrees downward and extends down into the soil next to the tank foundation.

A central vertical wrought iron bell guide column approximately 6 inches in diameter stands at the center of the bell. The top of the column supports a cruciform arrangement of horizontal heavy wood timbers secured to the brick Gasholder House walls with iron bolts and washers. These timbers as well as several remaining secondary timbers are the remains of the structural system that supported the gasholder house's flat, tarpaper- sheathed roof. The top of the column also incorporates an iron disk anchoring the inner ends of six iron rods that radiated out horizontally to and through the top of the brick gasholder house walls, where each rod was anchored at the outside of the wall with a curved rectangular iron strap. The rods incorporate threaded tensioning turnbuckles.

Tar Separator Pits (c.1910-1930)

Two rectangular tar separator pits are located immediately adjacent to the Gasholder House, a larger, more intact one to the south and a smaller, less intact one to the northwest. The larger pit to the south is partially filled in with soil and debris with approximately 10 feet exposed on the west side and approximately 20 feet exposed on the north side. It consists of a rectilinear arrangement of plank sidewalls and intermediate transverse baffles forming a series of parallel, rectangular open, water-filled chambers. A vertical iron rod with square ends is mounted to the side of one baffle and appears to be a shaft for actuating a gate or valve between two chambers. The smaller pit to the northwest is of similar construction, measuring approximately 6 feet by 9 feet and incorporating four transverse baffles.

Changes to the Complex, as shown on maps dated 1860 – 1948

Historic maps indicate that the Claremont Gas Works complex has changed a great deal over time, with several buildings and structures added and removed. The presence of the Gas Works complex is first documented on an 1860 H. F. Walling wall map, which depicts a “Gas Works” as a large square at the west end of Rock Island in the Sugar River. A “Saw Mill” is shown on the north side of the island, spanning a raceway. A building north of the Gas Works is labeled “M. M. Co” for the Monadnock Mills Company. Two unknown buildings were located at the south-central end of the island. A bridge or other link across the south channel of the river was oriented on a north-south axis and attached to a large mill structure to the south, likely Mill No.2. This bridge was the only connection shown between the island and the surrounding area.

The earliest view of the complex’s physical appearance is seen in a bird’s eye view of the village in 1877 (A. Ruger, delineator). Indicated as "#19 Gas House," the complex includes the round Gasholder House, Retort House, a store house, and two coal storage buildings. The latter four gable-roofed buildings were arranged on a north-south axis with the tallest to the south. The two coal storage houses at the south end appear to have been connected, while the separate retort building and storehouse stood close together. The coal houses and storehouse were three bays long on their east elevations. The Retort House had a large chimney on the center of the northern wall. The round Gasholder House was just west of the storehouse. The Gasholder House roof appeared conical in shape though later photographs show a flat roof; a series of seams or lines are shown radiating from the roof’s center, which may indicate a metal standing seam roof. The view shows a large pile of wood east of the four buildings. A sawmill on the east side of the island included three connected structures with large doors on their east elevations. More wood piles are depicted just east of the complex, and in a large open triangular space within the road to the east (the current intersection of North Street and Broad Street, named Washington Square on the 1884 Sanborn map). The Moseley Wrought Iron Arch Bridge is shown on this view, located very close to the southernmost coal house. The bridge is depicted as parallel to Dam No. 2. This view does not show the narrow channel or raceway on the north side of the island leading to the sawmill, although the channel is depicted on both earlier and later maps.

The 1884 Sanborn map shows only part of the Claremont Gas Works complex. Only the two southern buildings, which are labeled as “open coal ho’s”, are shown. Both were rectangular one-story wood frame buildings. Although the island north of the coal houses was not included, there is a label indicating “Gas Works of M. M. Co. Beyond.” The map shows the Moseley Wrought Iron Arch Bridge diagonally connecting the gas works complex with Mill No. 2 to the southwest; it is no longer shown as parallel with the nearby dam. The sawmill, owned by the Monadnock Mills Company, was located to the east as depicted on the 1877 bird’s eye view. A narrow water channel terminated at the sawmill complex and presumably functioned as a raceway for the mill.

The 1889 Sanborn map shows the entire Gas Works complex, labeled as “M.M. Co’s Gas Wks.” The map shows the two open connected wood coal houses at the south end of the complex, a round brick “gas tank” (Gasholder House) north of the coal houses, a one-story brick "store house" east of the gas tank, and the one-story brick Retort House with a one-story wood addition on the east elevation, located at the north end of the complex, The Monadnock Mill Company’s sawmill was still located east of the Claremont Gas Works complex.

The Gas Works as shown on the 1894 Sanborn map is identical with the exception of the absence of the wood addition to the Retort House. A brick chimney is shown on the east elevation of the Retort House. The Monadnock Mill Company’s sawmill, which burned in 1894, is not shown.

The 1899 Sanborn map shows little overall change to the Gas Works complex. A brick addition was made to the west side of the Retort House, and the chimney moved from the east to the north side. An "upright boiler" is indicated inside the main section of the Retort House. The wood addition at the east side of the Retort House shown on the 1889 map but not on the 1894 map has returned, but is smaller. The north coal house is labeled as a "lumber house."

The 1904 Sanborn map shows the Gas Works was much the same as it was in 1899. Building functions were updated: the coal and lumber houses at the south end of the complex were indicated as "fuel sheds," the Gasholder House was labeled “gasometer,” and the adjacent store house was labeled "coal house." The Retort House was relabeled a "gas house," and still contained its upright boiler, however, the wood addition at the east side was replaced by underground oil tanks. The fuel sheds were shown as 1½ stories tall, when previous maps indicated they were one story in height, and the south fuel shed was shown open on the south and east sides.

The 1910 Sanborn map shows major changes to the buildings, most significantly replacement of the former brick store house/coal house east of the Gasholder House by the current two-story Gas Generator House, labeled as a “gas ho.” The building is shown divided into a two-story south section and a high, open north section, separated by a wall with a connecting doorway. The Retort House extended from the north side of the building, but is not labeled by function. It is shown as one story high, with a chimney on the north elevation. The underground oil tanks remained shown at the east side of the Retort House. A second gasometer is shown to the east of the underground tanks. At the south end of the complex, the two coal/fuel sheds were replaced or renovated. The previous north shed is shown as a "power house," indicated as a wood frame building covered in “concrete on wire lath.” This building has exactly the same footprint as the previous north shed, and it is unclear whether the original building was replaced or extensively renovated. A new one-story wood-framed fuel shed was located just south of the power house, with a different footprint than the previous shed at this location.

The 1918 Sanborn map indicates further Gas Works growth, and is the first map that calls it the “Claremont Gas Light Company.” At the north end of the complex, two small one-story buildings were shown adjacent to the second gasometer added in 1905, and a third one-story wood-framed building was shown to the south. A one-story lumber shed appeared at the east side of the complex, near the former sawmill location. The Gas Generator House interior included four circles in the east side of the north section, likely indicating the major vessels comprising the single carbureted water gas generator set. An interior door connected it to the Retort House to the north. A wood-framed automobile garage connected the Gas Generator House and the power house, which is indicated as sheathed with stucco on wire lath. The fuel shed at the south end of the complex was replaced by a three-story brick boiler house with a frame cornice, cement floors and four upright boilers. A note indicates that the building had pilasters spaced 15 feet apart. A brick pump house on the west side of the boiler house shared walls with both the boiler house and the power house, and interior doors connected the entire complex. This map also shows a six-inch water pipe between the complex and Broad Street, and a penstock and covered raceway between the power house and Broad Street, presumably extending to Dam No. 1. A "cement tar tk." [tank] was located at the extreme east side of the complex on the access road to Broad Street.

The 1925 Sanborn map indicates isolated changes at the complex. The biggest change was the addition of another, larger gasometer (1924) on the east side of the property, near the one added in 1905, but larger in diameter. Two of the nearby wood buildings are not shown. The Retort House at the north end of the complex was extended to the west toward the river. No other changes were indicated.

In 1948, the 1925 Sanborn map was updated, showing minor changes and additional details throughout the complex. At the north end of the complex, the earlier underground oil tanks just east of the Retort House were replaced by a set of five parallel rectangular tanks at the north side of the building.[1] The Retort House roof is shown as having a four-foot monitor. A rectangular "ir. [iron] purifier tank" was constructed immediately east of the Gas Generator House, and the 1924 gasometer included a one-story building on its southwest side. The power house was indicated as a Central Vermont Public Service Corporation hydro-electric plant.

STATEMENT OF SIGNIFICANCE

The Claremont Gas Works, a contributing resource to the National Register-listed Monadnock Mills Historic District, is significant for its essential function in providing illumination to the Monadnock Mill complex mill, the streets of Claremont (until the turn of the century), and surrounding commercial and residential customers from just before the Civil War until 1948.

It is an example of greater national, regional and state gas industry trends from early gasworks of the mid-19th century associated with industrial facilities or chartered as early local public utilities, through the early 20th century formation of larger holding companies to later absorption by major public utility companies.

Despite demolition of later, larger gasometers and minor outbuildings, the changing functions and use history of the surviving buildings reflect the complete 19th and 20th century technological arc of manufactured gas technology from coal gas to oil-gas to carbureted water gas and eclipse of coal-based gas production by natural gas. It retains its original 1859 retort house and 1859 Gasholder House, the two original primary elements associated with manufacturing, storing and distributing gas.

The complex’s Gasholder House is an extremely rare, if not internationally unique, surviving example of c.1818 British-designed center column-guided gas bell apparatus.

HISTORICAL BACKGROUND

<u>Overview and Context</u>

The Claremont Gas Works was originally chartered in 1854 and began operation in 1860, formed by Claremont residents and businessmen who were very active in commercial and industrial enterprises in the town. Its original purpose was for lighting the streets and many of the town’s buildings, including the industrial buildings that belonged to the Monadnock Mills, which was an early stockholder in the endeavor. The Gas Works was subsequently purchased by the company in 1888, which continued to own and operate it until the company was sold to Bates Manufacturing Company of Lewiston, Maine in 1932. The Gas Works was sold separately at that time to Charles Hatfield, treasurer of the Monadnock Mills. In 1950, the Claremont Gas Light Company came under the general ownership of the Central Vermont Public Service Corporation. In 1978, the Claremont Gas Light Company was still in existence and used the c. 1905 Gas Generator House for gas tank storage (Johnson 1978). The complex is currently vacant.

Claremont, first established as a town in 1764 and named for the English estate of Lord Clive, was six miles square in size and contained 24,000 acres. Like many New Hampshire towns, settlement was slow

---

[1] These tanks may be the 30,000 gallon tanks added in 1945 and at later dates after propane gas was introduced in 1945, described in *Claremont Daily Eagle* 1964: October 20).

to progress in the late eighteenth century. Claremont is situated about three miles east of the Connecticut River, with its major river, the Sugar River running mostly east-west through the town. The Sugar River's falls were capable of supplying "superior water power" (Waite 1895: 191) which derived from the damming of Sunapee Lake by the Sunapee Dam Company, composed of mill owners in Claremont, Newport (VT), and Sunapee (Waite 1895: 191), established in 1820. But manufacturing did not commence in earnest until about 1833, the mill privileges prior to that time supporting traditional saw and grist mills and other small mills dependent on water power (Waite 1895: 192).

One of the town's leading manufacturing company in the mid to late nineteenth century was the Monadnock Mills, which was originally chartered in 1831 as the Sugar River Manufacturing Company. The company was formed by local investors to counteract the movement of commercial and industrial activity from the village center to the Lower Village nearby to the west. The mill was started in the 1830s during what was called "Speculation Times" in the community (Croft n.d.) The company was one of the earliest in the state and the largest textile company in the upper Connecticut River valley (Tolles 1974). Construction of buildings began in 1836, but was halted by a national depression. The company was sold to Parker, Wilde and Parker and others of Boston in 1843 after which mill construction and the manufacture of cotton sheeting commenced and quickly grew. It gained the name of Monadnock Mills in 1846 when the company was re-chartered in New Hampshire (Tolles 1974).

The Establishment of the Claremont Gas Light Company

Similar to Monadnock Mill's original development, the community's gas works was formed by local investors. The investors chartered the gasworks in 1854, the same year as Keene, Exeter, and Concord, preceded in the state by Somersworth (known as Great Falls at the time), Dover, Portsmouth, and Nashua in 1850 (Lawry 1997). Most were formed to light the streets, buildings and stores, and an associated mill or mills and were owned by a series of private investors who were typically involved with an industrial enterprise in the town, although not exclusively (Lawry 1997). Most New Hampshire gas works were created by Acts of the State Legislature. The charter and incorporation dates of these companies typically differed by a few years, which explains differing dates ascribed to the companies. None were owned or established by the towns as publically-owned facilities.

The Claremont Gas Light Co. was chartered in 1854 (NH General Court 1854: 1480, 1481). The original incorporators were Jonas Livingston, George N. Farwell, John S. Walker, and Aurelius Dickinson to "carry on the manufacture, sale, and distribution of gas for the purpose of lighting the streets, factories, and all other buildings in the village of said Claremont, and to erect such buildings and works, and to construct such furnaces, reservoirs, gas holders, and gas pipes, and all other things that may be requisite and proper for said purpose; provided however that the location of the works shall not be in the compact part of any village unless the place of such location be first approved by the Selectmen of said town of Claremont" (NH General Court 1854: 1480, 1481). Similar charter language was applied to the other communities that established gas light companies at this time.

The gas light company's four original incorporators were all local men who were prominently associated with several industrial and commercial enterprises in the town. Jonas Livingston was the manufacturing agent of the Monadnock Mills Co., a position he held from 1845 until 1863 (Waite 1895: 194. With another incorporator Aurelius Dickinson, Livingston was also a director of the Sullivan Railroad, the first railroad through Claremont (Adams 1852: 258). Aurelius Dickinson was the owner of the Tremont House, the town's major hotel (GenDisasters.com), and patented an early gas apparatus (Senate of the United States, Volume 6: 459). George N. Farwell owned an early shoe manufactory in the town with Lewis Perry and his brother Russell W. (Waite 1895: 432). The enterprise was described in 1855 as one of “two large shoe manufactories here…furnishing employment for 40 males and 36 females, owned by G. N. Farwell & Co., and furnishing 25,000 pairs of ladies' shoes annually” (Charlton 1855: 151). Mr. Farwell was associated with the town’s earliest bank, the Claremont Bank, in the mid-1840s and its successor of the same name beginning in 1848 (Waite 1895: 347). He later served as the president of the Claremont National Bank, established in 1864, a recognized entity of the earlier bank (Waite 1895: 348). Mr. Farwell was also a state legislator in 1868 and 1869 (Waite 1895: 433). John S. Walker was a holder of several patents, including a shoe spring (US Commissioner of Patents 1891: 428) and was a president of the Sullivan County Agricultural Society (Waite 1895: 158, 159) and one of the organizers of the New Hampshire Agricultural Society (Waite 1895: 492). Mr. Walker was also the editor of the *National Eagle*, one of the local newspapers (Walling 1860). All four men originally incorporated the Claremont Railroad Company, also established in 1854 (NH General Court 1854: 1484).

Several years passed before the Gas Works was actually incorporated and constructed in Claremont, similar to others in the state. A meeting was held by the incorporators (which by then included an individual from Massachusetts) to adopt the charter and organize the company in 1856. The newspaper reporter covering this event stated, “we have all necessary assurances from the ample experience of these parties that the works if erected will be perfect and durable, combining all the latest improvements.’ (*National Eagle* 1856: March 20). The meeting was held in April 1856 at the Tremont House in the village center, in which nine men were elected to serve as directors of the gas light company.

These nine men included the original four incorporators - Jonas Livingston, Aurelius Dickinson, G. N. Farwell, J.S. Walker – along with E. L. Goddard, also of Claremont and later an officer of the Concord & Claremont Railroad (NH Board of RR Commissioners 1876: 12); William Rossiter, with the Sullivan Woolen Mills and an original stockholder of the Claremont Manufacturing Company established in 1832, and a selectman and state legislator in the mid-nineteenth century (Waite 1895: 198, 460); Lewis Perry, co-partner with George N. Farwell in his first shoe manufactory (Waite 1895: 432); Otis F. R. Waite, author of the 1895 history of the town who was involved with many newspapers in several of the New England states (Waite 1895: 490); and Dr. F. T. Kidder, co-founder of a short-lived local carpet factory in 1852 and a representative in the state legislature (Waite 1895: 205, 311). Jonas Livingston was elected as president and John .S. Walker as clerk (*National Eagle* 1856: April 10). Although the Monadnock Mills company had considered building their own gas works, the company was initially only a shareholder (*National Eagle* 1856: April 10). Residents and business owners alike appreciated the importance of the gas works to the town’s continued development. Described as producing the “best light in the world – the sun, moon, and stars excepted – as more economical, safe, and every way desirably than any other artificial light. Every individual living within the limits of the village is interested in this subject, and we trust they will take hold and give a strong lift towards introducing it here the present season (*National Eagle* 1856: April 10).

The Claremont Gas Light Co. was officially incorporated on June 27, 1860 by an act of the state legislature (State of NH 1860: 2317, 2318). The incorporators were Jonas Livingston, John L. Farwell, Otis F. R. Waite, Lewis Perry, B. P. Gilman, and John M. Whipple. Mr. Gilman and Mr. Whipple, not previously noted in earlier actions regarding the Gas Works were likewise civic-minded residents of the town. Benjamin P. Gilman was involved with George Farwell and Aurelius Dickinson in the construction of the town’s first high school in the 1860s (Waite 1895: 136) and the Soldiers’ Monument (Waite 1895: 270). John M. Whipple, a member of the Governor’s Council and the state legislature in 1891 and 1892 (Waite 1895: 303, 313)). Mr. Whipple was the paymaster of the Monadnock Mills beginning in 1857, a year after his arrival in Claremont, until he was appointed postmaster in 1874 (Waite 1895: 495).

Original Construction of the Claremont Gas Works

The construction of the Gas Works had previously commenced in 1859, with a Boston engineer unidentified by name hired to erect the necessary building and apparatus and lay the main gas pipe at an expense of $30,000 (Johnson 1978). The Town of Keene, whose gas works was also originally chartered in 1854, was similarly engaged in construction of their gas works in 1859. The Town had hired a Dorchester (MA) engineer named Edward Gustine to supervise J. H. Carter of Boston in "erecting the necessary buildings and putting in the machinery for manufacturing the gas, for laying the pipes & etc. – all to be completed by December next if nothing breaks." (*National Eagle* 1859: September 15). Mr. Carter owned most of the shares and was the first president of the Keene Gas Light Company until 1871 (Child 1885: 250). By September 1859, the Monadnock Mills' factory buildings were lit by manufactured gas, shortly afterwards followed by stores and houses in the village (Johnson 1978).

The Gas Work's location was adjacent to the Monadnock Mills operations and next to a sawmill owned by the company on an island in the Sugar River. Unlike many gas works, it was not located near a railroad line or navigable river, which would have more easily supplied the coal needed for manufacturing the gas. It is unknown how coal was transported to the Gas Works. The Gas Works was relatively distant from residences in its earliest years, based on an examination of historic maps, and was sited north of the most congested part of the village south of the Sugar River.

Late Nineteenth Century Operations

Little was found that reported about the company and its operations in the 1860s and 1870s besides a price increase in January 1866. In that year, the *National Eagle* noted the company was raising their rates from $4.00 per thousand feet to $5.00 per thousand feet, due to the increased cost of manufacture. The newspaper further explained that the company had delayed the increase some months longer than other gas companies in the country and it was understood that "the company will be pleased to return to the old rates as soon as the price of coal and freights will warrant" (*National Eagle* 1866: January 20).

Interestingly, the company did decrease its rates by the 1880s; the 1886 *Directory of Gas Light Companies* reported that the company charged $3.00 per 1000 feet. There were 12 New Hampshire companies in this directory – Claremont, Concord, Dover, Exeter, Great Falls (now Somersworth), Hanover, Keene, Laconia, Manchester, Nashua, Portsmouth, and Salmon Falls (now Rollinsford). It appears that the larger the community or district served, the lower the rates were typically. For example, both Nashua and Manchester charged $1.60 per 1000 feet, with populations of 15,000 and 38,000 respectively, while Hanover had a rate of $10.00 per 1000 feet and a small population of only 1,000. At the time, the Claremont Gas Light Company served a community of 5,000. Annual output of gas may also have played a role in the price, as the larger communities' facilities had a much higher output – from a high of 75,000,000 cubic feet in Manchester to 1,500,000 cubic feet in Laconia; Claremont's annual output in 1866 was 2,000,000 (Goodwin Gas Meter & Stove Co. 1886: 122-124).

Although the company was officially acquired by the Monadnock Mills through their purchase of all outstanding stock in 1888 (Johnson 1978), the officers in 1886 were local men, one of whom was a long-time employee of that company. The company's president was Morris C. Fitch; George W. Fitch served as both secretary and treasurer, and Henry C. Fitch was the superintendent (Goodwin Gas Meter & Stove Co. 1886: 122). George W. Fitch was the master builder and carpenter with Monadnock Mills for 43 years, and had built many of its structures (The American Textile Trade Review 1906: Volume XLIV: 13). The relationship of the other two men to the Monadnock Mills is not known.

The Gas Works continued to supply the town's street and building lighting into the 1890s, but it is clear from the Town's annual reports and the 1895 history that the increased use of electricity for these purposes was being considered in this decade, if not earlier. The Claremont Electric Company had been established in November 1887 (NH General Court 1901: 787; Waite 1895: 205) and as early as 1891 warrants were introduced "to see what action the town will take in regard to lighting the streets, and raise and appropriate money therefor" and "to see if the town will authorize the selectmen to contract with the Electric Light Co. for lighting the streets by means of arc lights" (Town of Claremont 1891: 3, 4). Payments for street lighting in the Town's annual report included the provision of alcohol for thawing gas lights ($.90) and payment to the Claremont Gas Light Co. for gas ($127.00) as well as the Claremont Electric Light Co. ($948.52). There were also payments for oil, wicks and chimneys (Town of Claremont 1891: 11).[2] The 1895 history of the town by Otis F. R. Waite, one of the Claremont Gas Light Company's original directors, noted that the streets, public buildings, stores, offices, and residences were lighted by gas and electricity (Waite 1895: 71). By the late 1890s, most of the Town's payments for street lighting were to the Claremont Electric Light Company ($3,398.08), although small sums were also made to the Claremont Gas Light Company ($36.64) and individuals were still paid to light street lamps. But a warrant still appeared in the 1898 annual report that called for the Town to light the streets with electricity (Town of Claremont 1898: 4).[3]

Early Twentieth Century Operations

Just after the turn of the century, the town of Clermont considered itself "metropolitan in every detail" with a bright industrial future, and was, at the time, the largest town in New Hampshire (Cheney 1908: 142).[4] In 1900, the town had a population of 6, 948; its highest percentages of growth occurred from 1890 to 1930 (Wikipedia). In the first decade of the twentieth century, the town experienced a series of major changes in its utility systems, including the Gas Works.

By 1903, it appears that an official decision regarding lighting the streets with electricity was close, as a town warrant for that year was proposed "to see if the town will vote to instruct the Selectmen to base their contract with the Claremont Railway and Lighting Co. for street lights upon the moonlight schedule, so called."[5] The Claremont Railway and Lighting Company, chartered in 1901,[6] had been established to construct an electric railway to link freight and passengers to the Boston & Maine railroad lines to the south and west, which was completed by 1903 (Anonymous n.d.: 2). The Claremont Electric Light Co. had been purchased and merged with the company in 1901 (Louis Berger & Associates 1995: 3). A 1908 article extolling Claremont's excellence noted that "it goes without saying that the town is lighted by electricity and that it has an electric railway connecting its villages and railway stations" (Cheney 1908: 189).

---

[2] The 1891 annual report was the earliest report that could be found online at http://www.library.unh.edu/digital/islandora/solr/search/%2520/1/category%3ANH%5C%20Cities%5C%20%2526%5C%20Towns~slsh~Claremont~slsh~Annual%5C%20Report*~/dismax
[3] No annual reports between 1891 and 1898 were online.
[4] The Town was considering incorporation as a city in 1908, but did not make this change at that time. It was officially chartered as a city in 1948 (City of Claremont 1948: 19).
[5] A moonlight schedule refers to the practice of not lighting the street lights on cloudless nights.(http://www.belmontlight.com/about-us/mission-history.php)
[6] A franchise for the Claremont Street Railway, its original name, was first granted in 1899 (Anonymous n.d.: 2)

At the same time that electric lighting was taking over one of its original roles, the Monadnock Mills Co. commenced a series of capital projects and built a new gas tank beginning in 1904 with the capacity to hold 50,000 cubic feet in the hope to "…manufacture and store a sufficient amount of gas so that the pressure on the pipes may be materially increased, and the supply drawn may have age (sic, should be "gas") sufficient to improve the quality. A new gas manufactory is one of the possibilities in the near future" (*National Eagle* 1904: October 1). One year later, the company was re-organized and, in addition to the new gasholder, built nine additional miles of gas lines built in the town (Johnson 1978). In 1905, the company sold 7,000,000 cubic feet of gas and in 1906, it rose to 9,000,000 cubic feet, with the price of gas for fuel and lighting at $1.60 net per thousand cubic feet and for power at $1.25 per thousand. Its low price was attributed to the fact that the Monadnock Mills, which owned and operated the Gas Works, were themselves large consumers of gas. In 1907, William Burns was the superintendent of the company and Frank. P. Vogel, agent of the Monadnock Mills Co., held the office of treasurer and had the active management of the gas company's business (*Claremont Advocate* 1907: January 18). By this time, the company also offered a series of gas-related products in their Tremont Square store, including "one of the most complete lines of gas stoves to be found in New England" (*National Eagle* 1907: January 12).

The year 1907 also witnessed the proposed consolidation of the Claremont Gas Light Company with the Claremont Railway & Lighting Co., which the state legislature ultimately did not approve (*National Eagle* 1907: January 19). But the Claremont Railway & Lighting Co. was recognized in that year, with the rail and lighting service transferred to the Claremont Power Company, which was a subsidiary of the New York-based company of W. S. Barstow (Anonymous n.d." 3). By 1911, the Claremont Power Co. supplied electric light and power to Claremont and the Vermont towns of Cavendish, Springfield, Amsden, Felchville, and Ascutneyville and owned a hydroelectric plant at Cavendish, VT. The company also held Claremont's contract for street lighting (Poor's Railroad Manual Company 1911: 115).

By 1911, the Claremont Gas Light Company, headed by G. W. Stowell as president, had 10 miles of mains and produced 9,000,000 cubic feet of gas which served a population of 9,000 (Poor's Railroad Manual Company 1911: 115). The company continued to expand its production, signified by a new steam boiler plant that was connected to the gas manufacturing equipment in 1911 and a new gasholder built in 1924 that was even larger than the one installed in 1905 (*Claremont Daily Eagle* 1943: September 26; Johnson 1978). In 1930, the company grew again, with its removal to a larger space at the corner of Pleasant and School streets for the consolidation of its offices, sales, and showroom in one space. The manager of the company, Fred R. Thomas ascribed the move to the increased demand for gas home heating installations and gas refrigerators and other home appliances, including laundry dryers, water heaters, and small home appliances. He also noted the "perfecting of the heating equipment and also to the special home-heating rates provided by the local company" as reasons for the popularity of gas appliances. The company also planned to provide space for "classes in cooking and domestic arts where demonstration and lectures by domestic arts experts will be available to people in the community." Claremont Daily Eagle 1930: February 8).

Mid-Twentieth Century Changes

In 1932, the business, stock, and equipment of the Monadnock Mills Company was sold to the Bates Manufacturing Company of Lewiston, Maine. The Gas Works, however, was sold to Charles Hatfield, treasurer of the Monadnock Mills Company (Johnson 1978). The Monadnock Mills Company then rented its boiler plant to the gas light company (*Claremont Daily Eagle* 1943: June 26), but resumed operation of the boiler plant in 1935 having leased one of its buildings to a shoe manufacturing concern with a covenant to supply steam to that building. In 1940, the gas light company was sold to Charles S. Morgan, who managed the Monadnock Mills at the time, and then sold again four years later to Virgil

Stark of North American Utility & Construction Corporation of New York City (*Claremont Daily Eagle* 1964: October 20). The Monadnock Mills concern similarly changed hands during World War II, with its sale in 1943 to the United-Carr Fastener Corporation, a plastics company (*Claremont Daily Eagle* 1943: June 26).

Two sources regarding the Gas Works' history state that the complex came under the general ownership of the Central Vermont Public Service Corporation in 1950 (Johnson 1978 and Croft n.d.), although the name of the original company was kept. The Central Vermont Public Service Corporation was originally founded in 1929, formed from eight Vermont utility companies (Anonymous 1980: 46) and was first listed in Claremont annual reports by this name as the provider of electric street lighting in 1932 (Town of Claremont 1932: 33). Prior to 1932, the provider's name was the Vermont Hydro-Electric Corporation which was first listed in 1925; this company was one of the original eight consolidated into the new corporation.[7]

In 1945, propane gas was first made available in Claremont, which was received by railroad tank cars and mixed with air at the local gas plant (*Claremont Daily Eagle* 1964: October 20). A 30,000 gallon tank was installed at that time on the site to take care of storage with two additional tanks added later due to increased business. Service was extended in the 1940s after this conversion to propane to rural areas around Claremont, and for a radius of 30 miles in the form of bulk and bottled gas. A further service improvement was the installation of "15-air jet machinery…thereby making it possible to send the gas directly into the mains, eliminating the use of the gasholder" (*Claremont Daily Eagle* 1964: October 20). The original gasholder house, which was noted as "a landmark for so many years," was dismantled in 1964 (*Claremont Daily Eagle* 1964: October 20).

Comparative Analysis

The Claremont Gas Works' initial establishment and construction by 1860 places it in the earlier wave of incorporated gas manufacturing concerns in the state. The charters for six earlier gas light companies were approved by the NH State Legislature in June and July 1850, with most beginning operation a few years later. These companies were the Great Falls Light Company in Somersworth (which was originally called Great Falls), Nashua Gas Light Company, Dover Gas Light Company, Portsmouth Gas Light Company, the Manchester Gas Light Company, and Concord Gas Light Company. The Claremont Gas Company was first chartered in 1854, along with the Keene Gas Light Company, the Exeter Gas Light Company, and the Concord Gas Light Company.[8] The Laconia Gas Light Company was established by 1860, although an exact date was not found. The Salmon Falls Gas Light Company in Rollinsford was in operation by 1870, but again no specific date was found (Lawry 1997a: 4). The Hanover Gas Light Co. followed in 1872, for a total of twelve companies in New Hampshire by 1886 (Goodwin 1886: 122-125). The Farmington Gas Light Company in Farmington, Strafford County was in operation by 1890 (Brown 1890: 64), resulting in a total of thirteen companies in New Hampshire by that date. Most were incorporated in association with a textile or other manufacturing concern, although their purpose also included lighting the town's street lights and other buildings.

There were fourteen gas light companies in New Hampshire by c. 1909, all of them owned by corporations and largely located in the southern half of the state. The Rochester Gas Company joined the older companies with its incorporation in 1905; the community had previously received its gas from

[7] No annual reports were found for the dates between 1918 and 1925, and 1929 and 1932, so dates stated in the last two sentences of this paragraph are approximate.
[8] It is unknown why the company was incorporated in both 1850 and 1854.

nearby Somersworth. By 1912, fifteen companies produced manufactured gas in the state, many of them also associated with electric companies due to mergers. These companies, in alphabetical order by community in which they were located, were: Claremont Gas Light Co.; Concord Gas Light Co./Concord Light and Power Co.; Twin State Gas and Electric Co. in Dover; Exeter Gas Light Co.; Franklin Light & Power Co.; Keene Gas and Electric Co.; Laconia Gas and Electric Co.; Manchester Gas Light Co./Peoples Gas Light Co.; Nashua Light, Heat and Power Co.; New London Acetylene Co.; Pittsfield Gas Co.; Portsmouth Gas Co.; Strafford-York Gas Co., Rochester and Somersworth; P. J. Abbott & Co., Wilton; and Winchester Gas Light Co.(Driemeyer and Monroe 2011:7).

Not accounted for in any systematic manner is the existence of gas works at various NH institutions in the nineteenth or twentieth centuries. Many institutions, such as St. Paul's School in Concord and Phillips Exeter Academy in Exeter, had their own gas works, but the location and identity of these works was not sought, and generally not encountered, during the research for this report.

The process of manufacturing gas by these companies progressed and changed over time, with a variety of processes in use at the same time. In 1886, most of the twelve companies noted in the Goodwin Gas Stove & Meter Co. list still used coal (although some companies used other processes early on – see copy of article about NH gas companies by Allen W. Hatheway in Appendix 1), but other manufacturing processes were oil, Hanlon, Patton, and Lowe (see Appendix 2 for the 1886 listings.) By 1890, the thirteen companies listed in Brown's directory were also using different processes, which included oil, coal, Hanlon, and Lowe (see 1890 Brown's Directory listings in Appendix 3.) In 1912, one year after the companies were subject to regulation as public utilities by the state, the use of coal gas (Exeter, Manchester, Portsmouth, Strafford-York Co., Rochester and Somersworth) and water gas (Claremont, Keene, Laconia, Manchester, Twin State Gas and Electric Co., Portsmouth; Strafford-York Co., Rochester and Somersworth) was most common of the fifteen companies operating in New Hampshire; others were acetylene gas (P. J. Abbott & Co., Wilton; New London, and Winchester) carbureted water gas (Concord), and naphtha gas (Franklin, Pittsfield) (Driemeyer and Monroe 2011:7). The 2005 Environmental Protection Agency's map of former manufactured gas plants (FMGP) in the state noted 16 separate locations that correspond to the locations noted above, except that Wilton, Winchester, New London, and Pittsfield are not indicated[9]

Most of the gas works were no longer in operation by the 1950s, many having served their respective community for nearly 100 years. Examples include Exeter's gas works, in operation from 1864-1955; Keene, from 1859 until the mid-1950s[10]; Concord from c. 1852 until c. 1952; Somersworth's earliest plant, operated by the Great Falls Gas Light Co. was in operation from 1856 until the 1930s; Rochester from 1906 until 1956; Dover from 1853 until the 1950s; and Laconia, which lasted from c. 1860 until the gasholder's spectacular explosion in 1952 (Lawry 1997b: 13).

Extant facilities

Few of the gas works in New Hampshire are extant, and those that are known to remain are only partially intact. Only four communities – Claremont, Concord, Nashua, and Dover are known to retain any remnants of their nineteenth- and/or twentieth-century components. Claremont's complex is the only one that at least retains structures from its earliest period of operation, represented by the remnants of its 1859 brick gasholder house and retort house, as well as its surviving gas storage bell and center column gas bell guide system, while Concord is the only complex in New Hampshire with an intact round gasholder

---

[9] http://www.hatheway.net/state_site_pages/nh_epa.htm).
[10]http://www.psnhnews.com/content/keene-celebrates-monumental-environmental-effort

house. Concord's 1888 brick gasholder house, which was similar in form to the 1859 structure at Claremont, is deemed to be the only gasholder house with an intact gasholder in the United States (Taylor 1984:17).[11] Nashua's works, recorded in 2011 by Preservation Company, contain early to mid-twentieth century buildings, which replaced the ones originally built on the site in the 1850s. These buildings are a c. 1907 boiler room and retort house, 1912 water gas plant, both constructed of brick, and 1912 concrete coal shed, with two later buildings that date to between 1952 and 1962 (Driemeyer and Monroe 2011:8, 9). Dover's nineteenth century two-story gas works building and a remnant of a brick cistern are all that remain of the complex on Cocheco Street at Portland Street, now part of a property owned by George's Marina (Lawry 1997b:15).

Of the remaining communities that had gas works, most have been remediated, with all buildings and structures removed in the process. Exeter's gas works, located at Water and Green Streets (277 Water Street) north of the downtown, is now occupied by a senior housing complex and a landscaped lot. The Franklin gas works site, near Rt. 127 and the Winnipesaukee River, were thoroughly remediated and it appears nothing remains above or below ground.[12] Keene's gas plant, formerly located at 227 Emerald Street, was likewise remediated, with no remaining above-ground components retained although the parcel later hosted a district office of PSNH (now Eversource Energy.)[13] [14] Manchester's gas works, operated by People's Gas Co. as early as 1892, was located between Elm Street and Canal Street opposite Prospect Street; based on a comparison of the 1892 Hurd Atlas with current views, it appears no remnants remain of this complex (Hurd 1892:76).

Technological Context

Introduction

The manufactured gas production history of the Claremont Gas Works mirrors the basic technological chronology of the nineteenth and twentieth century manufactured gas industry worldwide. Research in available archival repositories in Claremont and elsewhere in New Hampshire did not identify or locate any primary source materials such as business or technical records of the Claremont Gas Light Company and its predecessors, or any maps, engineering plans, correspondence, etc. that could confirm specific gas manufacturing processes, equipment or associated changes, decisions or motivations. Determination of the specific technological site history and surviving resource functions was made through examination of Sanborn fire insurance maps, limited newspaper accounts, historic photographs and the buildings and structures themselves, as interpreted through the history of manufactured gas industry trends and technology. This evidence points to manufacture of coal gas at Claremont starting in 1859, supplemented by an interim, secondary petroleum oil-gas process in the 1890s, followed by carbureted water gas (CWG) from 1905 to 1948, when gas making ceased and the site was converted for natural gas storage and distribution.

Manufactured gas production processes, including many not used at Claremont, generated combustible gases through destructive distillation of organic feedstock. Solid hydrocarbon feedstock (coal or coke)

[11] Two other similar brick gasholder houses have been identified in the country – the 1873 structure in Troy, NY and one that dates to 1889 in Oberlin, OH, but neither appears to retain the interior gasholder component.
[12] http://trueblueenvironmental.com/projects/environmental-services/mgp-remediation/former-mgp-remediation-franklin-nh/
[13] http://trueblueenvironmental.com/projects/environmental-services/mgp-remediation/former-keene-mgp-land-based-remediation/
[14] http://www.psnhnews.com/content/keene-celebrates-monumental-environmental-effort)

and/or or vaporized liquid hydrocarbons (oils) were pyrolytically "roasted" in a variety of sealed (tight against the external atmosphere) apparatus to produce gases with varying illuminating and/or fuel-heating value for domestic and/or industrial lighting and manufacturing processes. As manufactured gas technology became more widespread, complex and specialized, a separate engineering community and industry emerged in the late nineteenth century to plan, design, construct and operate manufactured gas plants, or "MGPs." Regardless of process or period, MGPs all generated quantities of hazardous, even toxic residuals and waste products, characteristically disposed of on or near the plant source, or selectively marketed as by-product fuels or chemical industry raw feedstocks. The physical and technological complexity of MGP sites make their history particularly challenging to interpret. Complete understanding of the historic industrial processes used at a given MGP site often informs critical aspects of the environmental site assessment and cleanup process.

Manufactured Gas General History

Manufactured gas history begins with the natural mineral coal. Raw coal had been burned for heat for thousands of years before serious attempts were made to distill it to yield gases or liquids of greater energy efficiency and output for making heat or light. Experiments began in the eighteenth century, when the Rev. John Clayton distilled gas from Lancashire, England coal but without practical application. In the 1780s, Scotsman Archibald Cochrane experimented with and patented closed retorts for distilling coal to coke and tar byproducts including gas for illumination, which he installed in a university in Belgium in 1785. In 1792, William Murdoch developed the first practical retort for coal gas production in Birmingham, England, and established the world's first commercial gasworks there in 1808. Negative, unfounded public concerns about coal illuminating gas safety hampered development in England until Napoleonic War trade restrictions made it an attractive option. In 1812, Frederick Windsor's London Gas Light & Coke Company became the world's first large urban city gasworks. The first gas street lighting system in Paris was established in 1817-1818. British inventors played a major role in early coal gas manufacturing and distribution technology and equipment development (Grossman & Assoc. 1993 in Pratt & Nolte 1998:3, 5, 6; Hatheway 2012a:14, 16-17, 67).

Coal gas manufacturing was demonstrated in the United States in the 1790s and European success prompted adoption for industrial commercial and public illuminating uses in the wake of Napoleonic War trade interference. In 1816 the Gas Light Company of Baltimore installed the first gas streetlight system in the United States. Illuminating gasworks and systems were established in New York City in 1823, Boston in 1827, Philadelphia in 1834, Pittsburgh and New Orleans in 1835, and Portland, Maine in 1849 (Driemeyer and Monroe 2011:5-8; Grossman & Assoc. 1993 in Pratt & Nolte 1998:6-9; Lawry 1977a:4,19).

New England coal gas manufacturing began in Newport, Rhode Island in the 1810s when several small textile mills were illuminated by a small central gas plant. Beginning with the War of 1812, private consortiums or manufacturing concerns began to produce gas to illuminate New England industrial workplaces to increase production. Excess gas was sometimes sold to surrounding customers for lighting streets, businesses and homes near the mills. For much of the first half of the nineteenth century, coal gas manufacturing was small in scale and privately owned. These concerns often evolved into separate private or public utility companies. By 1859, nearly 300 small manufactured gas companies were operating in the United States. In the 1850s and 1860s, the New Hampshire State Legislature granted charters for gasworks in Claremont, Concord, Dover, Exeter, Great Falls, Keene, Laconia, Manchester, and Portsmouth; several of these were associated with textile or other industries (Driemeyer and Monroe 2011:5-8; Lawry 1977a:4,19; Pyne 1989:55).

Gasworks have always been faced with accumulation and disposal of increasing quantities of noxious tarry waste material; viscous, as tar light oils, and as contained in the plant's gas liquor wastewater. Starting in the 1820s, operators began to recognize simple, viable commercial applications for these materials, when efforts were expended to capture the more valuable components of the tar-bearing residuals, thereby creating salable by-products and, at the same time reducing the volume of the noxious waste.

Most of the early captured tar became the stuff of industrial sealants, tar for waterproofing rope, creosote for preserving railroad ties, and for road surfacing of the macadam type. These uses supported a crude coal tar industry before the Civil War. In 1856, chemist William Henry Perkin synthesized a purple dye from distilled light coal tar oil, an event considered the birth of organic chemistry. Coal tar was transformed from a nuisance to a raw chemical commodity to be transformed into artificial aniline dyestuffs, spreading to development of important industrial chemicals such as ammonium sulfate, benzene, naphthalene, toluene, and many others. The coal tar byproduct industry fully emerged by the 1890s, and a portion of former coal gas waste material was saved and converted into value-added products including chemical fertilizers, dyes, medicines, perfumes, disinfectants, solvents, paints, and distilled tars, oils and asphalts for building materials, roofing and road construction (Grossman & Assoc. 1993 in Pratt & Nolte 1998:10-11; Hatheway 2012a:4).

During the second half of the nineteenth century, demand for commercial manufactured illuminating gas increased, particularly for residential consumers in growing cities. More, and larger, coal gas plants were established across the United States, and by the mid-1870s most towns with a population of more than 10,000 had at least one manufactured gas plant. Toward the end of the century, new manufactured gas processes using combinations of coal, coke and steam were invented to make different kinds of gas for heating as well as illumination. As U.S. population centers spread west away from convenient coal supplies, processes that made gas from cheap petroleum oil from new sources in Pennsylvania and elsewhere became popular. Beginning in the 1880s, the spread of the carbureted water gas (CWG) process, economical at both small and large scales, led to construction of more MGPs, and many in smaller communities. The number of gas plants in the United States increased to nearly 700 in 1890 and roughly 1,300 by 1909, at least fourteen of them in New Hampshire (Driemeyer and Monroe 2011:5-8; Hatheway 2012a:4).

Beginning in 1885, in America, the phenomenon of consolidation of opposing gas companies in individual cities began. After 1900, particularly in New England, speculative utility holding companies formed, controlling and consolidating urban manufactured gas systems. The development of high pressure pipes and pumps by the 1920s made construction of large, centralized distribution systems possible, in turn allowing construction of larger central MGPs utilizing the popular and dominant CWG process, and ever-larger gas storage and distribution tanks, known as gasholders. With these expansions came corresponding hazardous waste issues. The CWG process generated unmarketable, poor-quality, water-saturated tar, and big gasworks made lots of it. Large quantities were often stored or disposed of on gas works sites, becoming major modern-day contamination problems (Driemeyer and Monroe 2011:5-8; Hatheway 2012a:96-98, 127-128, 139-140; 2014: personal communication).

The manufactured gas industry peaked in the 1920s and began a slow decline during the 1930s and 1940s. It increasingly lost market share for heat and light energy to electricity and to natural gas, which has approximately twice the thermal energy of gas made from coal. Long-distance gas pipeline systems made transportation and distribution of natural gas from other regions of the United States possible, but hilly topography and hard, near-surface bedrock prohibited or delayed benefit from those systems in places like west-central New Hampshire. Butane and propane-air gas service emerged to fill that niche, with those oil-and-gas refinery byproduct gases delivered in bulk by rail, and then distributed via limited existing local gas line systems. After World War II, butane and propane were more commonly distributed to fill tanks of compressed gas for smaller individual consumers. Many manufactured gas plants were decommissioned and demolished after World War II and replaced with natural gas systems. In New Hampshire, some CWG plants were briefly converted to high-BTU oil-gas generating plant systems prior to having their distribution systems switched over to natural gas. New Hampshire manufactured gas production ended rather dramatically at Laconia on March 4, 1952 when the oil-gas-converted CWG generating set there exploded (Driemeyer and Monroe 2011:5-8; Hatheway 2012a:4; Hatheway 2012b; Lawry 1977b: 13,15).

Coal Gas

Development of the coal gas generating oven or "retort," first made practical in Birmingham, England by William Murdoch in 1802, set the stage for more aggressive promotion of English gas light, and subsequent gas cleaning, storage and distribution technology. This ultimately led to the spread of illuminating gas systems to major European and American cities in the early nineteenth century. Coal gas production can be broken down into basic steps: destructive distillation of coal to drive off and capture hot gases, clarifying and purifying the gas to rid it of tar and other impurities, and storage in tanks for distribution to consumers through a system of pipes.

Distillation

The feed material for the coal gas destructive distillation phase was certain grades of bituminous (soft) coal naturally high in volatile chemicals that produced combustible gases when heated. The coal was baked at between 600 and 800 degrees Fahrenheit for several hours to drive off the gases. Heating took place in a specialized industrial oven, consisting of a single-story rectangular masonry brick structure called a "bench." A typical coal gas bench consisted of a conventional coal-fired firebox at the bottom to provide heat for baking the coal, and a series of five or six cast iron or fired clay retort chambers stacked in horizontal or slanting rows above the firebox (Figure 1). Retorts were typically D-shaped in section and about 8 feet long and 2 feet wide, and sealed at the back end with a door at the front. Coal was manually loaded into the retorts which were closed and sealed. Heat from the coal fire in the firebox rose, passed around the retorts full of coal, and was drawn out through a chimney that acted as a draft stack. The heat baked the coal in the oxygen-free environment inside the retorts, driving off the volatile constituents as a hot gaseous mixture that was collected for further processing (see below). Workers opened the retorts and raked out the hot spent coal, which consisted of ashes and coke, a pure fixed carbon material that was either treated as waste and disposed of or sold as a byproduct for its value as metal foundry, blacksmithing or home heating fuel. The workers quenched the hot material with water, generating liquid runoff. The work was harsh, hot, labor intensive and often performed by unskilled, immigrant laborers. Coal gas retorts had to run constantly to be productive, and could fracture if they were allowed to cool off and had to be reheated. A bench containing several retorts, and when multiple benches were set in a continuous line, was referred to as a "stack," and the building that housed one or more, a "retort house" (Driemeyer and Monroe 2011:5-8; Grossman & Assoc. 1993 in Pratt & Nolte 1998:11; Hatheway 2012a:21-22, 91, 105-108).

Clarification

Clarification refers to all steps taken to remove tar and other chemicals entrained in the fresh hot coal gas from retorts, prior to the final purification step. The hot gases from a retort bench rose through vertical ascension pipes to a single horizontal manifold or hydraulic main that was a sealed trough half full of hot gas tar that stripped tar from the hot gas made to bubble into the main. Next the gases flowed through a wash box that acted as a water seal to prevent gas backflow to the retorts and possible gas explosions, and also served to remove additional tar. The next component was the exhauster, a negative-pressure gas pump that sucked hot gases from the retorts through the hydraulic main and wash box, and forced them through the following tar extractor and into the condenser. In the condenser the cooling gases were forced through a series of iron pipes exposed to air or water to further cool the gas and remove yet more tar from it. The cooled gases then passed through a scrubber/washer to remove ammoniacal liquors and tar through solid filters. Clearly tar was a major contaminant that had to be removed as completely as possible to produce marketable illuminating gas. Atomized tar particles sent forward to gas-light consumers, brought about noxious fumes, stained wall-paper, curtains, linens and all manner of surfaces, and were a serious concern for a high degree of removal right at the gasworks. Coal gas tar was rich feedstock for the coal tar byproduct chemical industry and tar from the above steps was sometimes saved in an on-site tar storage well for periodic removal and sale to chemical manufacturers. It was, however, difficult to gather, handle, package and submit to by-product applications and was therefore also often disposed of on or near gasworks sites (Benjamin 1880:901; Driemeyer and Monroe 2011:5-8; Hatheway 2012a: 21-22, 113-114, 116, 312-371).

Purification

The final in-plant step in making marketable illuminating gas was purification to remove sulfur, cyanide and very small amounts of remaining residual tar from the gas, in order to improve its illuminating qualities, meet health regulations, eliminate hydrogen sulfide odor, and protect consumer distribution and illumination equipment from ammonia-based corrosion. The gas was filtered through any one of several impurity-sorption media; dry mixed ground lime, iron filings and wood shavings; to remove sulfur, cyanide, arsenic, and tar. Early coal-gas purifiers were simple wood or iron boxes and were known to explode occasionally from the heat and gas pressure generated from internal chemical reactions. Nineteenth-century purifiers were usually housed in physically separate, masonry-walled buildings to contain explosions and to protect workers and other gasworks equipment. After about 1900, purifiers were heavy cast-iron boxes or cylinders located outside gasworks buildings (Grossman & Assoc. 1993 in Pratt & Nolte 1998:9, 11; (Hatheway 2014a:21-22, 98,116, 375-381,387; Lawry 1977b: 13, 15).

Gas Storage

Once the cool, clean coal gas emerged from the purifying step, it was ready to burn for illumination, but it had to be stored and distributed at regulated pressure to consumers via a local gas main pipe system. This was accomplished by a large, simple device known as a gasholder, which served as a storage, distribution and regulation device. Regardless of age or size, most gasholders shared the same basic structure and operated on the same general principles (Figure 2). A typical gasholder consisted of a large inverted hollow cylindrical sheet metal vessel, or "bell," floating with its open end down in a slightly larger diameter, watertight masonry or concrete pit, or "tank." This arrangement created a sealed, interior void under the bell, allowed the bell to move vertically within the tank, and provided a contained pool of pit water to form the seal between the interior and exterior. Fresh clean manufactured gas was pumped through an inlet pipe that penetrated the tank floor and rose vertically, under the bell and up to a height just under the roof of the tank. The piped gas filled the bell and caused it to rise within the gasholder house, and the bottom ring of the bell submerged in the tank formed a water seal to prevent the gas from escaping. The bell acted essentially like a giant piston within its tank cylinder. The weight of the gas-filled bell pressing down on the water created the pressure to force the gas out of the bell through a second outflow pipe to distribute the outgoing gas through mains to consumers. This counterbalancing effect also regulated pressure differences between production and consumption. One negative aspect was that the pit water was cool and tiny tar particles that remained in the gas, precipitated, sunk, and over decades filled a portion of the water-seal tank. This problem was magnified in the carbureted water gas process (see below). In all gas processes, the eventually treated gas was pumped from the gasholder through service mains to customers, and metered to track production and consumption (Hatheway 2014a:116, 410-413; 2014: personal communication; Thomas 2014:1, 4).

Gasholder Houses

Early gasholders were sheltered in round masonry buildings called "gasholder houses." The primary reason for these buildings was to avoid winter freezing of the water seal, as well as to contain escaping gas to prevent fires, however, explosions of trapped gas proved a greater problem, and enclosed bells fell out of favor earlier in England and Europe. They remained in favor and use longer in North America for the basic climatic reasons. Masonry shelters protected the riveted sheet iron or steel gas bells from snow and wind loads, protected the water seal in the tank from freezing, and kept the vertical movement guide mechanisms from jamming in very cold or hot weather. Steam heat and mechanical ventilation made the American gasholder houses safer and more reliable and inhibited moisture condensation. As was sometimes the case with visible, urban public utility buildings, some gasholder houses featured elaborate ornamental masonry or ironwork, such as the iconic Troy, New York gasholder house, now the symbol of the Society for Industrial Archeology (Hatheway 2014a:21-22; Lawry 1977b: 13,15; Pollak 1969:2; Thomas 2014:2).

Gasholder Tanks

The water seal for most nineteenth-century gas bells was provided by a subsurface round masonry tank, typically just a few feet wider than the diameter of the bell. Early tank walls extended about 15 feet below ground and were typically built of three or more layers of brick, sometimes backed up by cut stone on the outer side, with masonry increasing in thickness from top to bottom to contain the hydrostatic pressure of the sealing water. Support for the tank floor varied on local conditions, but was typically sealed with tamped earth or puddled clay to prevent water leakage. Some tanks were deeper at the edges, with a shallow, truncated conical dome, or "dumpling" at the center, which allowed residual coal tar to collect at the bottom outer edges for removal. These tanks typically did leak, and their sites are often highly contaminated with coal tar. As tanks were built larger, they became deeper. About 1900 tank construction shifted to aboveground tanks with sheet steel or reinforced concrete walls and reinforced concrete slab bases, which generally resulted in reduced soil contamination (Hatheway 2012a:413, 417, 420-429).

Gas Bell Travel Mechanisms

The vertical travel of a cylindrical gas bell had to be carefully controlled in order to keep it physically concentric with the water seal tank it rode and fell within. Vertical travel was controlled by a variety of mechanisms that evolved over time. Some of the very earliest, small systems had square tanks and bells, but the cylindrical model was quickly adopted for its greater stability, with installation at the first larger urban gasworks after 1810. Typical early urban gasholder bells were made large enough to store a 24-hour distribution supply of gas, which was filled during the day and consumed for illumination overnight. Many mechanical aspects of cylindrical gasholders, including movement-guidance systems, were developed by British gas engineer John Malam about 1820. The earliest bells used a central guide system, employing a vertical tube at the center of the bell, which itself rode up and down a fixed central column (Figure 3). This system was only practical for small installations. About 1850, the capacity of gas bells was increased through development of the double-lift bell, which incorporated a second, inner ring (lift) that telescoped up and down from the inside of the first and included a positive seal between the sections. Triple-lift holders emerged about 1870. As gasholders became larger, center columns faded from use and were replaced by systems where vertical travel was guided by a system of cables and rollers. About 1860 cable systems were replaced by multiple external columns, with vertical bell travel guided by rollers mounted on goosenecks attached around the upper exterior edge of the bell. That system was common through the 1880s, when columns were replaced by the more familiar external cage-like cylindrical frame and roller guide systems, which remained common well into the twentieth century. Alternative systems emerged that were guided by internal spiral guides, and by the 1920s, very large, waterless, non-telescoping models dominated the skyline at large urban gasworks (Hatheway 2012a:413-416, 423; Thomas 2014:6-9).

Typically, every gas company was driven by consumer demand to expand its distribution system and therefore increase all elements of production capacity. As gasworks expanded their gas making capacity, new, larger gasholders were installed. Often the original older, smaller gasholders were retained, as they could still serve one or more useful functions. This was particularly true where carbureted water gas (CWG) generating systems (described below) replaced former coal gas or other previous systems. In those cases at CWG plants, the original holder was retained as a "relief" holder, which provided regulating backpressure for the cyclical recurrence (nominally every few minutes) of blow and run of the CWG generator equipment and acted as a cooler for the fresh hot gas from the generator. Its water seal acted to remove tiny tar particles in the gas. CWG tar was not desirable as a coal tar chemical commodity, and it was not unusual for the relief holder water-seal tank to be used as a collection well for unmarketable tar (see below) (Hatheway 2014:140, 412).

At a minimum, a small, early, coal gas gasworks like the Claremont Gas Works would typically have had masonry buildings including a retort house, a physically separate purifying house, and a gasholder house for gas storage and distribution, as well as one or more coal storage sheds, which could be more ephemeral, wood-framed buildings. All coal gas plants required a boiler to raise steam to transport hot coal tar residuals and run mechanical equipment including large valves. Larger and later, more sophisticated operations included ancillary support features including meter rooms, a laboratory, administrative office, etc. (Grossman & Assoc. 1993 in Pratt & Nolte 1998:11; Hatheway 2012a:113).

Coal Gas at Claremont

The state of the manufactured gas industry in the 1850s dictates that the Claremont Gas Works was a coal gas plant as that was the primary available proven technology for practical production in that era, when gas manufacturing relied almost entirely on the simple coal gas process (Hatheway 2012:91). Construction of the nearby Central Vermont Railroad west of Claremont's mill district in the 1850s made delivery and construction of gasworks equipment practical. Pre-Civil War gas plants were typically constructed from premade or prefabricated specialized parts and standard building materials shipped by rail and assembled by journeyman builders and plumbers. By about 1885, specialty companies evolved to erect and equip entire gas plants (Hatheway 2012a:91; 2014: personal communication).

The 1884 Sanborn map shows only part of the Claremont Gas Works complex. Only the two southern buildings, labeled “open coal ho.’s”, are shown, indicating coal as the raw material for gas making.

The 1889 Sanborn map shows the entire Gas Works complex, including the one-story brick Retort House, round brick Gasholder House immediately southwest, and an adjacent brick "store house" east of the gas tank. The 1894 Sanborn map depicts a brick chimney on the east elevation of the Retort House, presumably serving as the draft stack for a single retort bench located against the east side of the building.

The Retort House would have also contained the condenser and other coal tar and impurity clarifying equipment. It is likely that the brick "store house" building housed the gas purifier for all or a latter portion of the coal gas phase at Claremont, as that equipment was typically isolated to protect other equipment and operating personnel from explosions (Sanborn maps 1884,1889,1894; Hatheway 2014: personal communication).

The building layout on the 1889 and 1894 Sanborn maps also shows the basic components of a typical small coal gas plant of the era: Retort House, purifier house (in this case, likely the "store house), and Gasholder House. The 1899 Sanborn map shows an "upright boiler" against the south wall inside the Retort House. A brick addition was made to the west side of the building, and the chimney was moved from the east to the north elevation. The location of that new chimney (no longer extant) can still be seen in the brickwork on the north elevation of the building. By 1899, the Claremont Gas Works had been operating for 40 years, and many aspects of the physical plant were worn out if not obsolete. The changes shown on the 1899 Sanborn likely reflect changes to gas making equipment that took place in the late 1890s. These could have included an expected rebuilding and expanding of the retort bench, possibly moving it to the north side of the building, and/or constructing a second bench to satisfy increasing demand. The changes could also reflect installation of newer gas making equipment using different technology (see below). Regardless, the condenser and gas cleaning equipment may then have been relocated to the new north addition (Sanborn maps 1899, 1894, 1899; Hatheway 2014: personal communication).

The Claremont Gasholder House

A partial survey of intact surviving New England gasholder houses conducted in 1989, which intentionally did not include ruinous examples like Claremont, identified thirteen examples. Four were originally constructed by and for industrial concerns. The survey did not identify some other surviving intact gasholder houses at locations such as Atlantic Mills at Olneyville (Providence), RI or the recently demolished example at Wanskuck Mill in East Providence. Two gasholder houses were recorded in New Hampshire, both in Concord (South Main Street, 1888; St. Paul's School, 1888), both constructed by the Concord Gas Light Company for municipal production. According to the survey, Concord's South Main Street gasholder house is the only one in the United States that retains its original gas bell. That superlative claim now seems hard to substantiate, particularly in light of the surviving Claremont gas bell (Pyne 1989:55-62).

Consultation with experts involved in manufactured gas plant environmental remediation and also knowledgeable about the history and technology of the manufactured gas industry in the United States and England indicates that the Claremont Gasholder House bell may indeed be a superlative survivor for its central vertical bell travel guide column. To paraphrase Dr. Allen Hatheway, author of *Remediation of Former Manufactured Gas Plants and Other Coal Tar Sites:* The British ca. 1818 Malam center column guided design is rare and virtually unreported in the U.S. The system would have been wholly obsolete when the Claremont Gas Works was built in 1859. Possibly some other post-1830 gas company, perhaps in or near Boston, Massachusetts scrapped the bell and sold it, for the above reason and likely because the holder simply was just too small to serve for that company. The holder and special hardware could have easily been dismantled and shipped on a railroad flat car. (Notably, the gasworks of the Keene [NH] Gas Works Company, also built in 1859, were constructed by the J.H. Carter Company of Boston). Hatheway concluded: "I am ready to say that this holder now remains unique to the extant American gas history record" (Child 1885:250; Hatheway 2014: personal communication).

Discussion with Dr. Russell Thomas, Technical Director, Environment, for Parsons Brinckerhoff in Redland, Bristol, England and a member of the Institute of Gas Engineers and Managers Panel for the History of the Gas Industry is even more compelling:

"We did have central column guided gasholders in Britain, a few diagrams remain, but no surviving examples exist in the UK. So [Claremont] could be a very rare example. I would be pretty certain this is the last example remaining in the world. I don't think any UK examples would have lasted into the twentieth century. It was a UK design originally but it is now a unique US example. So I would support its importance on an international basis. It would be very unlikely that any example in Europe would still exist."

Thomas consulted with a fellow Institute of Gas Engineers and Managers Panel for the History of the Gas Industry colleague, and reported:

"I have consulted further and the last remaining such gasholder in the UK was taken out of service in 1951, in Ingleton. We believe that this design is accredited to the Malam family of gas engineers, who were very active in the UK. It is likely that this design was exported by a British engineer or imported by a US gas engineer who had visited the UK. So we two representatives of the Institute of Gas Engineers and Managers Panel for the History of the Gas Industry are pretty certain this gasholder is unique in the world" (Thomas 2014: personal communication).

Secondary Gas Making Processes

During the 1880s and 1890s new gas-making processes and equipment were developed to replace or supplement coal gas. Many of these utilized lighter, refined grades of petroleum oils coming out of new oilfields in western Pennsylvania and refined at several East Coast U.S. cities. Oil was less expensive than coal, offered flexibility of gas making feedstock, and added illuminating value to coal gas. Existing coal gas equipment could be modified or supplemented to use the new oil-based processes, which made better-quality gas when equipment was old and/or coal supply was of poor or irregular quality. Some of the new processes utilized the fresh by-product coke pulled from coal gas retorts, at the termination of each charge. Fortunately for manufactured gas plant operators, the condensing, purification and storage steps downstream of the actual raw gas manufacturing equipment were not specific to the new equipment and could be adapted for use to treat raw gas from any and all later-period gas producing methods (Hatheway 2012a:61-62,122, 241-242; 2014: personal communication).

New Hampshire gas makers experimented considerably with various patented gas manufacturing processes, including the Sanders Process at Laconia in 1860, Tiffany oil-gas at the Portsmouth Naval Shipyard in 1873, an unidentified oil-gas process at Hanover in 1874, the Hanlon & Johnson process in 1878 at Dover, and widest-spread use of all secondary processes, the Springer producer gas at Great Falls in 1888. The Winnipesaukee Gas & Electric Company installed Kendall oil-gas equipment to replace coal gas at Laconia in 1894. The Kendall process now appears to have been the most common oil-gas process in use throughout New England in the 1890-1910 time period (Hatheway 2012a:166, 2012b, 2014: personal communication).

Secondary Gas Making at Claremont

As discussed above, the Claremont Retort House addition and relocated chimney shown on the 1899 Sanborn map indicate possible installation of updated gas making equipment in the late 1890s, after the Claremont Gas Works had been operating for 40 years. The 1904 Sanborn contains additional indications of a new gas making process. The Retort House is relabeled a "gas house," the terminology shift itself possibly indicating the presence of a new processes.

Most significantly, oil tanks appear for the first time on this map, indicated as underground units on the east side of the Retort House. A historic photograph of the Gas Works in the collection of the Claremont Historical Society dating from the mid- to late-1890s (Figure 4) shows two aboveground horizontal cylindrical metal tanks located immediately outside the east elevation of the Retort House, presumably analogous to the underground oil tanks on the Sanborn map. These tanks suggest need for large quantities of oil for an oil-based gas process in the Retort House supplementing the earlier coal gas equipment (Sanborn maps 1899, 1904).

The presence of a large supply of oil at Claremont suggests one of two possible approaches to oil-based illuminating gas production in this period, coal-gas enrichment, or an oil-gas process. In coal-gas enrichment, the simpler of the two options, light to medium grades of petroleum oil from the storage tanks, would have been sprayed into to the hot coal gas at some point soon after it emerged in the retorts and before arriving at the condenser, enhancing the gas with increased illuminating power. This process would have used the existing coal gas retorts, and may have been required in the instance of use of inferior gas-making coal feedstock. The other option, an oil-gas process, would have required a new, different kind of retort, possibly of horizontal configuration, with a thin "reactor bed" of coke placed in it. By-product coke from the adjacent coal gas retort would have been charged to the oil-gas retort as a heat source, and the petroleum oil sprayed over the bed of hot coke, making a separate component of illuminating gas that was then added to the coal gas, possibly directly after while the former yet was coming from the coal-gas retort. If an oil-gas generator was installed at Claremont, it would have been located adjacent to the earlier coal gas retort in the Retort House, and was possibly of the Kendall type also used at Laconia, New Hampshire (Hatheway 2012:122, 2014: personal communication).

Carbureted Water Gas

The last major manufactured gas process now identified at Claremont was carbureted water gas (CWG). CWG was perfected in 1873, and became popular in the 1880s, but grew out of a long history of experiments. In 1780, Italian mathematician Felicae Fontana discovered that when steam was blown over a bed of incandescent hot coke, it "cracked" the vaporized water into the separate flammable gases hydrogen and carbon monoxide, forming a compound gas called "blue gas," for its low-intensity blue flame. This gas, also called "water gas," had heat value, but minimal illuminating capacity. Its industrial heating and power generation applications were first exploited in the 1820s. By the 1860s specialized vertical cylindrical retorts for cracking steam with hot coke called "gas producers" were making what then became known as "producer gas" in industrial settings to fuel industrial steel-making furnaces, and later, to power internal combustion engines (Hatheway 2012a:67-68, 166-167).

Carbureted water gas was an outgrowth of efforts to perfect water gas and convert it to illuminating gas during the coal gas era. In 1873, Thaddeus Sobeski Constantine Lowe patented a process to enrich water gas with light coal-gas tar oils to boost its illuminating capacity. Lowe's apparatus was a three-compartment gas machine made up of three vertical cylindrical iron or steel shells, together known as a set. His essential innovation was to physically separate the first step of making water gas in a primary gas producer shell from the second step of adding the vaporized oil, which he accomplished in a second, refractory-brick-lined carburetor shell heated with the gases made in from the first. This development also coincided with a surplus of light oils from Pennsylvania refining, and became particularly desirable in places where coal was in short supply, particularly on the American West Coast. The gas had higher

BTUs and candlepower, and contained less dangerous carbon monoxide. A CWG generator set could last fifteen to twenty-five years if well maintained, as opposed to a coal gas retort bench, which required replacement of its cast-iron or ceramic-clay retorts every two to four years, and bench reconstruction at somewhat longer intervals. The CWG process had many other cost, labor, maintenance, flexibility, efficiency, and operational advantages over earlier processes. It could be connected to existing downstream clarifying and purifying components, although newer, larger downstream equipment was often installed along with new CWG equipment as part of an engineered package, particularly where increases of capacity were involved or planned. Lowe-patent and similar "oil-enriched water gas" systems intended to skirt Lowe's patents began to be used in the United States in the early 1880s. In 1884 Lowe sold his patent rights to the United Gas Improvement Company (UGI) of Philadelphia, which made continual technical improvements and increased CWG generator size capacity up to 1 million cubic feet per day. As the UGI Lowe patents began to expire in 1892, more Lowe-type CWG generators were quickly copied and installed by many gas-machine fabricators, and CWG largely replaced existing coal gas and oil-gas generation equipment across the United States by World War I (Driemeyer and Monroe 2011:5-8; Grossman & Assoc. 1993 in Pratt & Nolte 1998:11-12, 17; Hatheway 2012a: 94-96,123-129,157, 57-158; 2014: personal communication).

Carbureted Water Gas Generators and Buildings

Carbureted water gas systems typically required new facilities including a new two-story generator house. Condensing, purification and storage steps downstream of the actual raw gas manufacturing equipment were similar, although often larger and more sophisticated than for coal gas, and also often required more floor space to house them.

A CWG generator "set" consisted of a row or cluster of adjacent cylindrical steel vessels lined with an open "checkerwork" of firebrick passages: the three shells; a generator, carburetor and superheater, plus a *seal box* (Figure 5). In practice, coke or coal was first roasted in the generator on an internal supporting grate. In cyclical recurrence, "blow," air was forced onto the burning fuel, bringing it to white hot incandescence and heating the bricks. The second step called the "run," followed, when superheated steam was blown into the generator, "cracking" it into hydrogen and carbon monoxide "water gas" of about 260 BTU capacity. The hot gas was then forced into the carburetor (second shell), heating up an open liner of heat-retaining "checkerwork" of firebrick. Then coal-tar light oil, or refined petroleum light oil was sprayed into the carburetor, vaporizing it and mixing it with the basic water gas. The enriched water gas was then passed into the superheater, where contact with another hot checker-brick network completed the polymerization (fixing) of the water gas and oil vapor into carbureted water gas of about 550 BTU, with candle power (cp) generally above the usual minimal coal-gas requirement of 16 cp. The gas was piped through the clarifying and purifying equipment and thence to the gasholder for storage and distribution to customers. A CWG set was typically run by an operator stationed above and to the side of the set on an elevated floor level or "mezzanine" where they controlled the equipment through hand-operated (later steam-driven) wheels and levers connected to the machinery. It usually took just one or two additional workers to run a small CWG plant (Lawry 1977b: 13, 15; Hatheway 2012a: 94-98, 127-128, 131-139; Peele 1941:40/42-43).

Carbureted water gas sets were housed in a distinctive "generator house" that shared some features with most gasworks buildings of the era, including masonry brick walls, gable roofs, and ample fenestration for interior lighting. A CWG building was typically two stories tall, and divided into two major interior spaces. A larger, open, full-height room housed the generator set, and an adjacent, smaller space contained an elevated floor for gravity fuel feed for the generator and operator's control mezzanine. The roof was typically supported with fireproof steel trusses and sheathed with a fireproof slate or metal roof.

The generator room roof incorporated a longitudinal ventilation monitor to vent heat and stray gases. The superheater had a characteristic tall, narrow sheet metal vent stack rising above the roofline (Hatheway 2012:17-18; 129).

Gasholders in the Carbureted Water Gas Era

Establishment of a carbureted water gas plant required construction of a new, larger, companion gasholder to provide increased storage capacity. After 1900 these were new types with above-ground steel water-seal tanks, and telescoping bells, sometimes with multiple telescoping sections, supported by external, skeletal steel frames. Often the older, smaller gasholders were not demolished, however, as they provided important functions in the system as so-called "relief" holders. Relief holders performed two major functions, one related to the gas generating equipment and the other to the quality of the gas itself. A relief holder served as a separate internal plant equipment pressure regulator to equalize pressure between the "blow" and "run" cycles of the CWG generator. A relief holder also allowed the gas to cool. Tar in the gas accumulated on the surface of the bell seal water, providing an incidental last tar removal step. In some cases, a third, even larger distribution gasholder was built at a gasworks if additional gas-generators sets were added and corresponding storage capacity was needed. In those cases, the previous, second gasholder originally constructed as a storage and distribution holder became the relief holder, and in some cases the original, first gasholder, usually oldest, smallest, worn out and technologically obsolete, became a tar well (Hatheway 2012a:140; 432-433).

Gasworks Tars

At this point in time in the history of gas works equipment, technology and waste generation, the issue of tar accumulation, quality and disposal became important and intertwined with gas holders and other on-site features including tar separators and tar reservoirs or wells.

Unlike the earlier coal gas process, which generated marketable by-product tar valuable to the coal tar industry, the CWG process made large quantities of tar of variable quality and often worthless as a by-product. Ideally a CWG generator, as specified by its inventor, T.S.C. Lowe, employed coke and tar-oil naphthalene or refined petroleum oils which produced residual water-gas tar of generally less than 6 percent water that useful for many follow-on by-product applications. However, if bituminous coal was substituted for coke or anthracite hard coal, the resulting CWG gas tar became a tar-water emulsion, with water content bound to tar particles and globules, producing a residual with up to 60 percent water that was unwanted by tar-chemical industry. As more and more gas plants moved away from coal gas, coke was less immediately available, and gas plants increasingly turned to soft coal as their generator feedstock. As automobiles became more popular, quality oils soared in price and were simply no longer available to the CWG plants. CWG plants were forced to use lower-quality oils for the carburetion step, often resorting to use of crude oil. The advent of World War I removed both of the desired feedstocks completely, resulting in even larger quantities of unmarketable, high-water-content tar that had to be expensively treated for water removal or disposed of on-site or nearby, and tar separators and additional terminal-repository tar wells or reservoirs began to appear on gasworks sites (Hatheway 2012a: 96-101; Lawry 1977b: 13, 15; Peele 1941:40-43).

Tar Separators

The CWG tar emulsions that collected in gasholder bell seal water in "relief" holders, and ammoniacal liquors and other light tar-contaminated liquids from a gasworks had to be collected, separated from water, and periodically disposed of. Most tar separator installations were responses to public agency awareness of gasworks-related river and steam pollution, particularly where downstream industries requiring clean process water such as paper and textile concerns were located. Simple, dedicated separators began to appear by the 1920s and became more common with the advent of carbureted water gas in the 1930s. Tar separators were typically placed near the nearest stream or river where water and gas liquors stripped of tar could be pumped and flushed away. A typical separator consisted of a rectangular in-ground chamber containing a series of open rectangular sections (Figure 6). The liquors flowed over and under transverse wooden weirs (baffles) placed to lengthen the travel time and subsequent exposure of the gas-liquor wastewater to the chilling effect of cool water, dropping tar particles to the floor of the separator, leaving the clarified wastewater more acceptable for direct discharge to the nearest stream or river. Early and smaller separators had wood plank walls; larger installations had concrete side walls. Most leaked into surrounding soil. As manufactured gas tars were usually denser than water, tar accumulations fell to the bottom of the chambers and the liquor was skimmed off the top. Tar accumulations were periodically drawn from the bottom of the separator manually or by pump. These sludges were not marketable as a by-product, and were simply disposed of on site or nearby (Hatheway 2012:322, 329-330; Sperr 1921:566-571).

Tar Wells

As noted, after about 1910, tar accumulation at CWG plants became a chronic problem. A common solution was to convert an older gasholder into a tar storage well for tar-bearing water and liquors. Former relief gasholders became dumping grounds for accumulated unmarketable water-laden tar, sometimes leading to massive tar deposits that are now often the most significant hazardous waste issue found at MGP sites. Tanks built before about 1900 usually had permeable bottoms with no barrier to contaminant migration of contaminated seal water, and can potentially contain tar deposits as thick as the tank is deep, typically about 15 feet (Hatheway 2012a:139-140,309,432-433, Lawry 1977b: 13,15).

In New Hampshire, documented examples of this phenomenon include gasworks sites at Laconia and Concord. At Laconia, in 1929 the operators converted the oldest of three gas holders to a tar-collection tank from which decanted gas liquors were discharged directly into a small bay at the head of the Winnipesauke River. At the Concord gasworks, environmental remediation contractors discovered that an old gasholder (no longer extant) had been used to dump tar-water emulsions (Hatheway 2012a:336; Hatheway 2012b; 2014: personal communication).

Carbureted Water Gas at Claremont

The third and final manufactured gas process installed at Claremont resulted in major expansion and modernization that started in 1904-1905. These developments followed industry trends of the time and included features consistent with carbureted water gas production. In 1883, the A.O., Granger & Co. of Philadelphia, a subsidiary of the United Gas Improvement Company, installed New Hampshire's first Lowe-process carbureted water gas equipment at Keene, and thereafter new gas equipment installed in existing gas plants of New Hampshire were likely of the Lowe process (Hatheway 2012b).

According to an October, 1904 article in the *National Eagle*, Monadnock Mills had contracted with the Logan Iron Works of Brooklyn, New York for a 50,000 (cubic) foot "gas tank" (gasholder) to be completed by December of that year. Logan Iron Works was a custom steel fabricator specializing in tanks, holders, equipment for bridges, tunnel construction, oil works, water towers, boilers and gas works, and was the leading New York City-area gasholder fabricator from about 1870 through 1914. The *National Eagle* article stated that imminent construction of a "new gas manufactory" was possible, and that the purpose of the tank was to store more gas to increase delivery pressure and to "age" the gas to improve its quality. These factors indicate projected increased generating capacity and recognition of the need for removal of CWG tar-water emulsions via a relief gasholder (*American Society of Mechanical Engineers* 1920; Hatheway 2014: personal communication*; National Eagle* 1904: October 1).

A 1907 article in the *Claremont Advocate* is helpful for determining additional aspects of the Gas Works operation and equipment at that time. The gas company was reorganized in February of 1905 at which time the new gasholder, with stated capacity of 50,000 cubic feet, as well as 9 miles of gas distribution mains were installed. According to the article in the winter of 1906 a second "generator" was installed, indicating additional gas making capacity, with terminology consistent with CWG equipment. The article notes installation of "four large steel purifiers," indicating need for additional gas purifying capacity, also using new purification equipment. The article also states that the system was connected to "the old gas holder, which is used as a relief tank, thus ensuring always a plentiful supply of gas of good quality, free from tar or other impurities," again recognizing the need for removal of the valueless CWG tar-water emulsions and clearly stating use of the 1859 gasholder as a relief holder (*Claremont Advocate* 1907: January 18).

There is some discrepancy in the historical record regarding Claremont gasholder capacities. The 1907 *Claremont Advocate* article states that the capacity of the new 1905 holder was 50,000 cubic feet. The Historic American Engineering Record 1978 Inventory Card states that the 1905 holder capacity was 12,000 cubic feet and the 1924 holder capacity was 50,000 cubic feet. Thus, the HAER capacities appear erroneous. Gasholders were usually designed to contain a 24-hour supply of gas, which was typically generated during the day and consumed at night when most needed for domestic illumination and heat. Consumption was much greater in darker and colder times of the year. Based on estimated dimensions of 32 foot diameter and 15 foot height, the volume of the original 1859 holder is 12,000 cu ft. According to the *Claremont Advocate*, in 1905, presumably the first year for at least partial CWG production, the gasworks sold 7 million cubic feet of gas, and in 1906 they sold 9 million cubic feet. That represents an annual average of 19,178 cubic feet a day in 1905 and 24,657 cubic feet a day in 1906, with more than the latter figure typically consumed on winter days. These capacities would have clearly required a holder of more than 12,000 cubic foot capacity, certainly approaching 50,000 cubic feet, to allow for winter consumption and added generating capacity (*Claremont Advocate* 1907: January 18; HAER 1978).

An article in a 1943 issue of the *Claremont Daily Eagle* stated that in 1911, Monadnock Mills built their own steam boiler plant for heat and textile processing and that was also "connected to the gas light company's gas manufacturing equipment...to furnish all steam required by the gas light company to produce gas," indicating that steam was required to operate the mechanical equipment, and presumably as one of the key ingredients in CWG production specifically (*Claremont Daily Eagle* 1907: January 18).

The 1910 Sanborn fire insurance map indicates major changes to the Gas Works since the 1904 map. The 1859 store house (purifier house) east of the Gasholder House was replaced by the current Gas Generator House. The map indicates the Gas Generator House as divided into a two-story south section and a high, open north section, indicating the split-floor interior height characteristic of CWG generating houses. The old coal-gas Retort House remains attached to the north but not labeled by function. The underground oil tanks were still shown at the east side of the Retort House, with the area covered with a new wood frame shelter. The 1905 Gasholder No. 2 is shown east of the Gas Generator House (Sanborn maps 1904, 1910).

The 1918 Sanborn map includes a north-south aligned row of four small circles labeled "retorts" in the northeast corner of the Gas Generator House. The circles are not likely individual retorts, but instead represent the four major cylindrical Lowe-type CWG generator, carburetor, superheater and either the water seal or condenser vessels. The Retort House is labeled as a "coal house." Also, a "cement tar tk."

[tank] appears at the extreme east side of the complex on the north side of the access road to Broad Street (Sanborn map 1925). The latter tank was likely was an additional tar-separator placed to deal with an ongoing concern for managing tar-water CWG emulsions.

The 1925 Sanborn map shows a third, larger gasholder was added on the east side of the property, near the one added in 1905, but larger in diameter. The HAER inventory card indicates this gasholder as being built in 1924 and having a capacity of 50,000 cubic feet, however it appears that the 1905 gasholder is the 50,000 cubic foot unit, and the 1924 holder was of even greater capacity. The open sawmill tailrace channel indicated on previous Sanborn maps is no longer shown, suggesting that it was filled in with spent purifier box wastes and possibly other gas making wastes such as manually-collected tar-separator sludges by that time (HAER 1978; Sanborn map 1925).

The 1948 update to the 1925 Sanborn map shows that the underground oil tanks east of the Retort House were replaced by five parallel rectangular tanks at the north side of the building, suggesting additional oil storage for increased gas making feedstock capacity. The Retort House roof is shown as having a monitor, a feature consistent with the need to vent CWG equipment heat and gases. A new rectangular "ir. [iron] purifier tank" was shown immediately east of the Gas Generator House, also possibly indicating new equipment associated with added production capacity (Sanborn map 1948).

Claremont Tar: Gasholders, Separators, Wells and Tanks

The 1859 gasholder was used for manufactured coal gas storage and distribution from 1859 to 1905, when the new 50,000 cubic foot gasholder was constructed for CWG production capacity. Documentation shows that the 1859 gasholder then became the relief holder, partially to collect CWG tar emulsions that were precipitated in contact with the bell seal water. When the third, still larger gasholder was constructed in 1924, the 1905 gasholder would logically have become the CWG relief holder. It appears that after 1924, the 1895 gasholder was used as a CWG tar well.

The two rectangular, wood plank-lined tar separator boxes in the ground northwest and south of the 1859 Gasholder House were likely installed after the 1905 CWG equipment went on line to collect additional CWG tar-water emulsions being carried in the general CWG plant wastewater gas liquors. The separators were likely built after 1920, certainly by 1930, to address increasing tar accumulation issues from the CWG process itself, aggravated by loss of routine gas liquor direct discharge to the Sugar River and/or on-site disposal pits, increased production volume and possible use of poor-quality coal and/or oil feedstocks. The appearance of the concrete "tar tank" by 1918 may reflect installation of additional tar dewatering equipment in an effort to recover and market a portion of lower water content CWG tar for boiler and furnace fuel (Hatheway 2014: personal communication).

Conditions at the 1859 Gasholder House indicate its conversion to a secondary tar well after the 1924 gasholder was constructed and the 1905 gasholder became a relief holder. The scenario for this use would have been continued generation of tar-water emulsion beyond the c. 1924 ability of the gasworks management to deal with the quantities of unwanted tar-water emulsions. The network of various diameter pipes with multiple valves now found positioned on the top of the gas bell, including the one at the west side that crosses the edge of the bell and masonry tank and descends into the ground appear to be part of a system for pumping tar-water emulsions from the 1905 gasholder when it served as the 1924 gasholder's relief holder. Some of those pipes would have been for steam to keep the tar-water emulsions flowing in winter. This conversion may also have included penetration or even partial demolition of the Gasholder House outer masonry walls to allow access for the steam-heating and emulsion-delivery pipes (Hatheway 2014: personal communication).

BIBLIOGRAPHY

Adams, George
1852 The Massachusetts Register: A State Record for the Year 1852. Printed by Damrell and Moore, Boston, MA.

American Society of Mechanical Engineers
1920 Biography of William J. Logan. *Transactions, American Society of Mechanical Engineers.*

The American Textile Trade Review
1906 *Fibre & Fabric, A Record of Progress in American Textile Industries,* No. 1131, Volume XLIV, November 3, 1906, Boston, MA.

Anonymous
n.d. Claremont Railway & Lighting Company, 1903-1919, Claremont Railway Company, 1919-1954: Introduction to Claremont, New Hampshire's Electric Street Rail.

Atlantic Environmental Services, Inc.
1992 *Draft Remedial Investigation Report, Niagara Mohawk Power Corporation Site, Saratoga Springs, New York* Prepared for Niagara Mohawk Power Corporation, Saratoga Springs, New York by Atlantic Environmental Services, Inc., Colchester, Connecticut. September 1992.

Belmont Light
http://www.belmontlight.com/about-us/mission-history.php, accessed May 1, 2015.

Benjamin, Park
1880 *Cyclopedia of Applied Mechanics: A Dictionary of Mechanical Engineering and the Mechanical Arts.* Vol. 1 D. Appleton & Co., New York, NY.

Brown, E. C., compiler
1890 *Brown's Directory of American Gas Companies*, Press of "Progressive Age", NY.

Charlton, Edwin A.
1855 *New Hampshire As It Is in Three Parts: Part II, A Gazetteer of New Hampshire*, Tracy and Sanford Publishers, Claremont, N.H.

Cheney, G. A.
1908 "New Hampshire's Largest Town: The Claremont of Today and Tomorrow – Its Men and Affairs," *The Granite Monthly*, Volume XL, No. 4 and 5, April and May 1908.

Child, Hamilton.
1885. *Gazetteer of Cheshire County,* N.H., 1736-1885. Syracuse, NY.

Claremont Advocate
1907 "The Claremont Gas Light Company," January 18, 1907.

Claremont, City of
1948 City of Claremont, New Hampshire: First Annual Report, Fiscal Year Ending December 31, 1948.

Claremont Daily Eagle
1930 "Gas Co. to Move Offices to Pleasant Street," February 8, 1930.
1934 "Gas Co. Loses Action to Force Local Mills to Furnish Steam," September 26, 1943.
1964 "Utility Company Supplies Service and Appliances," October 20, 1964.

Claremont, Town of, Selectmen and Other Town Officers
1891 *Annual Report*, The National Eagle Press, Claremont, NH.
1898 Annual Report, The National Eagle Printery, Claremont, NH.
1903 *Annual Report*, The National Eagle Printery, Claremont, NH.
1918 *Annual Report*, The Advocate Press, Claremont, NH.
1925 *Annual Report*, Eagle Press, Claremont, NH.
1932 *Annual Report*, Eagle Press, Claremont, NH.

Croft, Georgia
n.d. A Walking Tour of Claremont Village Industrial District.

Driemeyer, Laura and Lynne Emerson Monroe
2011 Individual Inventory Form for the Nashua Gas Light Company/Nashua Light, Heat & Power Co., Nashua, NH, New Hampshire Division of Historical Resources Inventory #NAS0234, prepared by Preservation Company, Kensington, NH.

Fernald, Robert H. and George A. Orrock
1927 *Engineering for Power Plants.* McGraw-Hill Book Company, Inc., New York, NY.

GenDisasters.com
http://www3.gendisasters.com/new-hampshire/875/claremont,-nh-tremont-house-fire,-mar-1879?page=0,1, accessed May 2, 2015.

Goodwin Gas Stove & Meter Co., The
1886 Directory of Gas Light Companies and Their Officers in the United States and Canadas (sic), Fifth Edition, The Goodwin Gas Stove & Meter Co., Philadelphia, PA, New York, NY, and Chicago, IL.

Grossman and Associates, Inc.
1993 *Stage II Archaeological Data Recovery and Mitigation Results of the Investigation of the Historic Coal Gasification Works at the Niagara Mohawk Power Corporation Site, Saratoga Springs, Saratoga County, New York.* Submitted to the Niagara Mohawk Power Corporation, Syracuse, NY by Grossman and Associates, Inc., of New York, NY., pp.10-30. As reproduced in *Historic American Engineering Record documentation of the Saratoga Gas Light Company, Gasholder No. 2, Saratoga Springs, NY, HAER No. NY-313*, Daniel R. Pratt and Kelly Nolte, Panamerican Consultants, Inc. Tuscaloosa, AL.

Hatheway, Allen
2012a *Remediation of Former Manufactured Gas Plants and Other Coal Tar Sites.* CRC Press/Taylor & Francis Group, Boca Raton, FL.

Hatheway, Allen
2012b "Locations of Gas Plants and Other Coal-tar Sites in the U.S.: The State of New Hampshire." http://www.hatheway.net/state_site_pages/nh__main.htm

Hatheway, Allen
2014 and 2015 Personal communication with author Matt Kierstead, November, 2014-January, 2015.

Hawley, Monica, HAER/TPS
1978 Historic American Engineering Record, Claremont Village Industrial District, HAER No. NH-1., Data Sheet, Written Historical and Descriptive Data.

Hurd, D. H.
1892 *Atlas of New Hampshire*, D. H. Hurd & Co., Boston, MA.

Johnson, John P., HAER/TPS
1978 Historic American Engineering Record Inventory Card for Claremont Gas Light Company, Monadnock Mills Co., Claremont Project.

Lawry, Nelson
1977a "A look at Dover's vital, yet little-known gasworks," *Dover Times* "Past Perspective" July 31, pp.4, 15.

Lawry, Nelson
1977b "Classical gas: It's just a burning matter in Dover," *Dover Times,* "Past Perspective", August 7, pp.13, 15.

Louis Berger & Associates
1995 Claremont Railway Bridge, Claremont, NH, HAER No. NH-24.

Marks, L.S. and H.S. McDewell
1921 "Gas Producers." *Cyclopedia of Engineering.* American Technical Society, Chicago, IL.

National Eagle
1856 "Claremont Gas Light Company," March 20, 1856.
1856 "Claremont Gas Company," April 10, 1856.
1859 "Keene to be Lighted with Gas," September 15, 1859.
1866 "Home Matters: Gas," January 20, 1866.
1904 No title, October 1, 1904.
1907 "Claremont Gas Light Company," January 12, 1907.
1907 "We do not want it," January 19, 1907.

NH Board of Railroad Commissioners
1876 Report of the NH Board of Railroad Commissioners, June session, 1876, Edward A. Jenks, State Printers, Concord, NH.

NH General Court
1854 Laws of the State of New Hampshire, June Session, 1854, Amos Hadley, State Printer, Concord, NH.
1901 Laws of the State of New Hampshire, Passed January session, 1901, Arthur E. Clarke, Public Printer, Manchester, NH.

NYS DEC
MGP Glossary: http://www.dec.ny.gov/chemical/24907.html

Peele, Robert, ed.
1941 "Gas Producers," *Mining Engineers' Handbook.* John Wiley & Sons, Inc., New York, NY, Chapter 40, Section 15.

Pollak, Richard J.
1969 "Historical Report for Troy Gas Light Company, Gasholder House." Historic American Engineering Record, HAER No. NY-2.

Poor's Railroad Manual Company
1911 *Poor's Manual of Industrials: Light, Water, Power, Mining, Telephone, Telegraph, Manufacturing, and Miscellaneous Corporations*, New York, NY.

Public Service Commission of New Hampshire
1913 *Second Report of the Public Service Commission of New Hampshire, for the Period Ending August 31, 1912.* Concord, NH.

Public Service of New Hampshire
http://www.psnhnews.com/content/keene-celebrates-monumental-environmental-effort.

Pyne, Mary E.
1989 "New England's Gasholder Houses," *IA: The Journal of the Society for Industrial Archeology*. Vol.15, No. 1, pp.54-62.

Ruger, A., delineator
1877 Birds eye view of Claremont, Sullivan County, N.H. 1877, Shober & Carqueville Litho. Co, Chicago, IL.

Sanborn Map Company, New York, NY.
1884 Claremont, NH.
1889 Claremont, NH.
1894 Claremont, NH.
1899 Claremont, NH.
1904 Claremont, NH.
1910 Claremont, NH.
1918 Claremont, NH.
1925 Claremont, NH.
1948 Claremont, NH.

Senate of the United States
1860 The Executive Documents, Annual Report of the Commissioner of Patents, Volume 6, No. 11, George W. Bowman, printer, Washington DC.

Sperr, F.W. Jr.
1921 "Disposal of Waste From Gas Plants." *Gas Age Record*, November 5, 1921, pp.566-571

Taylor, William L.
1984 "Historical Report for Concord Gasholder House." Historic American Engineering Record, HAER No. NH-7.

Thomas, Russell.
2014 "Gasholders and Their Tanks: A profile of the construction of different types of gasholders, their associated tanks and their occurrence on former gasworks and gasholder station sites." Parsons Brinckerhoff, Redland, Bristol, England.

Thomas, Russell, Technical Director, Environment for Parsons Brinckerhoff, Redland, Bristol, England.
2014 Personal communication with author Matt Kierstead, 27-28 November 2014.

Tolles, Bryant F., Jr., New Hampshire Historical Society.
1974 Monadnock Mills National Register Nomination.

True Blue Environmental Services
http://trueblueenvironmental.com/projects/environmental-services/mgp-remediation/former-keene-mgp-land-based-remediation/

http://trueblueenvironmental.com/projects/environmental-services/mgp-remediation/former-mgp-remediation-franklin-nh/

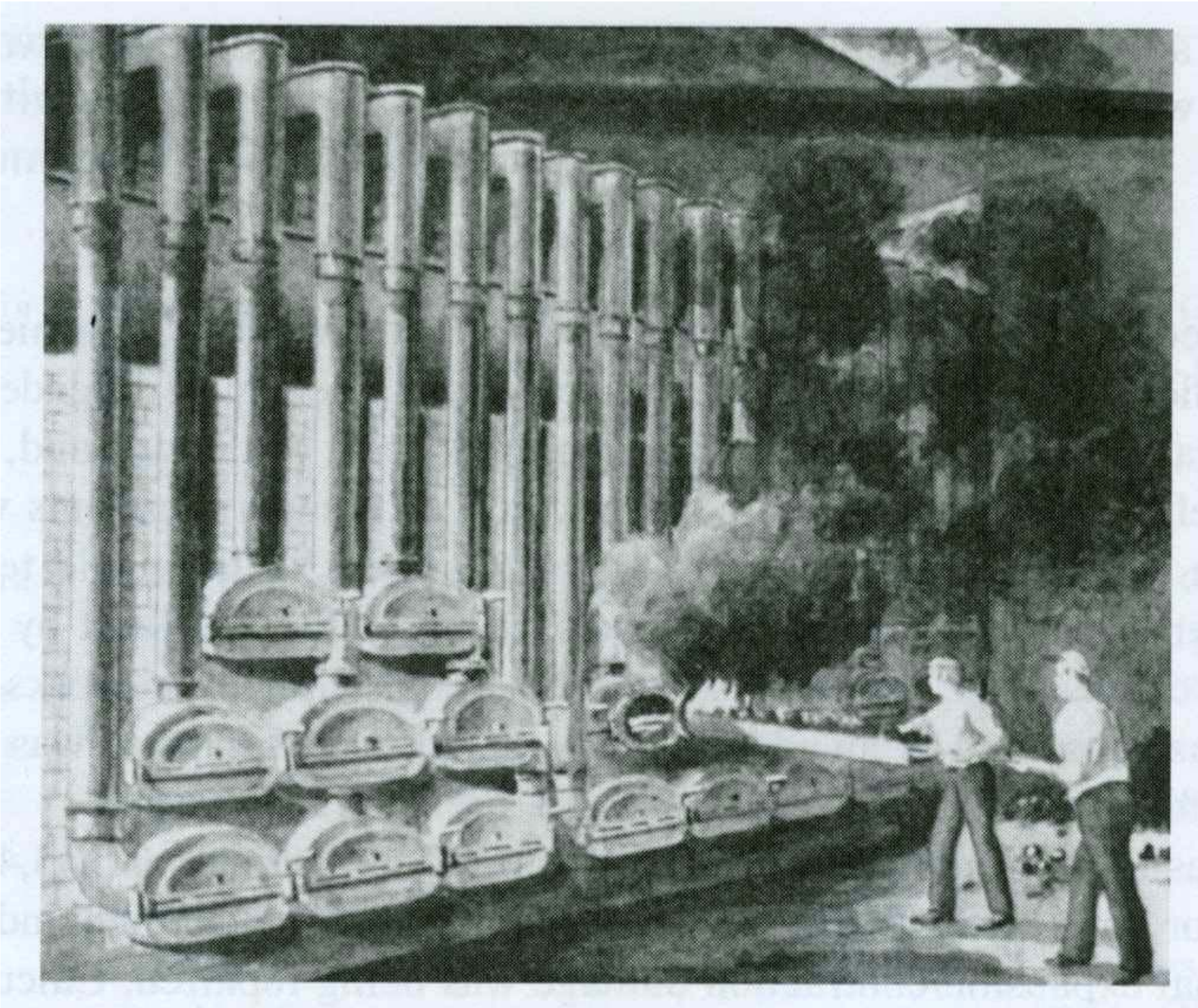
United States (US) Commissioner of Patents
1891 Annual Report of the Commissioner of Patents for the Year 1890, Government Printing Office, Washington DC.

Waite, Otis F. R.
1895 *History of the Town of Claremont, New Hampshire, For a Period of One Hundred and Thirty Years from 1764 to 1894*. Printed by the John B. Clarke Company, Manchester, NH.

Walling, H. F.
1860 Topographical Map of the County of Sullivan, NH.

Wikipedia
http://en.wikipedia.org/wiki/Claremont,_New_Hampshire, accessed May 1, 2015.

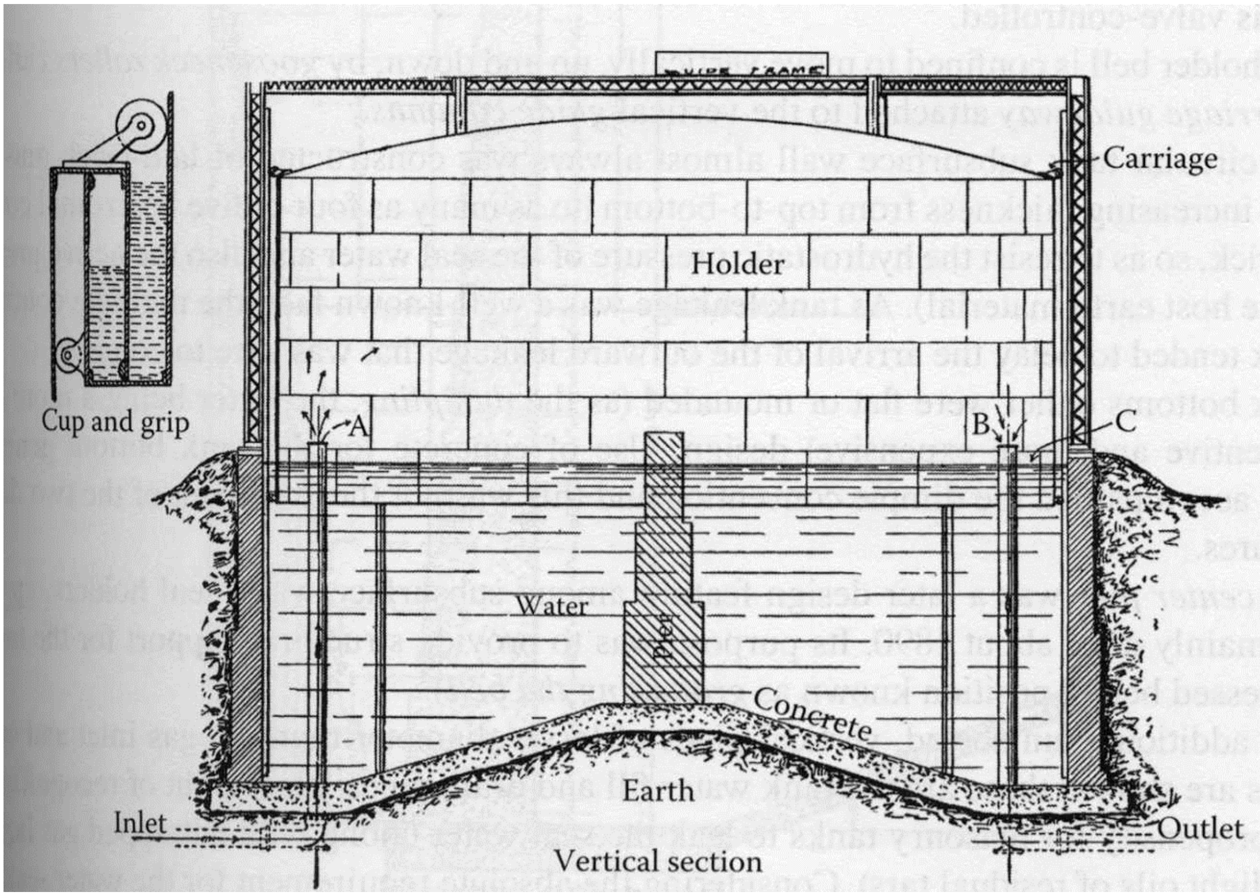
Figure 1. Coal Gas Retort Bench Illustration



Gasworkers withdrawing coke from a typical coal gas retort. Note clusters of retorts forming the "bench," and vertical pipes for collecting raw coal gas.

From United Otto Co., 1908 as reproduced in Hatheway 2012a:110, Fig. 1.12.

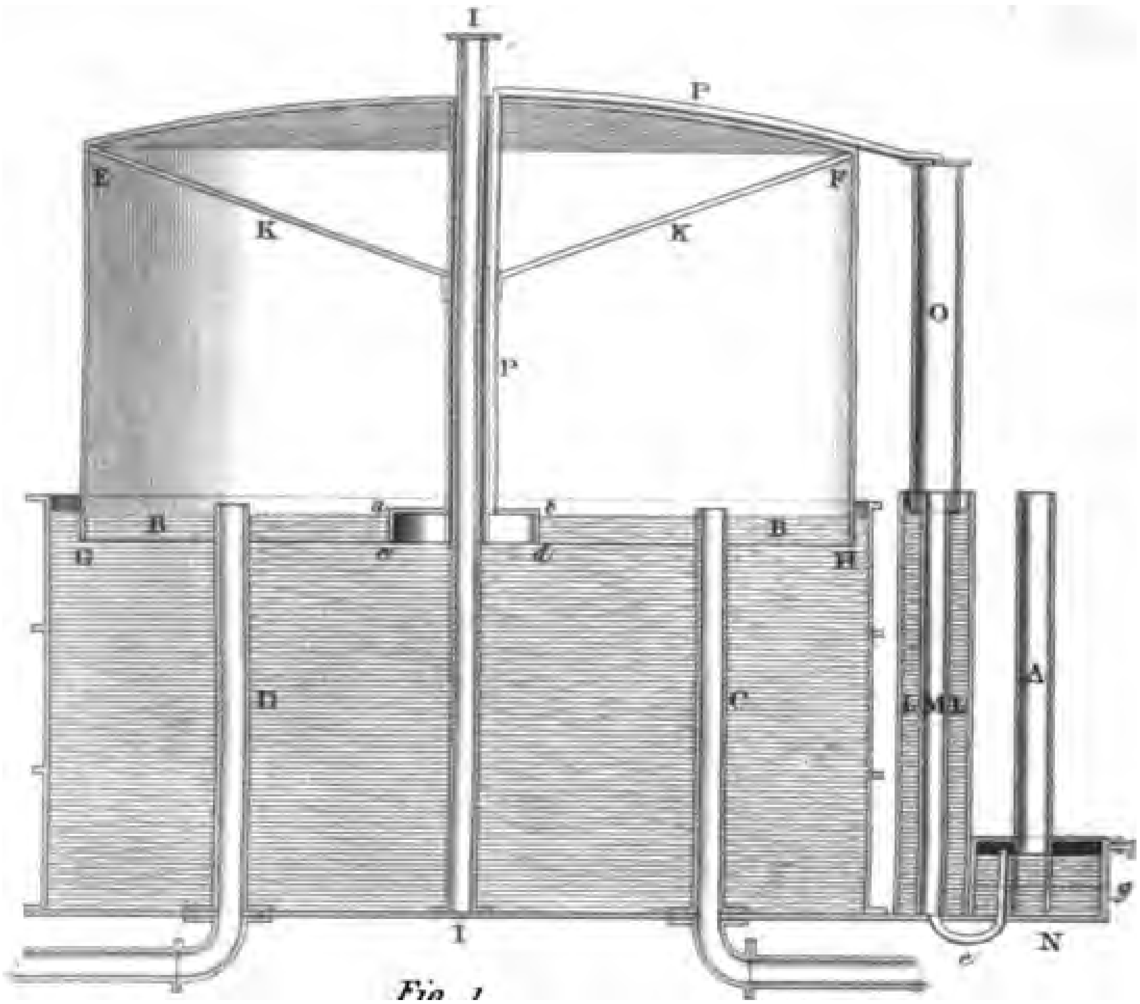
Figure 2. Typical Gasholder Cross-Section



Schematic section of pre-1900 subsurface gasholder with single-lift bell. Hollow bell ("Holder") rises and falls within water contained by underground tank. Gas is pumped in at pipe A and let out at pipe B; water forms seal for gas, and bell rises and falls according to gas volume. Floor in this example is concrete and includes raised central "dumpling" and support post for lowered bell. This bell is guided by rollers an external frame unlike Claremont's earlier center column-guided bell.

From *Catechism of Central Station Gas Engineering*, AGI, 1909 as reproduced in Hatheway 2012a:419, Fig. 6.18.

Figure 3. Center Column Bell Illustration



Cross section through a typical center-column guided gas bell, ca 1819. Bell above rises and falls within tank below guided by center column "I."

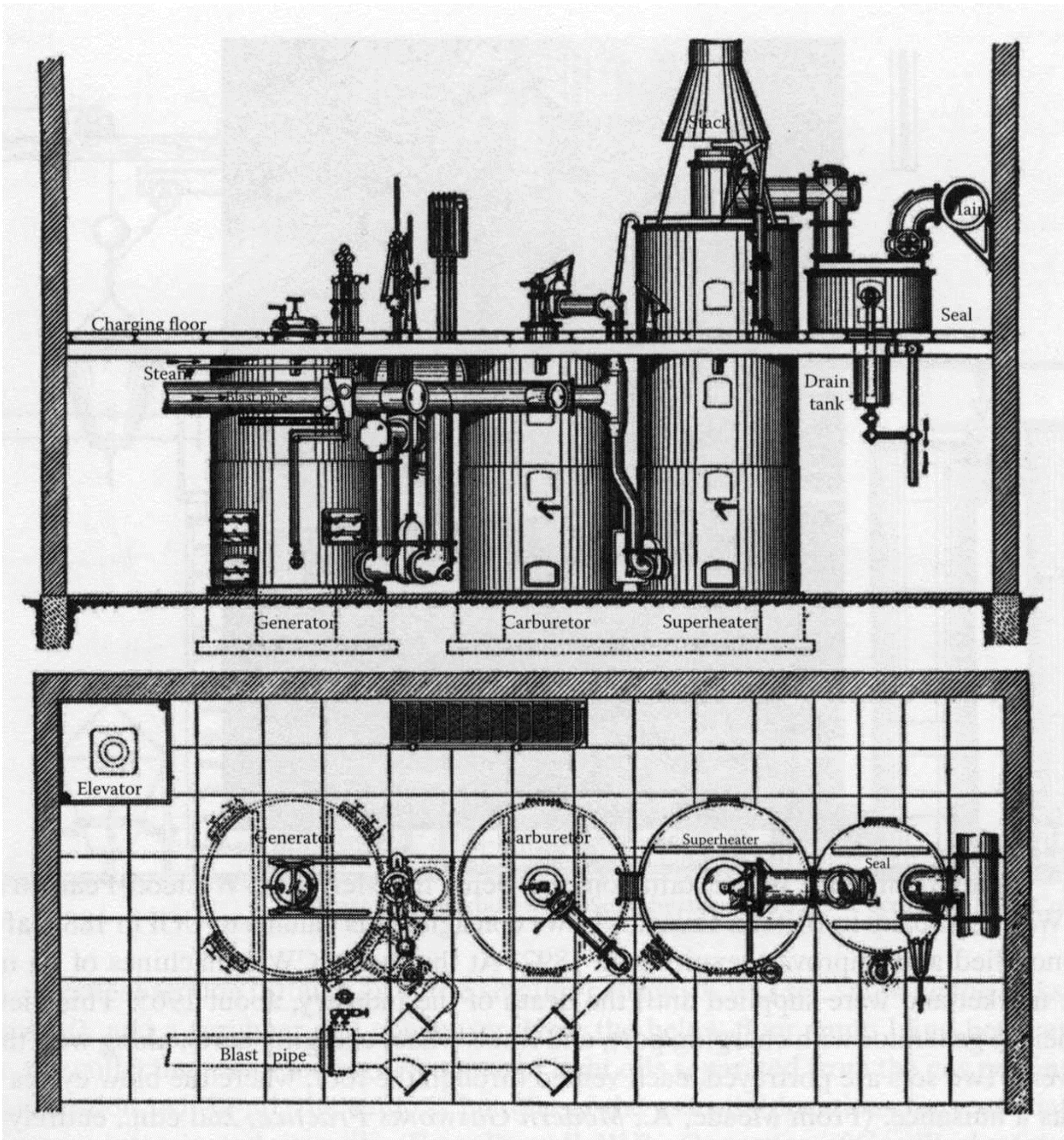
From Thomas Snowdon Peckston, *A Practical Treatise on Gas-Lighting*. Thomas and George Underwood, London, 1819. Plate XI, p. 256.

Figure 4. HAER NH-2-20 Photograph

(HAER NH-2-20. Photocopy of a photograph (original in the collection of the Claremont Historical Society) ca. 1890, photographer unknown. View of the Monadnock Mills from North Street, showing the Company's gas works in the foreground. Monadnock Mills, 15 Water Street, Claremont, Sullivan County, NH)

HAER NH-2-20, a copy of a historic photograph probably dating from the mid- to late-1890s, shows the coal storage sheds with coal piles at left. The Gas Works is shown in entirety including the Gasholder House at rear, storage house in front of it, and the original 1859 Retort House with attached retort draft stack (chimney) on the north elevation. Two long metal tanks are located immediately outside the Retort House, possibly analogous to the underground oil tanks that appear by the 1904 Sanborn map). These tanks suggest use of an oil-gas process in the Retort House in addition to the earlier coal gas equipment.

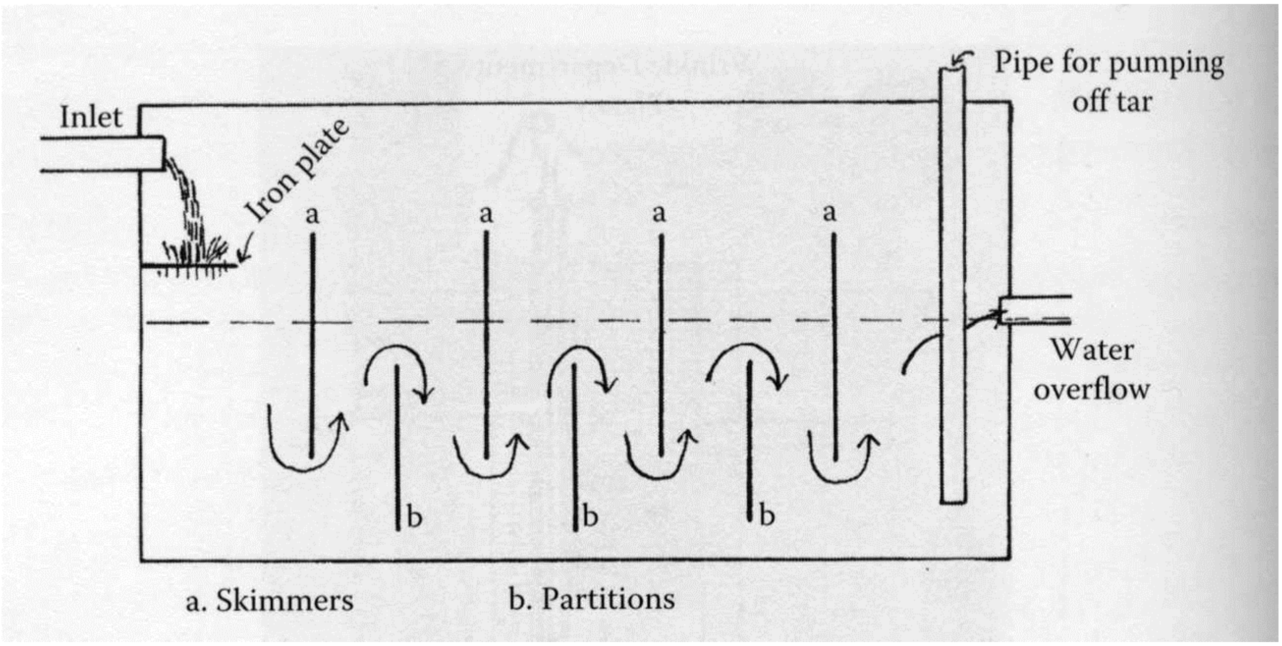
Figure 5. CWG Set Illustration



Vertical section and plan of a typical carbureted water gas generating set showing basic components from left to right: generator, carburetor, superheater and wash box (seal). These four cylindrical components are expressed by the four circles on the ca. 1910 and later Claremont Sanborn maps.

From W.R. Russell, *Operation of Gas Works*, 1st ed., McGraw-Hill Book Company, New York City, NY as reproduced in Hatheway 2012a: 131, Fig 2.23.

Figure 6. Tar Separator Illustration



Section through typical basic tar separator design, ca. 1908. Baffles slow the flow of gas liquor and promote skimming of light tar oils and settling of tar and sludge. Water overflow was disposed of in local waterway. Tar was periodically collected via the vertical pipe.

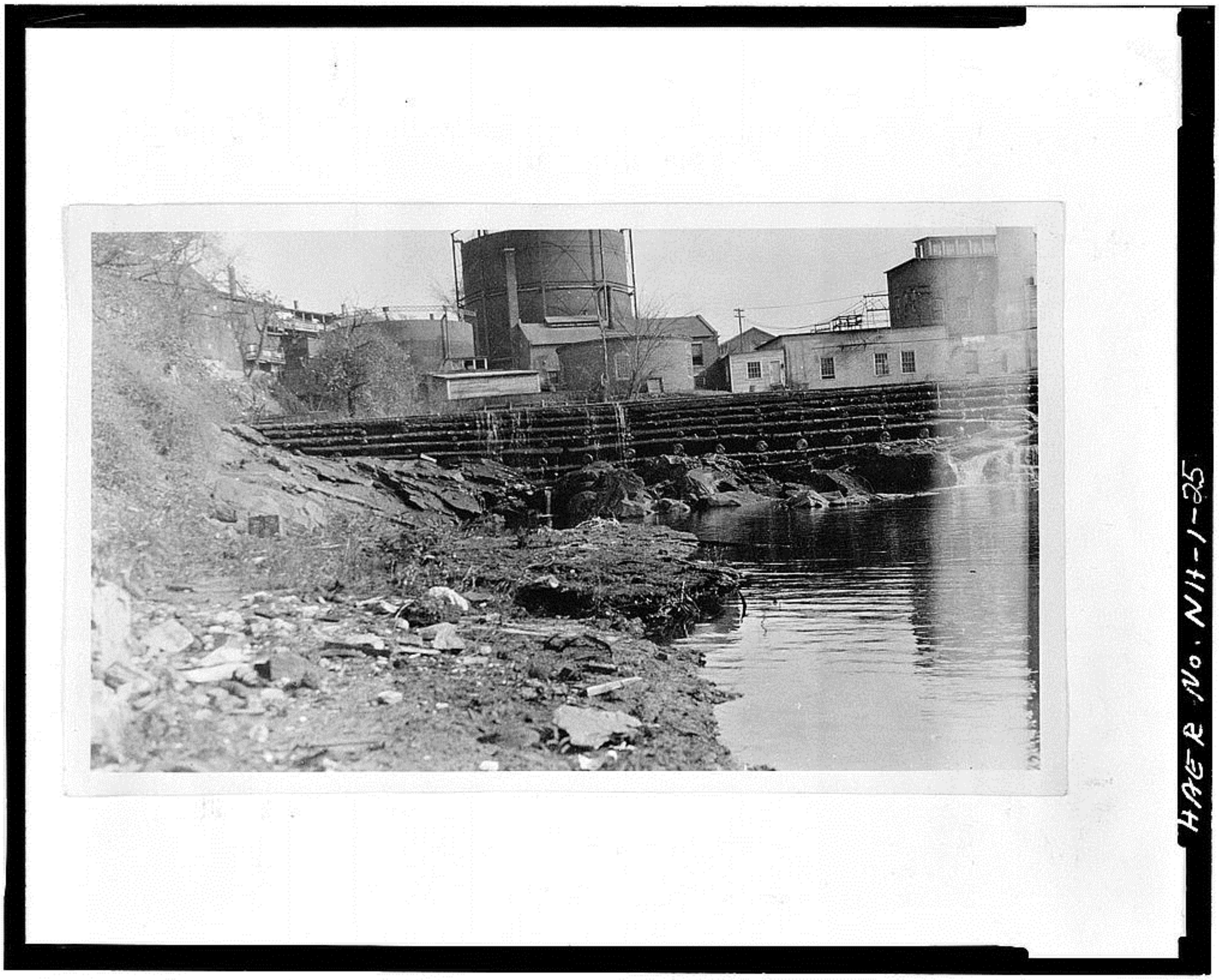
From *Proceedings of the American Gas Institute,* 1908 as reproduced in Hatheway 2012a: 330, Fig. 5-10.

Figure 7. HAER NH-1-23 Photograph

(HAER-NH-1-23. Photocopy of a photograph (original print in the collection of the New Hampshire Water Resources Board, Concord, New Hampshire) 1927, photographer unknown. BUILDING OF DAM No. 3, LOOKING EASTWARDS FROM THE NORTH BANK. CONSTRUCTION OF THE WOODEN FORMWORK USED IN CONSTRUCTING THE DAM IS VISIBLE IN THE FOREGROUND - Claremont Village Industrial District, Claremont, Sullivan County, NH)

HAER NH-1-23, a 1927 view looking east across the lip of then-under construction concrete Dam No. 3 from the north bank of the Sugar River showing from left to right, the Gasholder House, hydroelectric power house, pump house, and a portion of the boiler house and its round brick chimney. Sections of the massive concrete foundations for the boiler house remain today. The ogee-profile concrete Dam No. 3 that replaced the previous timber crib dam is still in place.

Figure 8. HAER NH-1-25 Photograph



(HAER NH-1-25. Photocopy of a photograph (original print in the collection of the New Hampshire Water Resources Board, Concord, New Hampshire) 1927, photographer unknown. VIEW OF THE NORTH END OF THE OLD TIMBER DAM AT DAM SITE No. 3 - Claremont Village Industrial District, Claremont, Sullivan County, NH)

HAER NH-1-25, a 1927 view looking east across the lip of timber crib Dam No. 3, showing, from left to right, the ca. 1905 gasholder, the rear (west) portion of the Retort House, the 1924 gasholder, the Gas Generator House, the Gasholder House, the hydroelectric power house, pump house, and a portion of the boiler house and its round brick chimney. The Gas Generator House includes a characteristic short carbureted water gas relief stack at the center of the roof, and a slender square brick chimney on the north elevation.

Historic American Engineering Record
Claremont Village Industrial District, Claremont, Sullivan County, NH
Library of Congress Prints and Photographs Division Washington, D.C. 20540 USA
Call Number: HAER NH, 10-CLAR, 5--25

Figure 9. Location Map USGS Springfield, NH

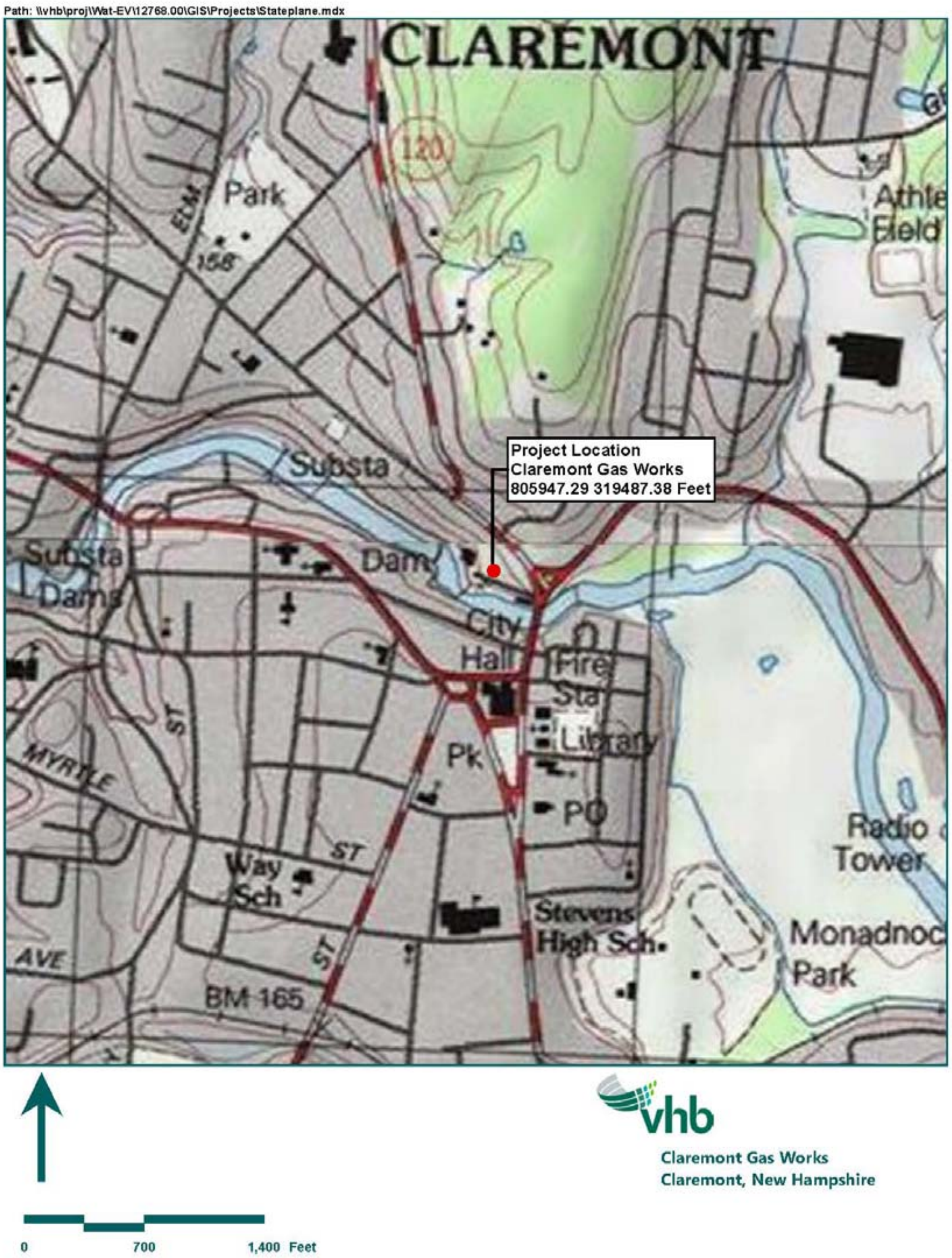
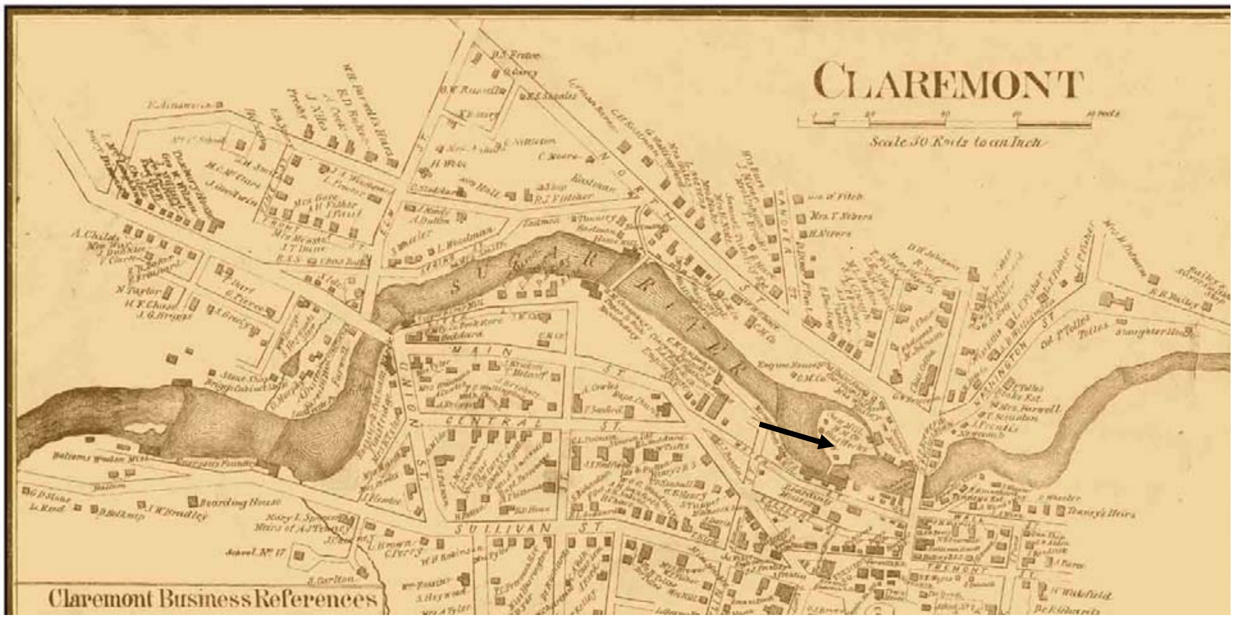


Figure 10. Excerpts from 1860 H. F. Walling Map of Claremont



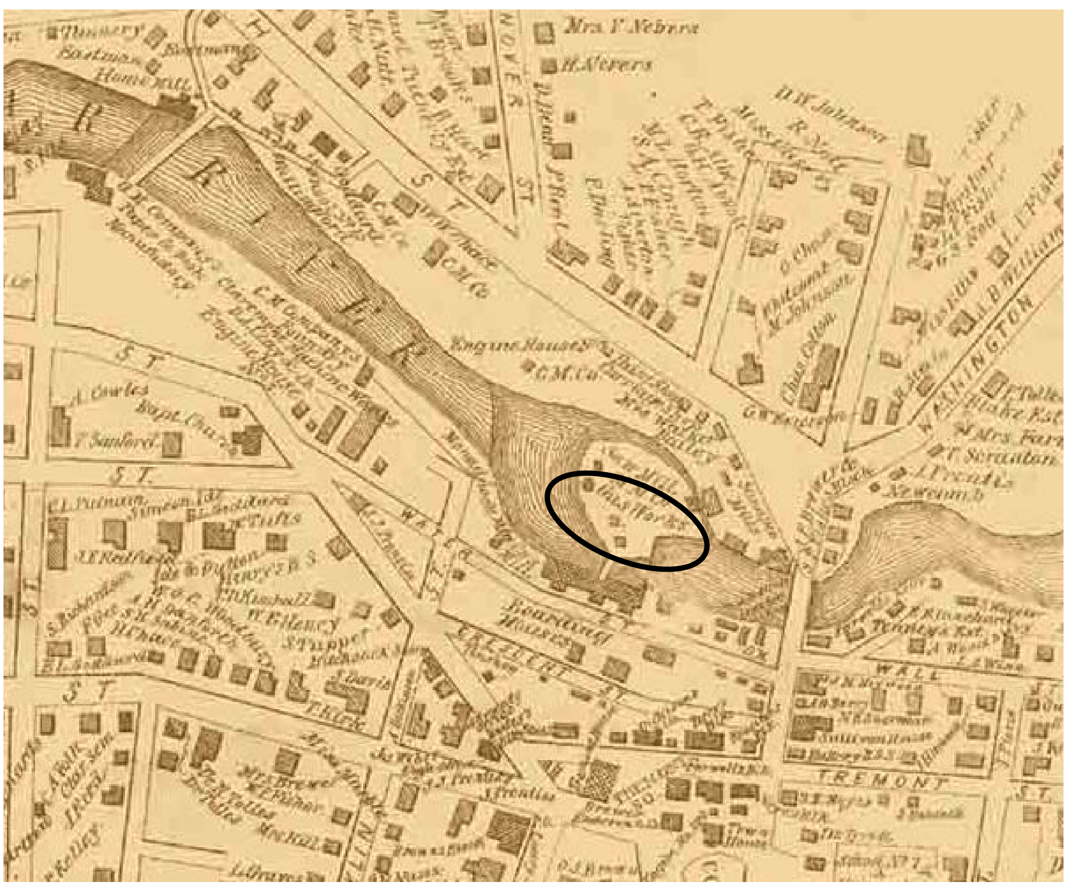


Figure 11. 1877 Bird's Eye Map of Claremont, NH

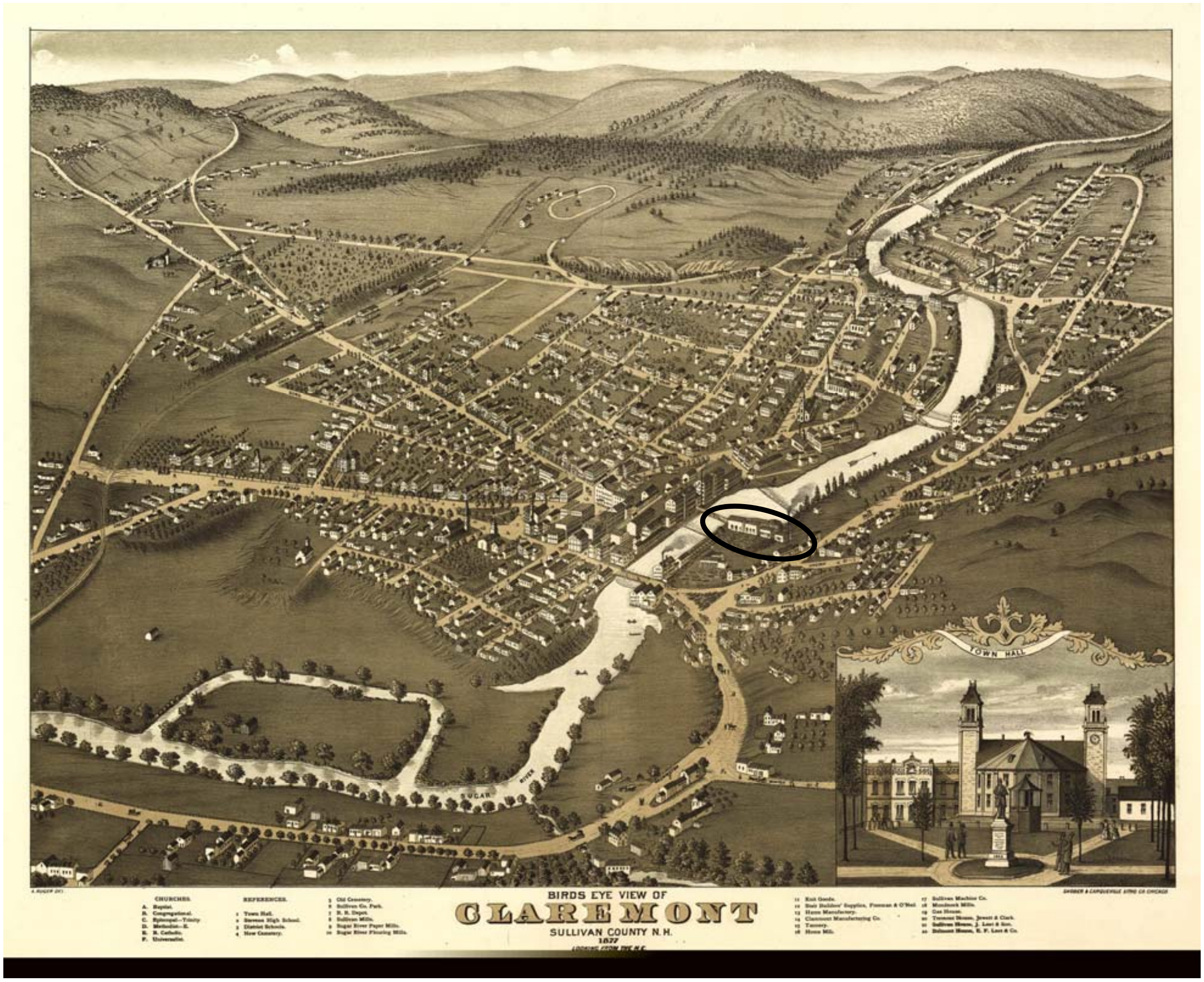


Figure 12. 1884 Sanborn Insurance Company Map; the complex is only partially shown on the page

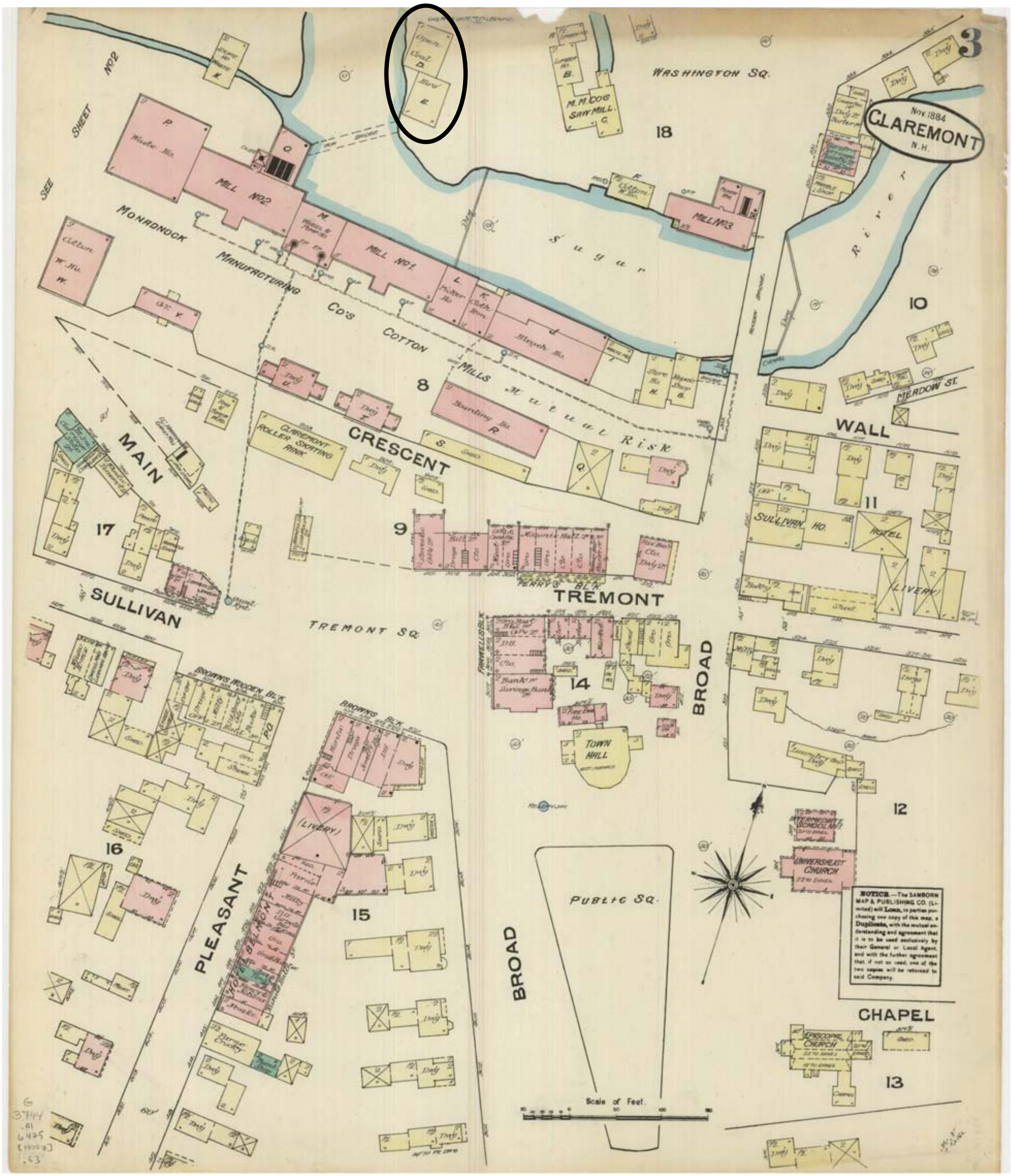


Figure 13. 1889 Sanborn Insurance Company Map

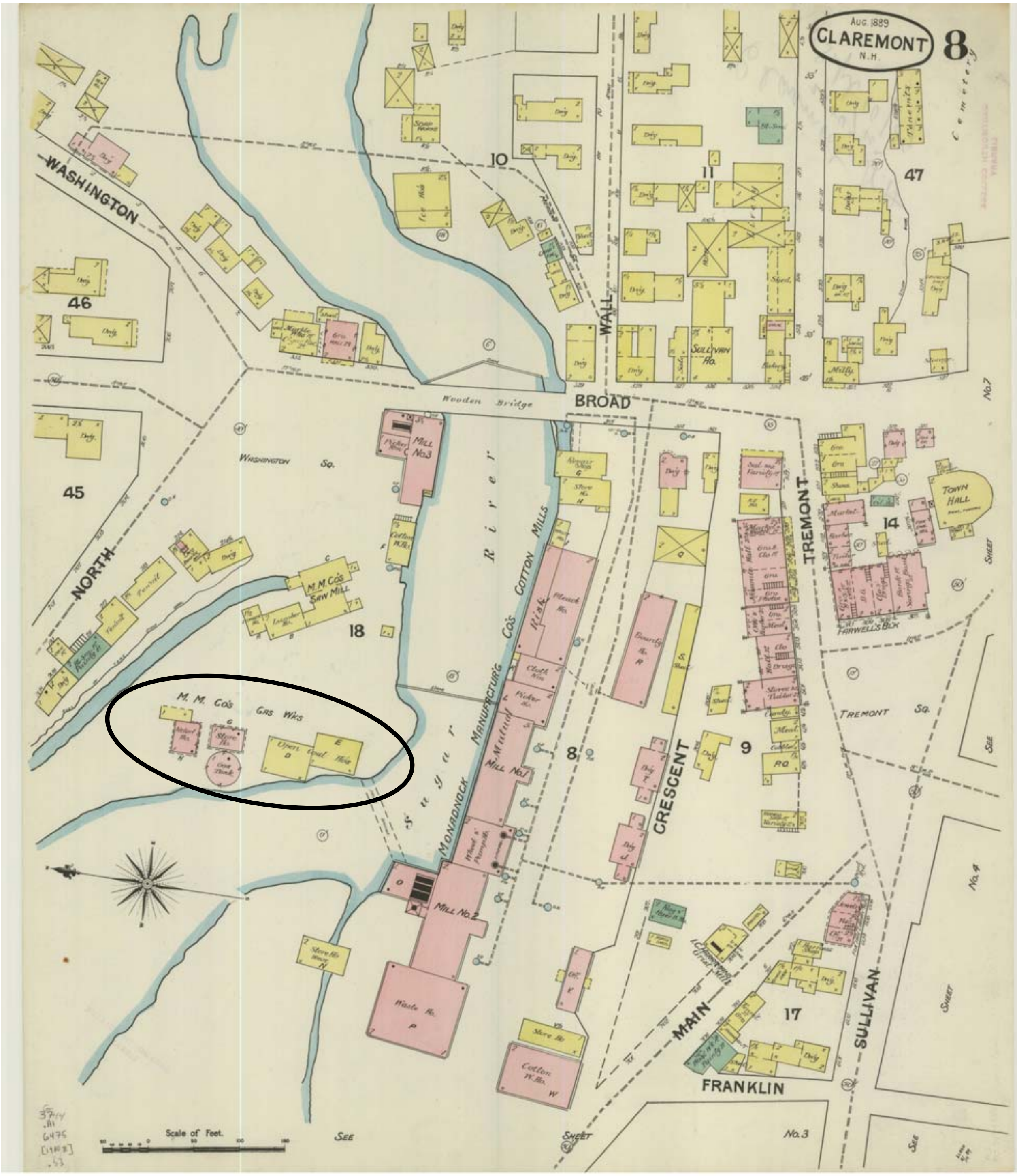


Figure 14. 1894 Sanborn Insurance Company Map

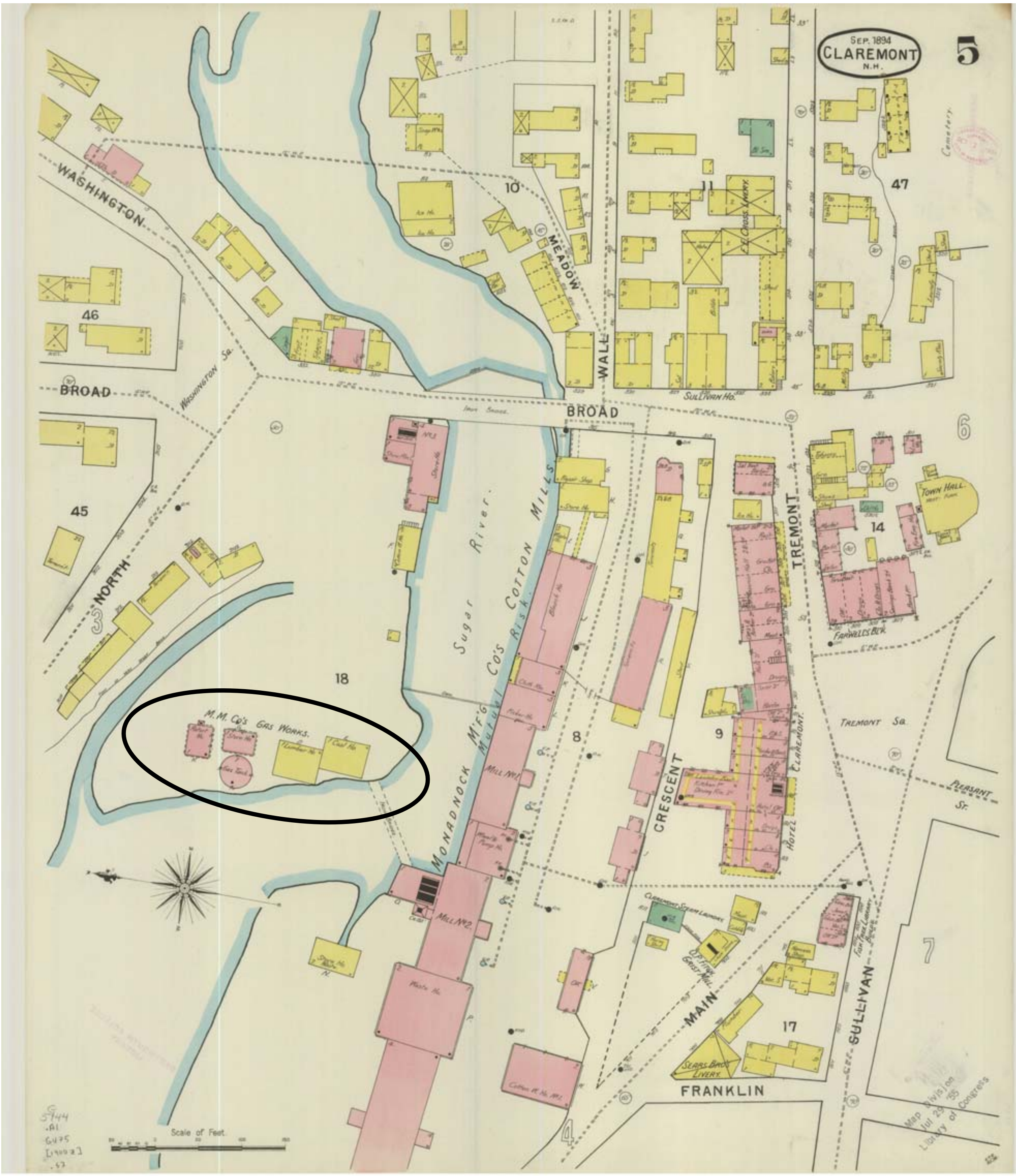


Figure 15. 1899 Sanborn Insurance Company Map

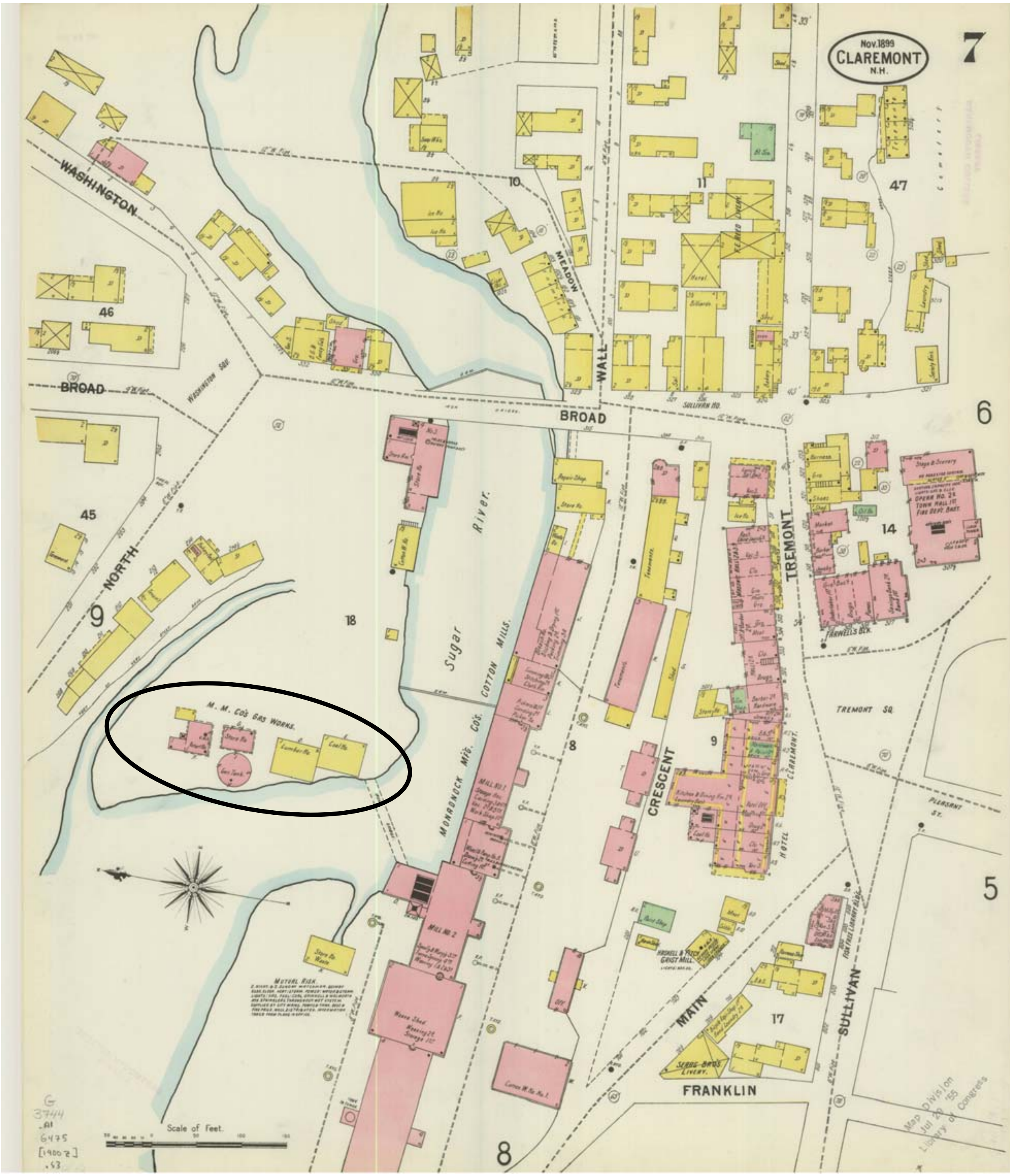


Figure 16. 1904 Sanborn Insurance Company Map

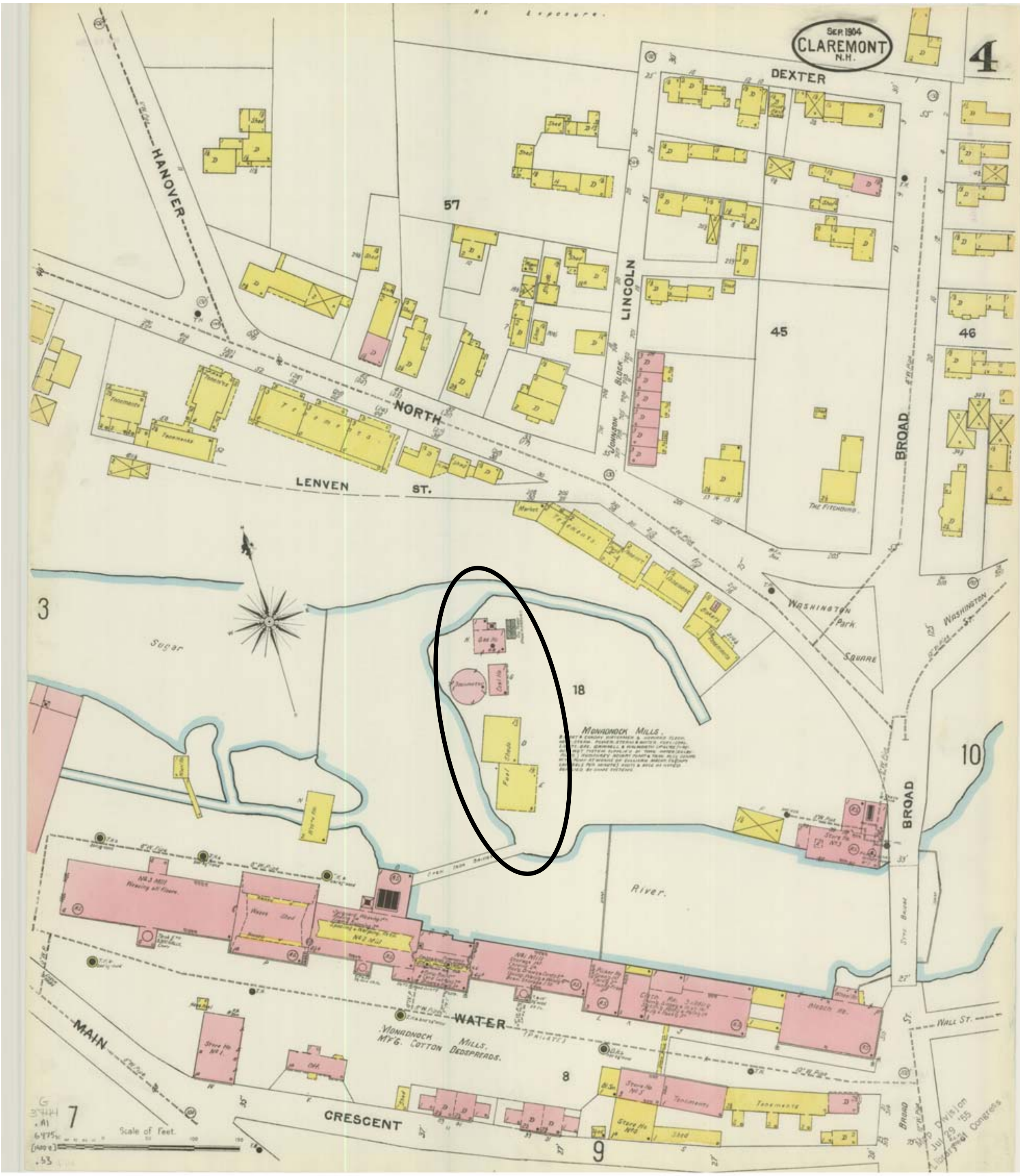


Figure 17. 1910 Sanborn Insurance Company Map

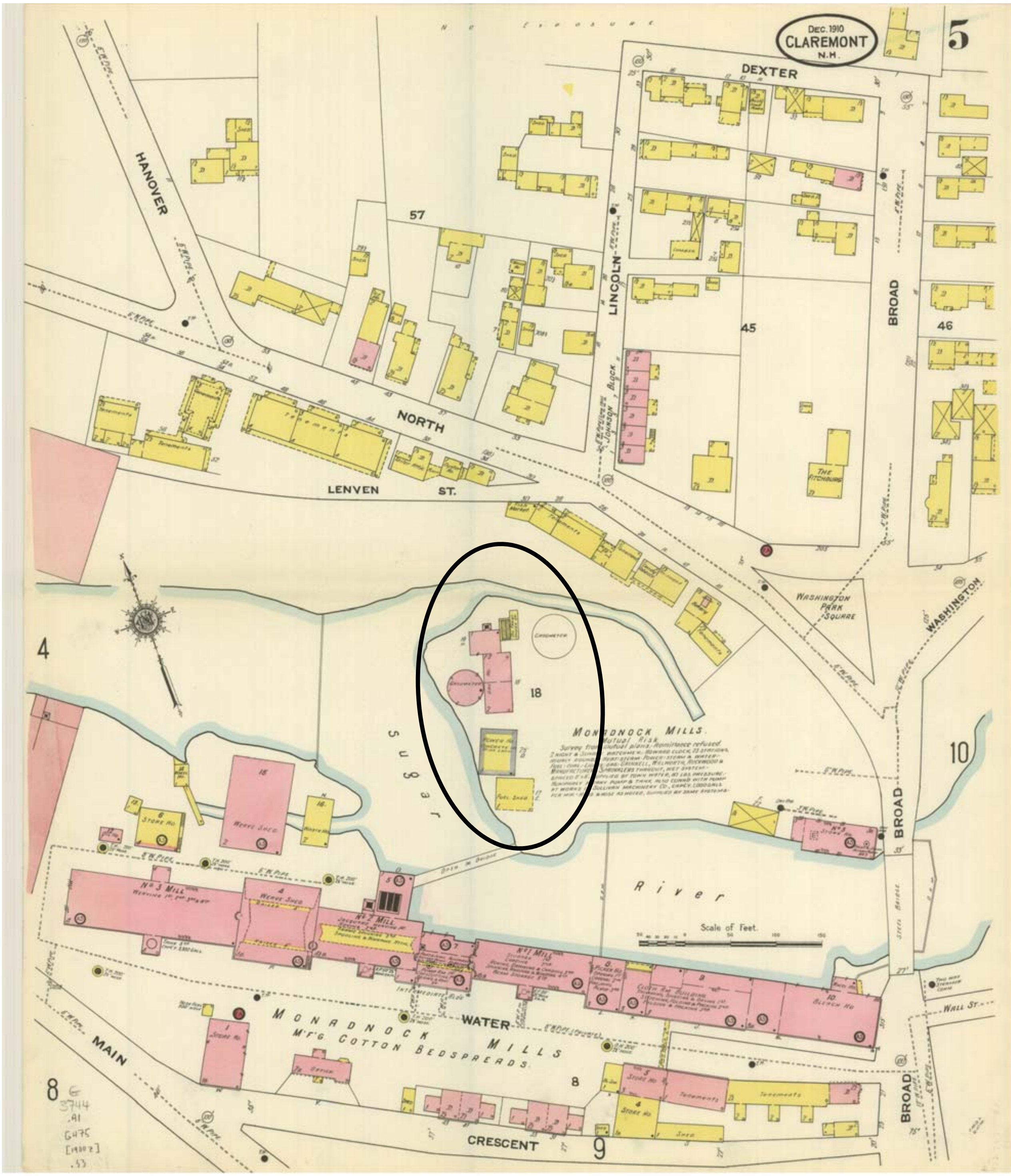
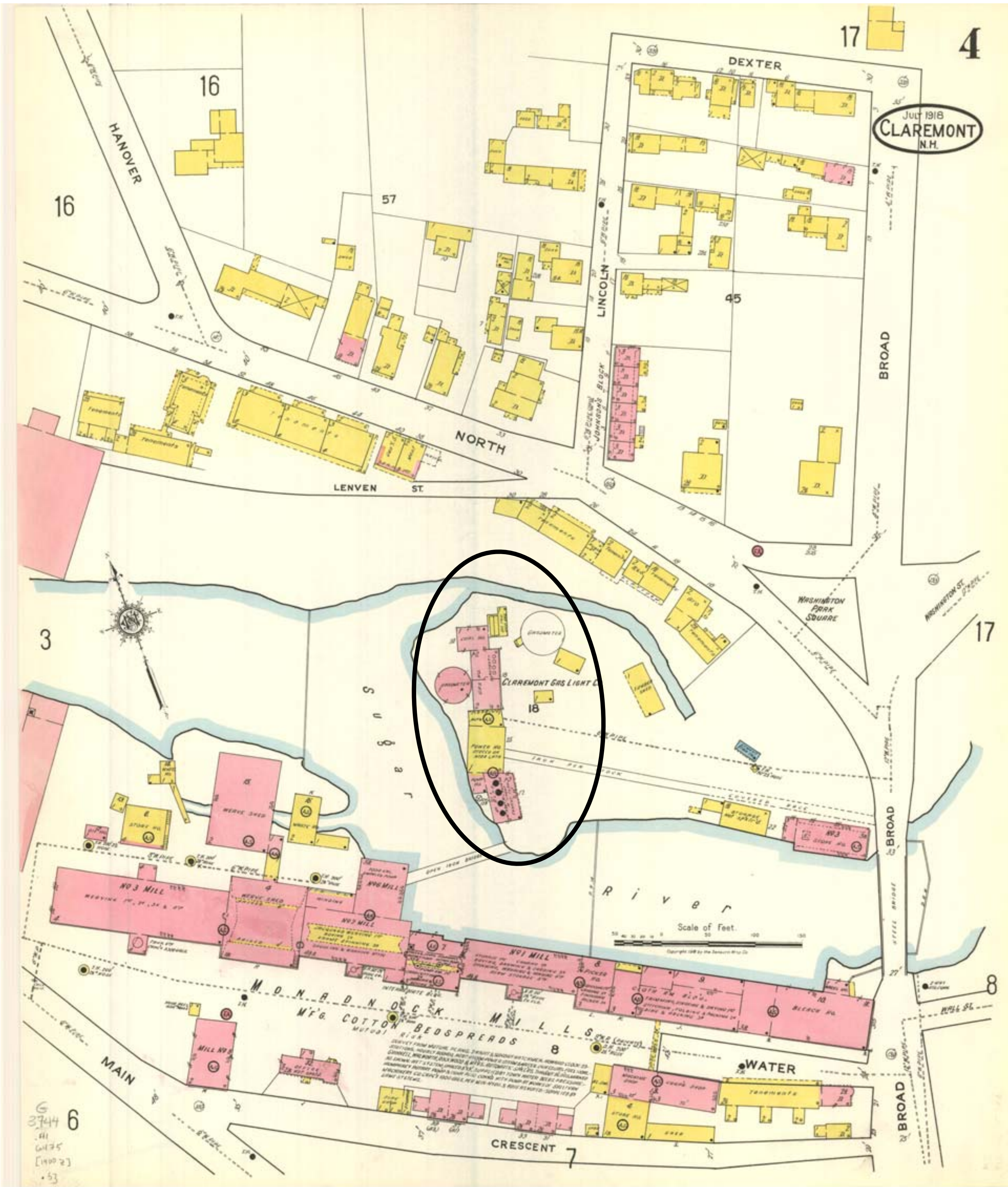


Figure 18. 1918 Sanborn Insurance Co. Map



INDEX TO PHOTOGRAPHS

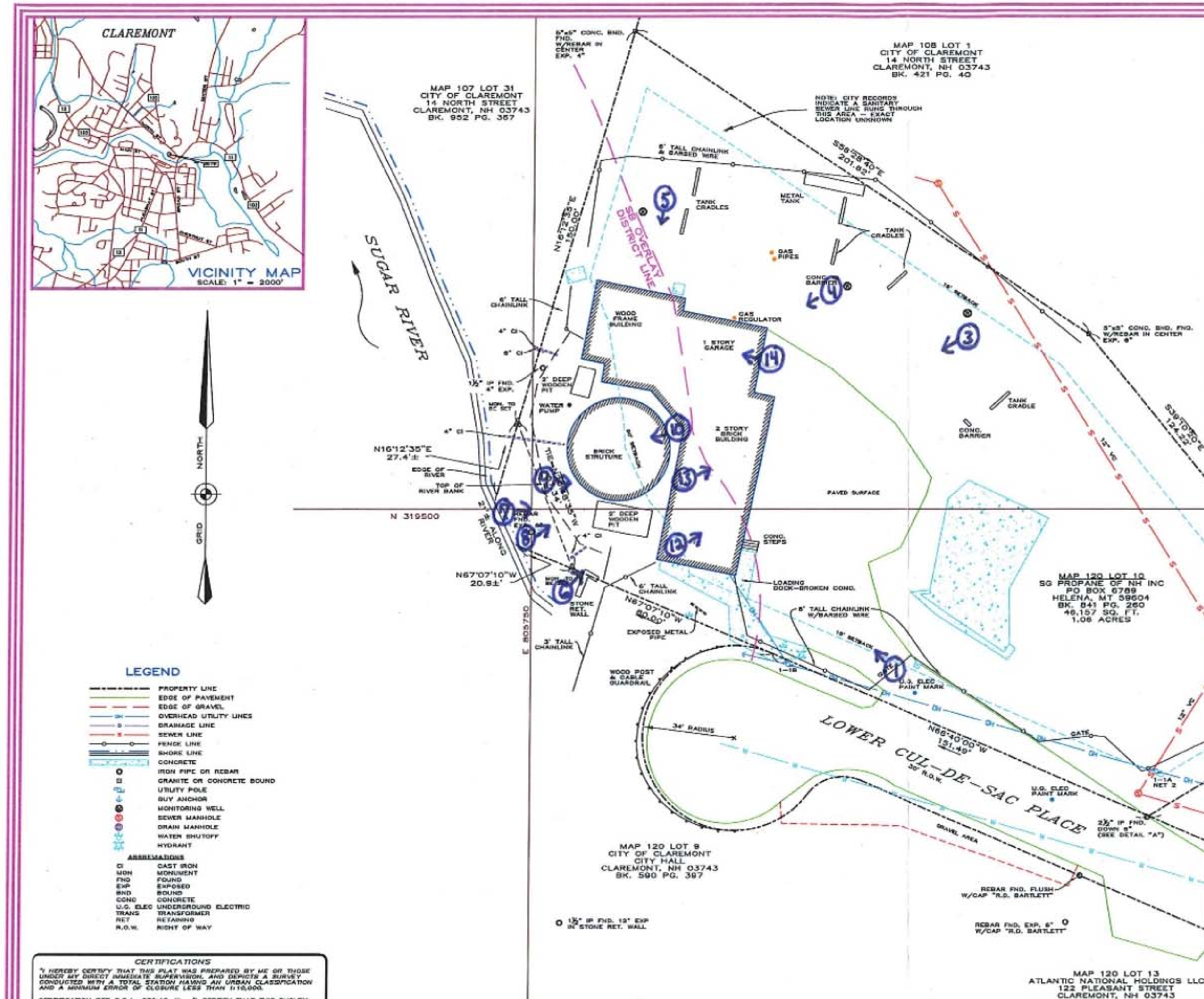
Claremont Gas Works Complex
Claremont
Sullivan County
New Hampshire

Photographer: Matt Kierstead
June 2014

NH-724-1	Overview of property including east façades of retort house and coal house, facing northwest from driveway of Lower Cul de Sac Place.
NH-724-2	Overview of property with gasholder and west elevation of retort house, facing northeast from Water Street near Monadnock Mill No. 2 (Common Man Inn).
NH-724-3	View of east façades of retort house and coal house, facing southwest.
NH-724-4	View of east façade and north elevation of coal house, east section, facing southwest.
NH-724-5	View of north elevation of coal house, west section, facing south.
NH-724-6	View of south side of gasholder and west elevation of retort house, facing northeast.
NH-724-7	View of west elevation of retort house, facing east.
NH-724-8	View of interior of gasholder, facing northeast.
NH-724-9	View of cross section of gasholder, facing east.
NH-724-10	View of gasholder interior lift frame, facing southwest.
NH-724-11	View of south elevation of retort house and west end of Lower Cul de Sac Place, north.
NH-724-12	View of interior of retort house, south room, east wall, facing east.
NH-724-13	View of interior of retort house, north room, north and east walls, facing east.
NH-724-14	View of interior of coal house, facing west.
NH-724-15	View of south end of property with bowstring arch utility/footbridge in foreground, facing northeast across the Sugar River from Monadnock Mill No. 2 (Common Man Inn).
NH-724-16	View across bowstring arch utility/footbridge to property, Lower Cul de Sac Place in background, facing northeast from Monadnock Mill No. 2 (Common Man Inn).
NH-724-17	View of south end of property and concrete retaining wall at west end of Lower Cul de Sac Place, facing northeast from courtyard of Monadnock Mill No. 2 (Common Man Inn).
NH-724-18	View of west side of property, dam at Falls #3 visible in foreground, facing east from pedestrian bridge over Sugar River

Appendices

Appendix 1:	Locations of Gas Plants and Other Coal-tar Sites in the U.S.: The State of New Hampshire, Allen Hatheway, 2012
Appendix 2:	Directory of Gas Light Companies and Their Officers in the United States and Canadas (sic), Fifth Edition, Goodwin Gas Stove & Meter Co., 1886
Appendix 3:	Brown's Directory of American Gas Companies, E. C. Brown, compiler, 1890



NOTES

1. Survey by total station between the dates of October 9 – October 10, 2013. Control Traverse error of closure is 1 in 65,654.

2. Horizontal datum is based on NH State Plane Coordinates NAD 83.

3. Owner of record: SG Propane of NH INC. PO Box 6789 Helena, MT 59604. Bk. 841 Pg. 260.

4. Parcel is zoned MUM–Multiple Use Mill District:
Minimum Frontage=50'. Building Setbacks new structures: Front & Rear–15', Side–10'. Min Lot Size–10,000 Sq. Ft. Max. lot coverage=75%
The premises is also subject to the provisions of the Historic Overlay District.
The portion of the premises adjacent to the Sugar River is also subject to the provisions of the Floodplain Overlay District and to the provisions of the SB Streambank District.

5. The portion of the premises adjacent to the Sugar River is located within Flood Hazard area Zone AE as shown on the FIRM for the City of Claremont Map No. 33019C0280E with an effective date of May 23, 2006.

6. The site is subject to the provisions of the Shoreland Water Quality Protection Act RSA 483–B.

7. The underground utilities depicted hereon have been located from field survey information and plotted from existing drawings. The surveyor makes no guarantee that the underground utilities depicted comprise all such utilities in the area, either in service or abandoned. The surveyor further does not warrant that the underground utilities shown are in the exact location indicated although they are located as accurately as possible from the information available. The surveyor has not physically located the underground portion of the utilities. All contractors should notify, in writing, any utility company and appropriate governmental agencies prior to any excavation work and call DIG–SAFE at 1–888–344–7233.

8. The intent of this plat is to depict the existing conditions of Map 120, Lot 10.

REFERENCES

1. "Boundary & Subdivision Map, Lacasse Park, Urban Renewal Project #NH R–21, Claremont Housing Athority", dated April 23, 1974 by K.A. Leclair Assoc. Inc., recorded at the SCRD as Pocket 2, File 2, Plan #13, Plan File 2.

2. "Boundary Plan of Former Joy Foundry Owned By City of Claremont", dated February 25, 1993 by Wayne McCutcheon Assoc. Inc., recorded at the SCRD as Plan #1189.

3. "Plan of Property to be Conveyed From Monadnock Mills to Monadnock Land Company", dated December 1942 by A.E. Hoxie, recorded at the SCRD as Book 1 Page 295.

4. "Sullivan Machinery CO. Claremont, NH", dated January 10, 1905 by Rush Chellis, recorded at the SCRD as Book 1 Page 35.

5. "Boundary Plot of 57 Broad St. prepared for Jesseman Associates", dated April 24, 2008, prepared by this office. (Unrecorded)

CERTIFICATIONS

"I HEREBY CERTIFY THAT THIS PLAT WAS PREPARED BY ME OR THOSE UNDER MY DIRECT IMMEDIATE SUPERVISION, AND DEPICTS A SURVEY CONDUCTED WITH A TOTAL STATION HAVING AN URBAN CLASSIFICATION AND A MINIMUM ERROR OF CLOSURE LESS THAN 1:10,000.

CERTIFICATION PER R.S.A.–676:18, III: "I CERTIFY THAT THIS SURVEY PLAT IS NOT A SUBDIVISION PURSUANT TO THIS TITLE AND THAT THE LINES OF STREETS AND WAYS SHOWN ARE THOSE OF PUBLIC OR PRIVATE STREETS OR WAYS ALREADY ESTABLISHED AND THAT NO NEW WAYS ARE SHOWN."

SIGNATURE | LICENSE NO. | DATE

"I HEREBY CERTIFY THAT I HAVE FILED A COPY OF THIS PLAN WITH THE PLANNING BOARD OF THE CITY OF CLAREMONT IN ACCORDANCE WITH R.S.A.–676:18 (IV)."

SIGNATURE | LICENSE NO. | DATE

EASEMENTS OF RECORD

1. The premises was conveyed to include all pipe lines of the Claremont Gas Light Company located outside its own lands and all rights, franchises and easements, and rights of the gas company in an to the main pipes situated on lands of the Monadnock Mills. Also, conveyed is a right of way to the land and works and pipe lines over land of the Monadnock Mill for all purposes necessary. For further description see V. 841 P. 260.

NO.	DATE	REVISION

FOR: RICHARD D. BARTLETT & ASSOCIATES, LLC

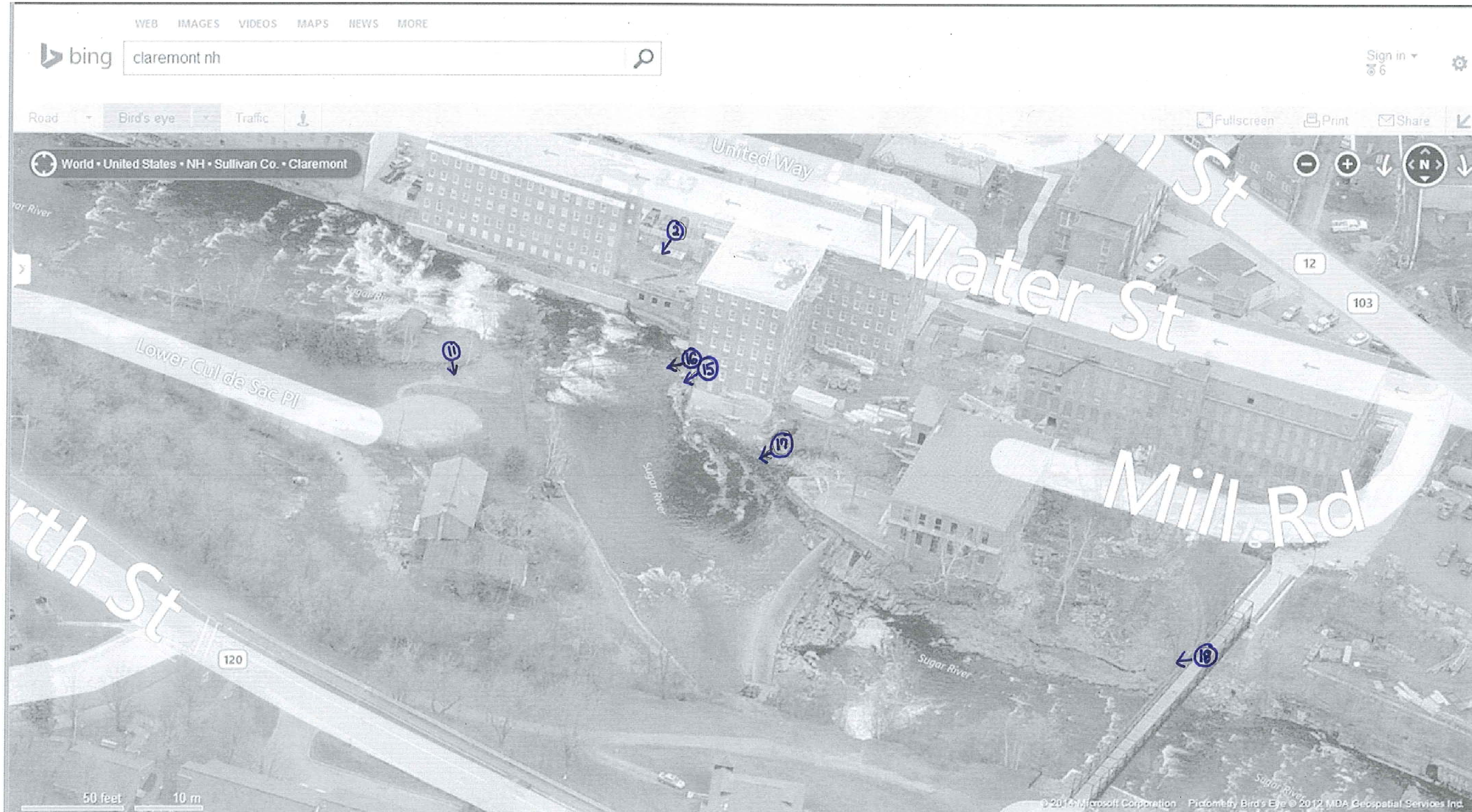
RICHARD D. BARTLETT & ASSOCIATES, LLC
214 North State Street
Concord, N.H. 03301
Tel.: (603) 225-6770
Fax.: (603) 224-6261
E-mail: info@richarddbartlett.com
World Wide Web Page: www.richarddbartlett.com
LICENSED LAND SURVEYORS

EXISTING CONDITIONS PLAT of land of SG PROPANE OF NH INC

PROJECT LOCATION: LOWER CUL–DE–SAC PLACE CLAREMONT, SULLIVAN COUNTY, NH

GRAPHIC SCALE 1" = 20'

DATE: OCT. 14, 2013
JOB NO.: 1013.171
SHEET 1 OF 1


WEB IMAGES VIDEOS MAPS NEWS MORE
bing
claremont nh
Sign in
Road
Bird's eye
Traffic
Fullscreen
Print
Share
World • United States • NH • Sullivan Co. • Claremont
United Way
Water St
Mill Rd
Lower Cul de Sac Pl
Sugar River
12
103
120
3
11
16
15
17
18
50 feet
10 m
© 2014 Microsoft Corporation Pictometry Bird's Eye © 2012 MDA Geospatial Services Inc.

Appendix 1: Locations of Gas Plants and Other Coal-tar Sites in the U.S.: The State of New Hampshire, Allen Hatheway, 2012

FMGP FORMER MANUFACTURED GAS PLANTS

Site and Waste Characterization. Remedial Engineering of Former Manufactured Gas plants and Other Coal-Tar Sites

Home
History
Environmental Threat
Site Characterization
Man. Gas Processes
Plant Wastes
Contamination Threat Modes
Residuals - Components
Sources of MGP Liquid Effluent
FMG Plants in the US
Parallel MG Technologies
Think you've found a gas works?
Locating and Confirming a Site
Locations of US Gas Plants
FMGP In The News
FMGP In The Arts
Coal-tar Site Litigation
Related sites on the Internet
Literature of Manufactured Gas
Hatheway Harangues
Publications by Dr. Hatheway
Slide Shows by Dr. Hatheway
Slide Shows by others
Hatheway Bio
Hatheway Resume
Legal Considerations

Search Reset

Locations of Gas Plants and Other Coal-tar Sites in the U.S.

► THE STATE OF NEW HAMPSHIRE

Introduction:

As was the case in Maine, the established early seacoast shipping

and communications with its own neighbor, Massachusetts, led to fairly early (1841) but limited establishment of manufactured gas. Cities and towns having manufactured gas before the Civil War included Great Falls (1849), Portsmouth (1851, Nashua (1852) and Claremont and Nashua (1860). Most New Hampshire gas works were created by Act of the State Legislature.

An early 20th century surge in small-town gas plant construction (including Sommersworth and Berlin) continued to expand manufactured gas coverage, though the combination of near-surface crystalline bedrock and generically-poor pipeline joint integrity was a deterrent to between-town gas piping.

New Hampshire gas makers experimented considerably with various patented gas manufacturing processes in the years before 1895: Tiffany oil gas (Portsmouth Naval Shipyard,1873); Sanders Process (Laconia,1860); an unidentified oil-gas process (Hanover,1874); Hanlon & Johnson (1878, Dover); Springer producer gas (Great Falls, 1888); and Kendall oil gas (Laconia No. 2, 1894).

In 1883, the A.O., Granger & Co. of Philadelphia, a low-profile early subsidiary of UGI, installed the Lowe process carbureted water gas devices at Keene, and thereafter any new gas equipment installed in existing gas plants of New Hampshire were likely of the Lowe process. That same 1883 Granger Lowe set was replaced in 1924 with a new UGI CWG set, giving a good example of the life span of a well-maintained set.

In the realm of innovation, UGI chose the Manchester gas works, in 1908, to install one of the first, if not first, vertical-retort coal-gas plants in the America; the German Dessau Process. In 1908 the Keene Gas & Electric Company chose to install a separate producer gas plant equipped with two 250-hp Westinghouse producers, to power three, vertical, three-cylinder gas engines used to drive dynamos..

In general, New Hampshire institutions are likely to have had their own gas plants, and most certainly those institutions lying at even a few km distant from existing gas works. Examples are Philips Academy at Exeter and the State Insane Asylum at Concord.

Gas company consolidation in New Hampshire was minimal due to the relatively small populations of even the major cities. There were, however, outside influences from holding companies. Of the very few examples of consolidation was the attempted 1910 merger of the Manchester Gas Light Company and the latter day (1887) Peoples Gas Light Company of that city, which was not effected until 1921, when the merged companies constructed a new gas works at South Manchester.

UGI appears to have been the first external gas entity to enter New Hampshire, at Concord, then Manchester, and stayed the course of manufactured gas at Manchester until divestiture in 1942, in accordance with the "death sentence" clause of the 1935 Federal Utilities Holding Companies Act. Further holding company activities appeared in New Hampshire early in the 20th century, with formation of Twin State Utilities Co. (NH and VT), which later took control at Dover, and then moving its offices to Boston and morphing (1926) into Public Service Co. of New Hampshire, organized as a Statewide gas and electric utility.

In 1932, the Associated Gas & Electric Company briefly owned the NH Gas & Electric Co., and supplied Dover with manufactured gas. Post-WWII: Throughout the era of manufactured gas, a significant degree of NH gas utility ownership remained in the hands of out-of-State interests, and after WWII some of this was represented by the gas-engineer Pritchard family of Massachusetts, who had been in gas manufacturing since the 1890s.

State regulation of public utilities was ordered in 1911 by creation of the State Public Service Commission.

Around 1940, improved pipe-welding technology allowed some mid-pressure distribution to adjacent towns, along routes where mains could be economically buried without encountering crystalline bedrock.

By 1952, gas manufacture in New Hampshire was mainly too expensive to employ even carbureted water gas, and coal gas was long a technology of the past in this region, in consideration of its lack of coal deposits. In general there was a defacto

Statewide conversion to high-Btu oil-gas production in anticipation of forthcoming natural gas supplies. Most of this production seems to have come from high-Btu conversion of existing CWG sets and some by installation of new Hasche-process high-Btu sets. At the same time, Butane-Air gas service was coming into place, whereby a low-cost mixing station (less than $10,000 capital, in most cases but as much as $45,000 at plants with more broad areas of distribution (such as at Laconia and its satellite towns). Railroad-delivered liquefied butane gas came mainly as derived oil refinery by-products. Butane-air was put in place at Laconia No. 2 in 1952, when the high-Btu-converted 1902 CWG set exploded. Gas Service Company, owner of the Laconia plant, went on to install Butane-air for standby and peak-shaving at Franklin in 1962.

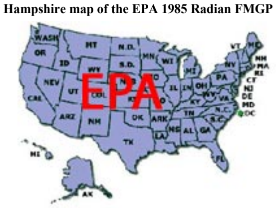
Natural gas was in place by the mid-1960s. New Hampshire’s traditional gas & electric companies then either sold their gas distribution rights or outright sold to utilities engaged solely in natural gas distribution. The northernmost three counties of the State never received any form of gas distribution until the arrival of natural gas in the mid 1960s.

The 1970s brought yet another change, when some natural gas distribution interests sold some of the FMGPs to follow-up companies such as Allied Gas Co. at Dover, in 1978. With the 21st century, the environmental remediation fate of most of New Hampshire’s larger town and city FMGPs was in the hands of various of the new wave of “super” utilities such as National Grid Transco Company and KeySpan. Also most of the small town gas plants remained unassessed in terms of environmental remediation.

Alternative coal-tar toxic waste sites include a few wood preservation plants, the first, in 1873 at Portsmouth, and two at Nashua, owned by the Boston & Main Railroad Co., which were treating 1.5 million cross ties per year in 1924.

Typical New Hampshire FMGP environmental impacts are related to omnipresent surface water. Former gas plants are typically l along rivers subject to flooding, and were especially so affected in the disastrous flood year of 1938 when considerable amounts discharge deposits were fluvially eroded and transported downstream. Tar ponds are known to have been used for discharge sur Concord and Laconia, and such likely were employed elsewhere in New Hampshire. The author’s research has shown that Laconia a 1929) converted its oldest of three gas holders to a tar-collection tank from which decanted gas liquors were discharged directly into a bay at the head of the Winnipesauke River. This, in addition to other tar separation devices, establishes that tar-water emulsions were produced as a result of CWG generation using materials inferior to those which were specified by Professor Lowe, originator process.

Click the blue "EPA" link below to view the New Hampshire map of the EPA 1985 Radian FMGP Report.



Click the green "Hatheway" link below to view the New Hampshire map of Professor Hatheway's research.

Appendix 2: Directory of Gas Light Companies and Their Officers in the United States and Canadas (sic), Fifth Edition, Goodwin Gas Stove & Meter Co., 1886

DIRECTORY

OF

GAS LIGHT COMPANIES

AND THEIR

OFFICERS

IN THE

UNITED STATES AND CANADAS.

FIFTH EDITION.

Price, - - - - - $10.00.

COMPILED AND PUBLISHED BY

THE GOODWIN GAS STOVE & METER CO.

Nos. 1012-1018 Filbert Street, Philadelphia,
142 Chambers Street, New York,
76 Dearborn Street, Chicago.

1886.

Press of Wm. H. Hoskins Co., 913 Arch Street, Philad a.

NEVADA.

460. Winnemucca Gas Co., . Winnemucca.

President,
Secretary,
Treasurer,
Superintendent, R. W. Wood.
Price of Gas per 1000 feet,
Number of Public Gas Lamps,
Price Received for Public Lamps,
Approximate Annual Output,
Process of Manufacture, Smith & Goldthorp.
Population of City or District Supplied, 700.

NEW HAMPSHIRE.

461. Claremont Gas Light Co., . Claremont.

President, Morris C. Fitch.
Secretary, George W. Fitch.
Treasurer, " "
Superintendent, Henry C. Fitch.
Price of Gas per 1000 feet, $3.00.
Number of Public Gas Lamps, 23.
Price Received for Public Lamps,
Approximate Annual Output, 2,000,000.
Process of Manufacture, Oil.
Population of City or District Supplied, 5,000.

462. Concord Gas Light Co., . Concord.

President, John Kimball.
Secretary, Sylvester Dana.
Treasurer and Agent, John M. Hill,
Superintendent, William Badger.
Price of Gas per 1000 feet, $2.00.
Number of Public Gas Lamps, 185.
Price Received for Public Lamps, $18.00.
Approximate Annual Output, 16,200,000.
Process of Manufacture, Coal.
Population of City or District Supplied, 14,200.

463. Dover Gas Light Co., . . Dover.

President, E. V. Brewster.
Secretary, T. B. Garland.
Treasurer, " "
Superintendent, George E. Nelson.
Price of Gas per 1000 feet, $2.50.
Number of Public Gas Lamps, 170.
Price Received for Public Lamps, $2.10 per 1000.
Approximate Annual Output, 13,000,000.
Process of Manufacture, Hanlon.
Population of City or District Supplied, 11,693.

464. *Exeter Gas Light Co., . . Exeter.
President, F. H. Odiorne.
Secretary,
Treasurer, Austin M. Copp.
Superintendent, Wm. N. West.
Price of Gas per 1000 feet, $3.50.
Number of Public Gas Lamps, 37.
Price Received for Public Lamps, $16.25.
Approximate Annual Output, 2,000,000.
Process of Manufacture, Coal.
Population of City or District Supplied, 3,700.

465. Great Falls Gas Light Co., Great Falls.
President, A. P. Rockwell.
Secretary, E. J. Randall.
Treasurer, E. M. Shaw.
Superintendent, Thos. G. Jameson.
Price of Gas per 1000 feet, $2.50.
Number of Public Gas Lamps, 74.
Price Received for Public Lamps, 6 cts per hour.
Approximate Annual Output, 7,000,000.
Process of Manufacture, Coal.
Population of City or District Supplied, 5,500.

466. Hanover Gas Light Co., . Hanover.
President, J. W. Patterson.
Secretary, C. A. Field.
Treasurer, " "
Superintendent, B. T. Blampied.
Price of Gas per 1000 feet, $10.00.
Number of Public Gas Lamps, 20.
Price Received for Public Lamps, $16.00.
Approximate Annual Output,
Process of Manufacture, Patton.
Population of City or District Supplied, 1,100.

467. Keene Gas Light Co., . . Keene.
President, John Henry Elliott.
Secretary, Walter R. Porter.
Treasurer, " "
Superintendent, W. H. Spaulding.
Price of Gas per 1000 feet, $3.00.
Number of Public Gas Lamps, 70.
Price Received for Public Lamps, $17.15.
Approximate Annual Output,
Process of Manufacture, Lowe.
Population of City or District Supplied, 7,000.

468. Laconia Gas Light Co., . Laconia.

President, John E. Moulton.
Secretary, Geo. B. Lane.
Treasurer, J. L. Moore,
Superintendent, "
Price of Gas per 1000 feet, $4.50.
Number of Public Gas Lamps, 41.
Price Received for Public Lamps, $17.00.
Approximate Annual Output, 1,500,000.
Process of Manufacture, Hanlon.
Population of City or District Supplied, 5,000.

469. Manchester Gas Light Co., . Manchester.

President, B. F. Martin.
Secretary, L. B. Clough.
Treasurer, Walter M. Parker.
Superintendent & Agent, L. P. Gerould.
Price of Gas per 1000 feet, $1.60.
Number of Public Gas Lamps, 342.
Price Received for Public Lamps, $1.50 per 1000.
Approximate Annual Output, 75,000,000.
Process of Manufacture, Coal.
Population of City or District Supplied, 38,000.

470. Nashua Gas Light Co., . Nashua.

President, Harrison Hobson.
Secretary,
Treasurer, Wm. D. Cadwell.
Superintendent, A. M. Norton.
Price of Gas per 1000 feet, $1.60.
Number of Public Gas Lamps, 321.
Price Received for Public Lamps, $1.60 per 1000.
Approximate Annual Output, 20,000,000.
Process of Manufacture, Coal.
Population of City or District Supplied, 15,000.

471. Portsmouth Gas Light Co., Portsmouth.

President, Christopher C. Jackson.
Secretary, Frank J. Philbrick.
Treasurer, " "
Superintendent, Thos. R. Martin.
Price of Gas per 1000 feet, $2.34.
Number of Public Gas Lamps, 100.
Price Received for Public Lamps, 1½ cts. per hour.
Approximate Annual Output, 1,000,000.
Process of Manufacture, Coal.
Population of City or District Supplied, 9,700.

NEW HAMPSHIRE.

472.*Salmon Falls Gas Light Co., Salmon Falls.

President, Robert M. Mason.
Secretary,
Treasurer, Howard Stockton.
Superintendent, Orange S. Brown.
Price of Gas per 1000 feet,
Number of Public Gas Lamps,
Price Received for Public Lamps,
Approximate Annual Output,
Process of Manufacture,
Population of City or District Supplied, 1,712.

NEW JERSEY.

473. Arlington Gas Light Co., . Arlington.

President, J. W. Edmonds, New York City.
Secretary, W. L. Stewart.
Treasurer, J. Q. Stearns.
Superintendent, Samuel D. Smith.
Price of Gas per 1000 feet, $2.00.
Number of Public Gas Lamps, 60.
Price Received for Public Lamps, $18.00.
Approximate Annual Output,
Process of Manufacture, Smith & Goldthorp.
Population of City or District Supplied, 1,000.

474. Asbury Park Gas Co., . Asbury Park.

President, Geo. H. Fletcher.
Secretary, J. W. Adler.
Treasurer,
Superintendent, T. F. Hoagland.
Price of Gas per 1000 feet, $2.25.
Number of Public Gas Lamps, Oil.
Price Received for Public Lamps,
Approximate Annual Output, 240,000.
Process of Manufacture, Water Gas.
Population of City or District Supplied, 2,112.

475. Atlantic City Gas and Water Company, Atlantic City.

President, John Roberts, Phila.
Secretary, Dr. Thos. Reed.
Treasurer, Charles Evans.
Superintendent, Geo. W. Jones.
Price of Gas per 1000 feet, $2.00.
Number of Public Gas Lamps, 230.
Price Received for Public Lamps, $25.00.
Approximate Annual Output, 22,000,000.
Process of Manufacture, Petroleum and Water Gas.
Population of City or District Supplied, 7,000.

Appendix 3: Brown’s Directory of American Gas Companies, E. C. Brown, compiler, 1890

BROWN'S

DIRECTORY

— OF —

American Gas Companies.

GAS STATISTICS.

PRICE, - - - - - $5.00.

Total Number	Compiled and Corrected by E. C. BROWN.	Companies, 1048

REMARKS.

Offering the third annual volume of this work, which has now become the recognized authority on the subjects of which it treats, the publisher desires to first return his thanks to the gas companies of the country who have, through their prompt and thorough presentation of facts necessary to its compilation, made the publication possible; and as a further evidence of his appreciation as heretofore, he presents each of the companies named herein with a complimentary copy of the work, with the hope that it will prove, as it most assuredly will, of special value as a guide and record of the progress of the great industry which it reports.

N. B.—The lists of natural gas companies are as complete as the nature and changing character of the business will allow.

PRESS OF "PROGRESSIVE AGE,"
18 BROADWAY, NEW YORK.

1890.

Carson City Coal Gas Co., Carson City.

Ormsby County.

Capital stock, $75,000.
Total bonds outstanding, none.
President, Geo. Tufly.
Treasurer, Bullion & Exchange Bank.
Secretary, T. J. Edwards.
Purchasing Agent, N. Wylie.
Superintendent, N. Wylie.
Process of Manufacture, Coal.
Population, 3,500.
Price of Gas in 1889, $6.00.
Number of public lamps, none.
Price received for public lamps,
Approximate annual output, 3,000,000.
Candle power, 17.

Reno Water, Land and Light Co., Reno.

Washoe County.

Capital stock, $300,000.
Total bonds outstanding,
President, C. C. Powning.
Treasurer, Bank of Nevada.
Secretary, J. F. Emmitt.
Purchasing Agent, C. C. Powning.
Superintendent, J. F. Emmitt.
Process of Manufacture,
Population, 6,000.
Price of Gas in 1889, $4.00.
Number of public lamps,
Price received for public lamps,
Approximate annual output,
Candle power, 20.

Virginia City Gas Light Co., Virginia.

Storey County.

Capital stock,
Total bonds outstanding, $
President, Chas. E. Paxton.
Treasurer, Chas. E. Paxton.
Secretary, M. C. Osborn.
Purchasing Agent, M. C. Osborn.
Superintendent, M. C. Osborn.
Process of Manufacture, Pitch and Coal.
Population, 12,000.
Price of Gas in 1889, $6.50, discount.
Number of public lamps, 37.
Price received for public lamps, $92.00.
Approximate annual output, 5,750,000.
Candle power, 17.

Winnemucoa Gas Light Co., Winnemucca.

Humboldt County.

Capital stock, $
Total bonds outstanding, $
Proprietors, Neth & Busch.
Process of Manufacture, Oil.
Population, 900.
Price of Gas in 1889,
Number of public lamps, none.
Price received for public lamps, none.
Approximate annual output,
Candle power,

NEW HAMPSHIRE.

Claremont Gas Co., Claremont.

Sullivan County.

Capital stock owned by Monadnock Mills.
Total bonds outstanding,
President, D. W. Johnson.
Treasurer, F. P. Vogl.
Secretary,
Purchasing Agent,
Superintendent,
Process of Manufacture, Oil.
Population, 5,000.
Price of Gas in 1889, $2.50 and $2.25.
Number of public lamps, 15.
Price received for public lamps, $2.50 per 1,000.
Approximate annual output, 2,000,000.
Candle power, 24.

Concord Gas Light Co., Concord.

Merrimack County.

Capital stock, $125,000.
Total bonds outstanding,
President, John Kimball.
Treasurer, Edgar H. Woodman.
Secretary,
Purchasing Agent, E. H. Woodman.
Superintendent, William Badger.
Process of Manufacture, Coal.
Population, 16,000.
Price of Gas in 1889, $1.80 and $2.00.
Number of public lamps, 151.
Price received for public lamps, $18.50.
Approximate annual output, 27,000,000.
Candle power, 17.
Operate Thomson-Houston Electric System, 171 Arc Lights.

Dover Gas Light Co., Dover.

Strafford County.

Capital stock, $75,000.
Total bonds outstanding.
President, Eli V. Brewster.
Treasurer, Thomas B. Garland.
Secretary, Thomas B. Garland.
Purchasing Agent, Thomas B. Garland.
Superintendent, W. T. Sanborn.
Process of Manufacture, Oil.
Population, 15,000.
Price of Gas in 1889, $1.80.
Number of public lamps, none.
Price received for public lamps,
Approximate annual output, 13,000,000.
Candle power, 21½.

Exeter Gas Light Co., Exeter.

President,
Treasurer,
Secretary,
Purchasing Agent,
Superintendent,
Process of Manufacture,
Population, 4,000.

The Farmington Gas Light Co., Farmington.
Strafford County.

Capital stock, $60.000.
Total bonds outstanding, none.
President, Hon. J. F. Cloutman.
Treasurer, Hon. C. W. Talpey.
Secretary, Hon. C. W. Talpey.
Purchasing Agent, Hon. E. T. Willson.
Superintendent, Joel Smart.
Process of Manufacture, Naphtha.
Population, 3,500.
Price of Gas in 1889, $6.00, less 10 per cent.
Number of public lamps, 35 Gas and 20 Oil.
Price received for public lamps, $700 per year for all.
Approximate annual output, 500,000.
Candle power,

Great Falls Gas Light Co., Somersworth.
Strafford County.

Capital stock, $47,500.
Total bonds outstanding,
President, J. Howard Nichols.
Treasurer, H. S. Chase.
Secretary, H. S. Chase.
Purchasing Agent, H. S. Chase.
Superintendent, H. S. Chase.
Process of Manufacture, Lowe (by Springer).
Population, 6.000.
Price of Gas in 1889, $1.50 to $2.50.
Number of public lamps,
Price received for public lamps,
Approximate annual output, 6,000,000.
Candle power, 22.

Hanover Gas Light Co., Hanover.
Grafton County.

Capital stock, $12,000.
Total bonds outstanding.
President, J. W. Patterson.
Treasurer, Geo. Hitchcock.
Secretary, Geo. Hitchcock.
Purchasing Agent,
Superintendent,
Process of Manufacture, Oil.
Population, 1.000.
Price of Gas in 1889, $10.
Number of public lamps, 13.
Price received for public lamps, $16.
Approximate annual output, 200,000.
Candle power,

Keene Gas Light Co., Keene.
Cheshire County.

Capital stock, $36,000.
Total bonds outstanding,
President, John Henry Elliott.
Treasurer, G. M. Rossman.
Secretary,
Purchasing Agent, G. M. Rossman.
Superintendent, G. M. Rossman.
Process of Manufacture, Lowe.
Population, 8,000.
Price of Gas in 1889, $2.50.
Number of public lamps. 20.
Price received for public lamps, $23.
Approximate annual output, 5,000,000.
Candle power, 24.
Operate Thomson-Houston Electric System, 75 Arc Lights.

Laconia Gas Light Co., Laconia.
Belknap County.

Capital stock, $16,100.
Total bonds outstanding,
President, John C. Moulton.
Treasurer, George B. Lane.
Secretary, George B. Lane.
Purchasing Agent,
Superintendent,
Process of Manufacture,
Population.
Price of Gas in 1889, $4.50.
Number of public lamps, 25.
Price received for public lamps,
Approximate annual output,
Candle power.

People's Gas Light Co., Manchester.
Hillsborough County.

Capital stock,
Total bonds outstanding,
President, John B. Varick.
Treasurer, W. L. Elkins, Jr.
Secretary, Walter G. Africa.
Purchasing Agent, Walter G. Africa.
Superintendent, Walter G. Africa.
Process of Manufacture; Coal and Hanlon-Leadley.
Population, 45,000.
Price of Gas in 1889, $1.40.
Number of public lamps, 100.
Price received for public lamps, $1.40.
Approximate annual output.
Candle power, 20.
Operate Thomson-Houston Electric System, 60 Arc Lights.

Nashua Light, Heat and Power Co.. Nashua.
Hillsborough County.

Capital stock, $200,000.
Total bonds outstanding,
President, F. W. Estabrook.
Treasurer, A. M. Norton.
Secretary, J. H. Tolles.
Purchasing Agent,
Superintendents: F. H. Norton, Gas; G. L. Sadler, Electric.
Process of Manufacture, Coal.
Population, 20,000.
Price of Gas in 1889, $1.40.
Number of public lamps,
Price received for public lamps,
Approximate annual output, 27,000,000.
Candle power, 20.
Operate Thomson-Houston Electric System, 250 Arc and 1,000 Alternating Incandescent Lights.

Portsmouth Gas Light Co., Portsmouth.
Rockingham County.

Capital stock, $142,000.
Total bonds outstanding,
President, John Sise.
Treasurer, Frank J. Philbrick.
Secretary, Frank J. Philbrick.
Purchasing Agent, Frank J. Philbrick.
Superintendent, Thomas R. Martin.

Process of Manufacture, Coal.
Population, 12,000.
Price of Gas in 1889, $2.50, 10% disc.
Number of public lamps, 30.
Price received for public lamps, 1¼ cents per hour.
Approximate annual output, 10,000,000.
Candle power, 18.
Operate Thomson-Houston Electric System, 120 Arc and 1,500 Incandescent Lights.

Salmon Falls Mfg. Co., Rollinsford.

President, Wm G. Meames.
Treasurer, Geo. H. Edwards.
Secretary, Geo. H. Edwards.
Purchasing Agent, Geo. H. Edwards.
Agent, O. S. Brown.
Process of Manufacture, Crude Oil.
Population, 1,700.
Price of Gas in 1889,

NEW JERSEY.

Arlington Gas Light Co., Arlington.

President, J. W. Edwards.
Treasurer, J. Q. Stearns.
Secretary, W. L. Stewart.
Superintendent, S. D. Smith.
Process of Manufacture, Smith and Goldthorp.
Population, 1,000.

Asbury Park Gas Co., Asbury Park.

Monmouth County.

Capital stock, $150,000.
Total bonds outstanding, $75,000, only $33,000 issued.
President, George H. Fletcher.
Treasurer, George H. Fletcher.
Secretary, James W. Hodges.
Purchasing Agent. Geo. H. Fletcher.
Superintendent, James W. Hodges.
Process of Manufacture, Hodges Water Gas.
Population, 3500.
Price of Gas in 1889, $2.00.
Number of public lamps, none
Price received for public lamps,
Approximate annual output, 8,500,000.
Candle power, 28.

Atlantic City Gas and Water Co., Atlantic City.

Atlantic County.

Capital stock, $200,000.
Total bonds outstanding, $
President, Joseph A. Barstow.
Treasurer, Charles Evans.
Secretary, Dr. Thomas K. Reed.
Purchasing Agent,
Superintendent,
Process of Manufacture, Lowe (by Granger).
Population, Winter, 12,000; Summer, 50,000 to 100,000.
Price of Gas in 1889, $1.50.
Number of public lamps, 230.
Price received for public lamps, $18.
Approximate annual output, 30,000,000.
Candle power, 20 to 22.
Operate Thomson-Houston Electric System, 200 Arc Lights.

Bayonne and Greenville Gas Light Co., Bayonne City.
(Operated by the U. G. I. Co.)

Hudson County.

Capital stock, $
Total bonds outstanding, $
President, Solon Humphreys.
Treasurer,
Secretary, W. W. Dashiel.
Purchasing agent, C. E. Morgan
Superintendent, W. H. Smith.
Process of Manufacture, Lowe.
Population, 20,000.
Price of Gas in 1889, $2.00, with disc.
Number of public lamps, 629.
Price received for public lamps, $20,00.
Approximate annual output, 3,000,000.
Candle power, 22.

Belvidere Gas and Electric Light Co., Belvidere.

President,
Treasurer,
Secretary,
Purchasing Agent,
Superintendent,
Process of Manufacture,
Population, 2,000.
Price of Gas in 1889,
Operate Schuyler Electric System.

Bordentown Gas Light Co., Bordentown.

Burlington County.

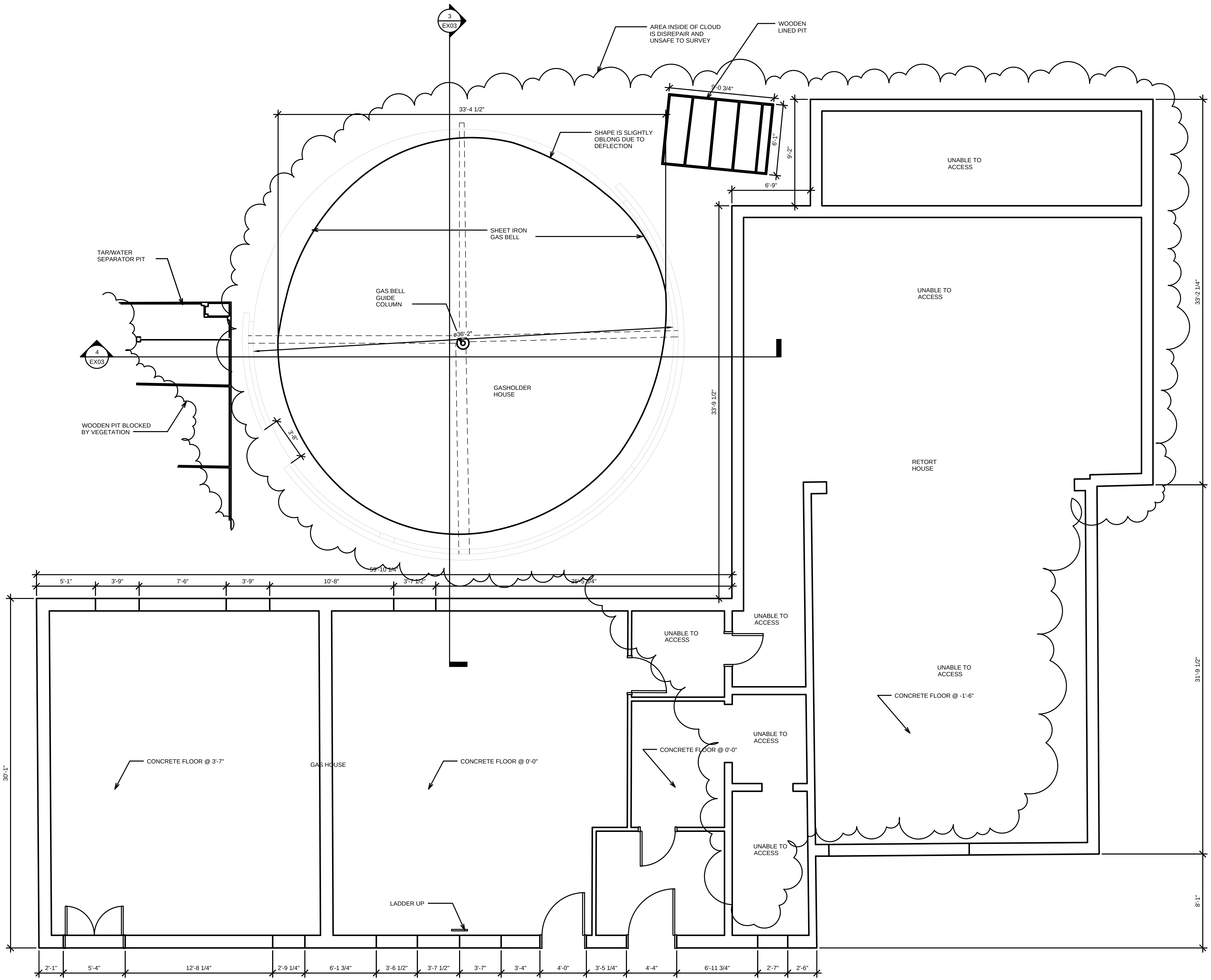
Capital stock, $
Total bonds outstanding, $
President, Mahlon Hutchinson.
Treasurer, Newton M. Potts.
Secretary, Newton M. Potts.
Purchasing Agent, J. O. Hudson.
Superintendent, J. O. Hudson.
Process of Manufacture, Coal.
Population, 7,000.
Price of Gas in 1889, $2.20 to $2.00.
Number of public lamps, 50.
Price received for public lamps, $18.
Approximate annual output, 3,250,000.
Candle power, 18 to 20.

Burlington Gas Light Co., Burlington.

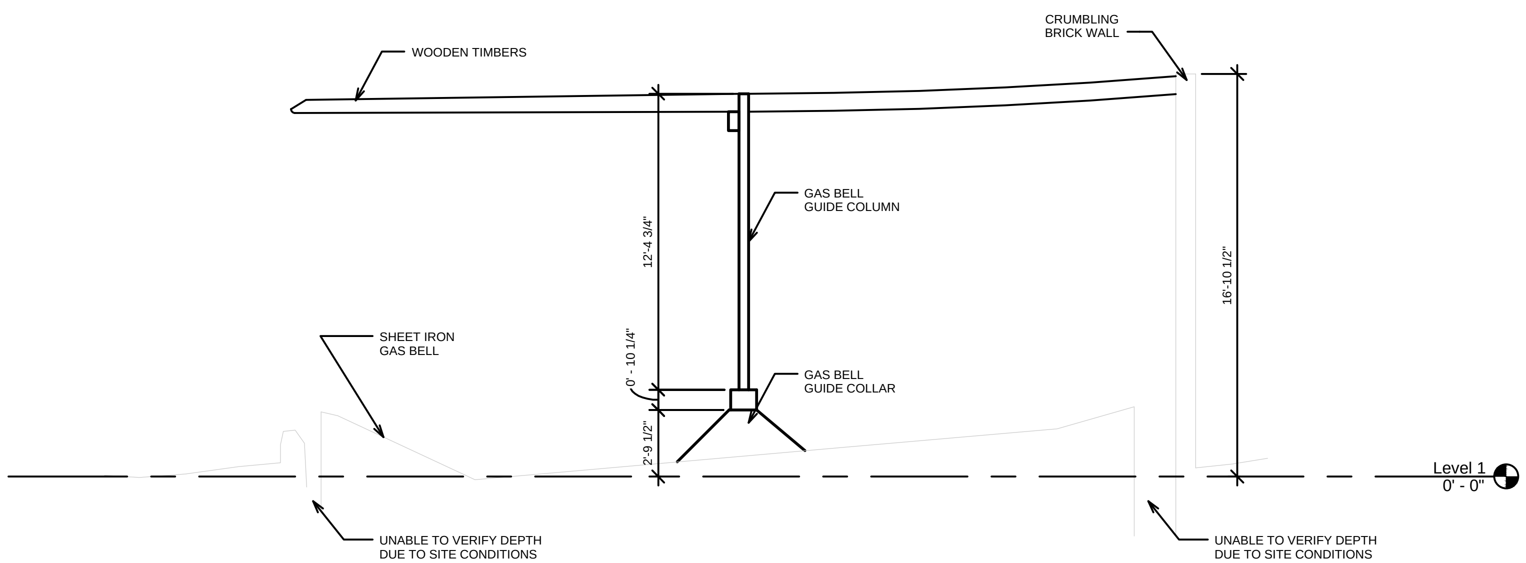
Burlington County.

Capital stock, $55,000.
Total bonds outstanding, $
President, Richard F. Mott.
Treasurer, Joshua Taylor.
Secretary, F. C. Woolman.
Purchasing Agent, Edw. Morris.
Superintendent, Edw. Morris.
Process of Manufacture, Coal.
Population, 10,000.
Price of Gas in 1889, $2,00.
Number of public lamps: Not lighted by gas.
Price received for public lamps,
Approximate annual output,
Candle power,

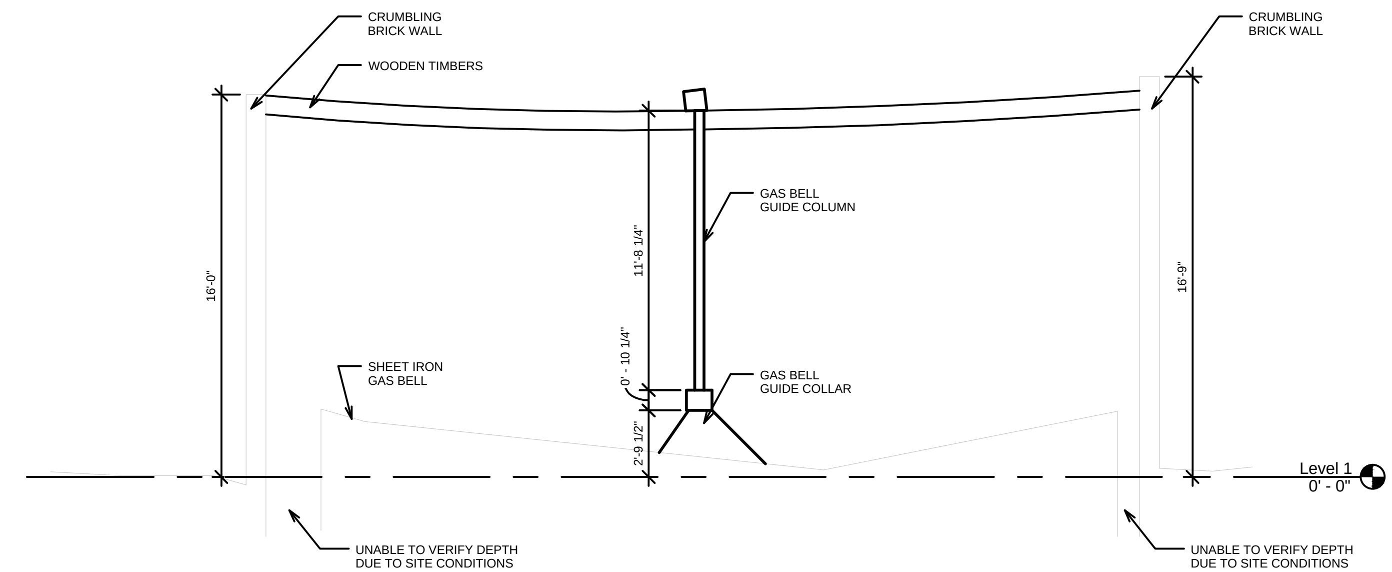
NH-724
Claremont Gas Works
Claremont, NH
Figure 19



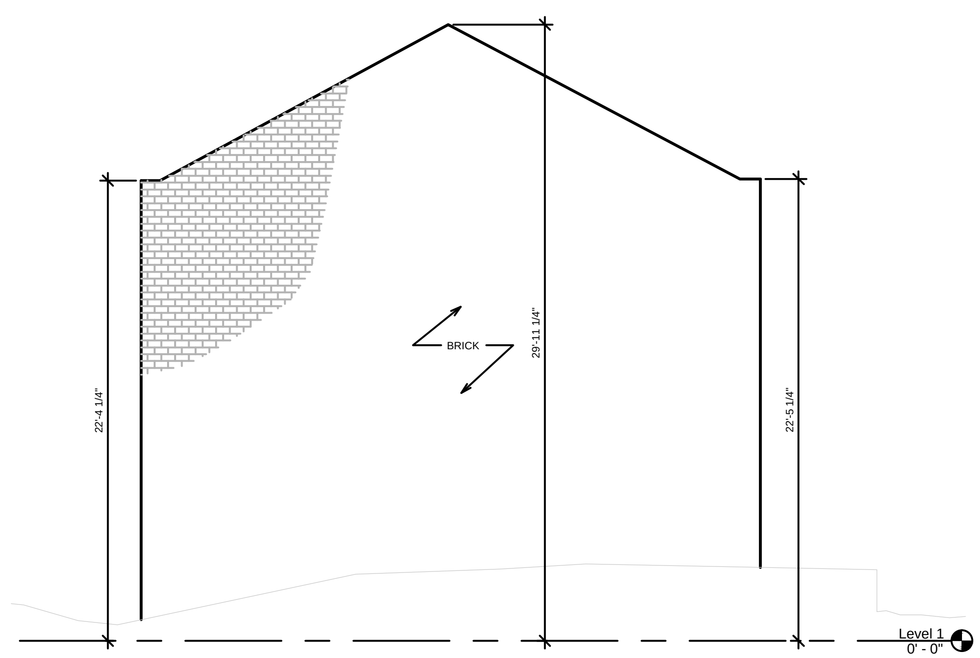
NH-724
Claremont Gas Works
Claremont, NH
Figure 20



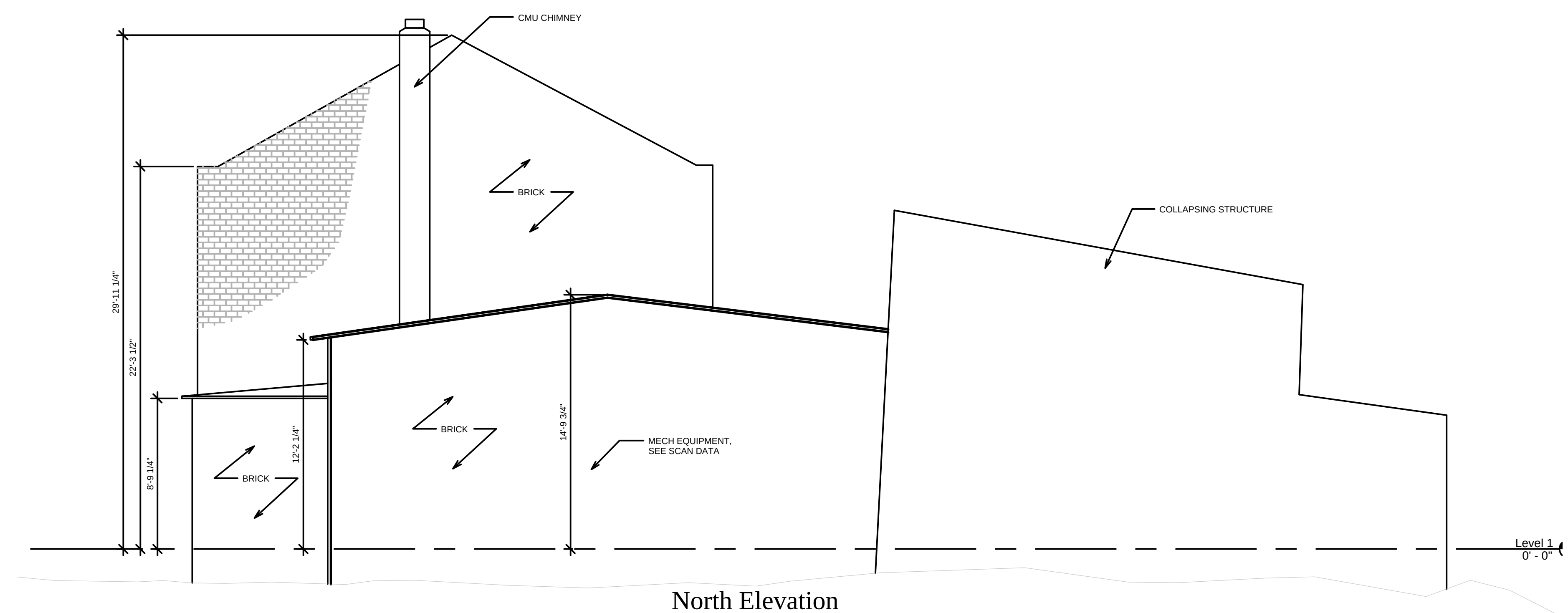
North Elevation



South Elevation

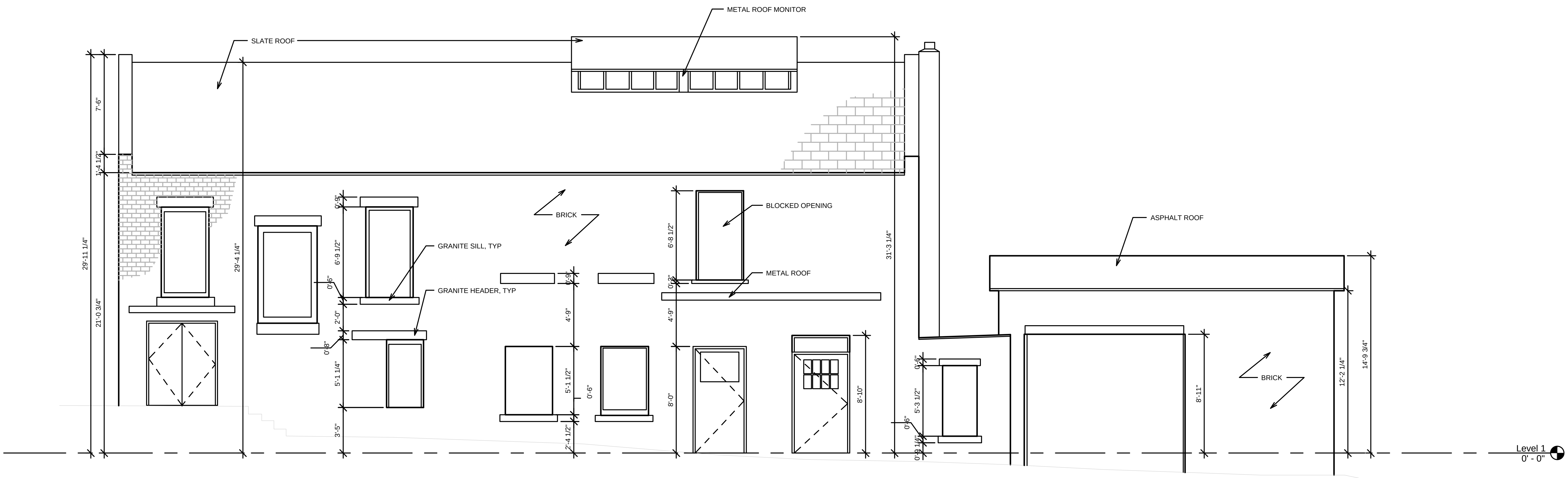


South Elevation



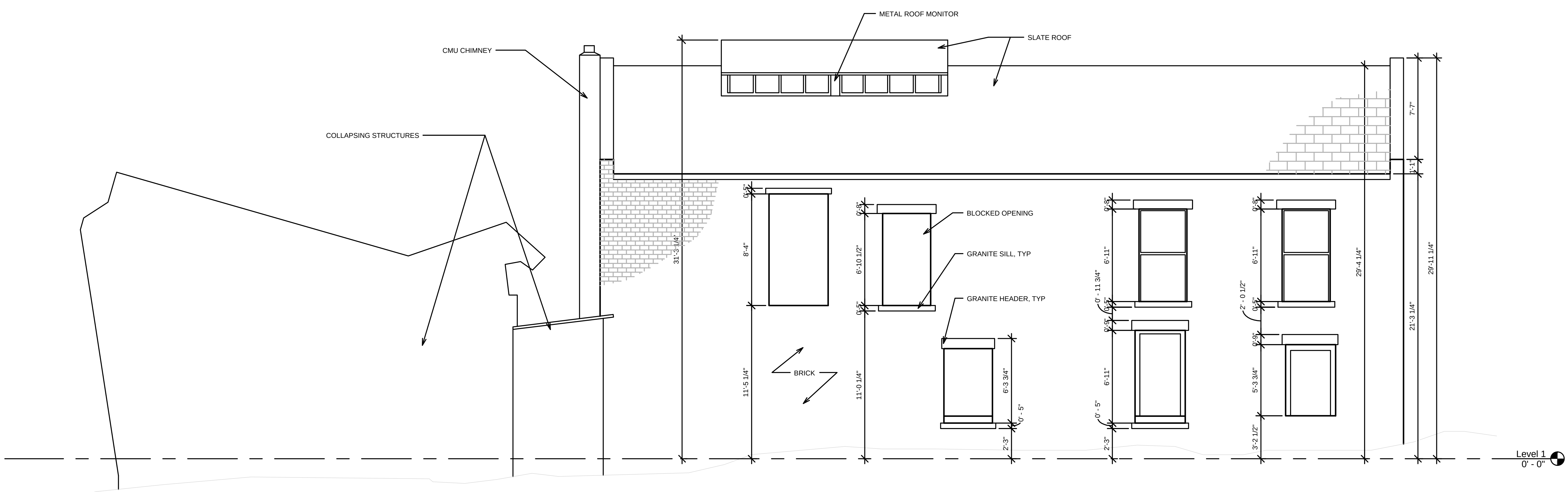
North Elevation

NH-724
Claremont Gas Works
Claremont, NH
Figure 21



East Elevation

NH-724
Claremont Gas Works
Claremont, NH
Figure 22



West Elevation

NH-124-1

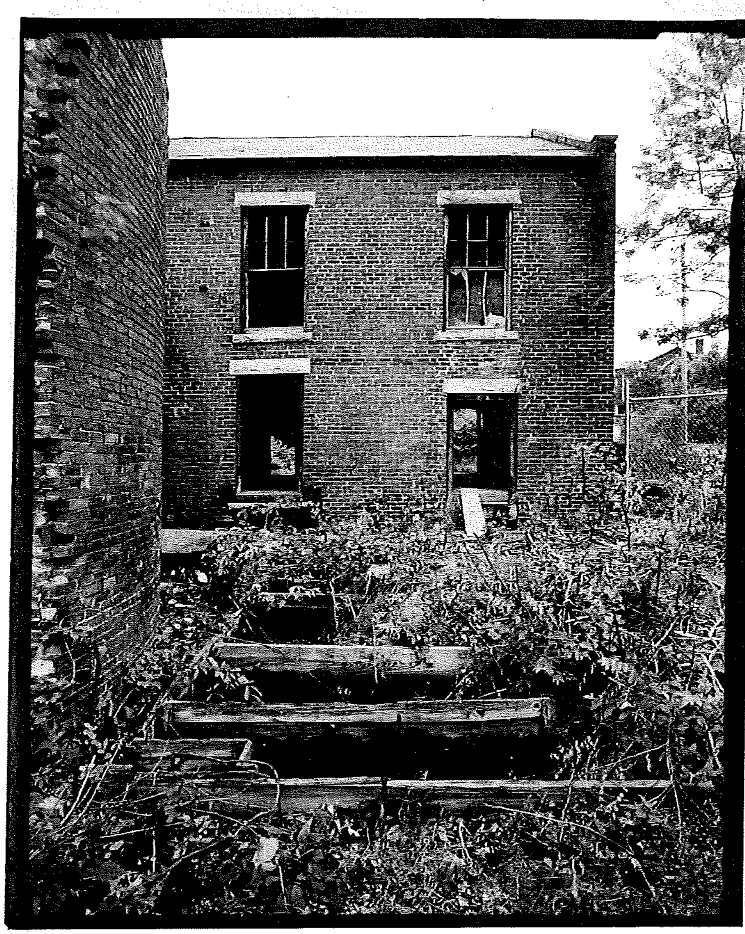
MH-724-2

MH-724-3

MH-724-4

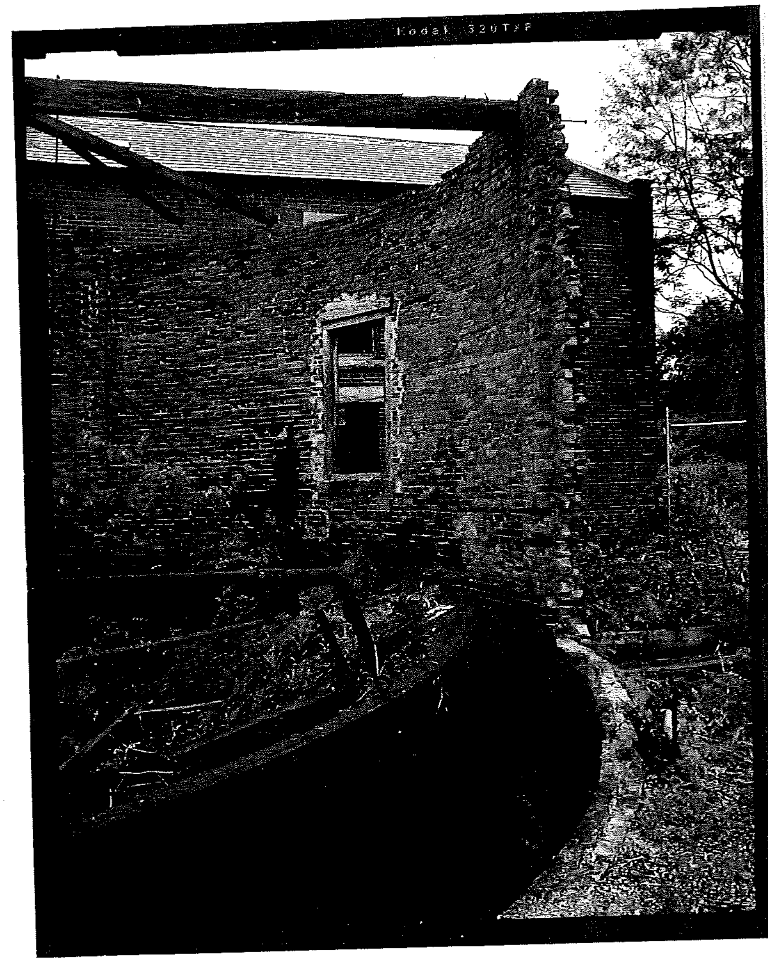
MH·724·5

MH-724-6



MH-724-7

NH-724-8



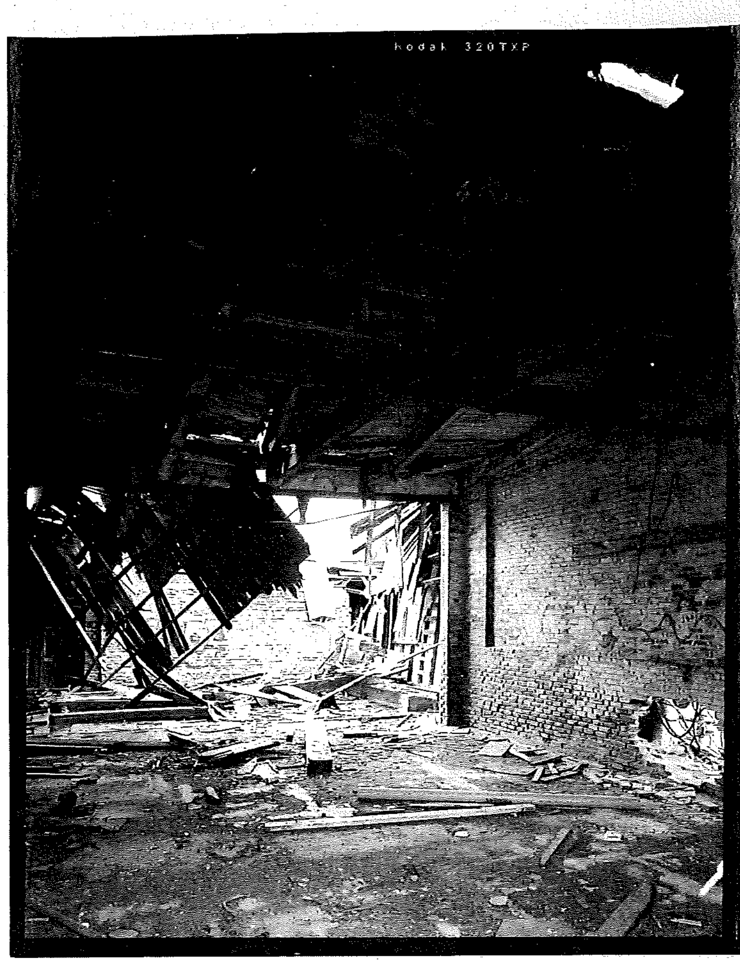
NH-724-9

NH-724-10

NH·724-11

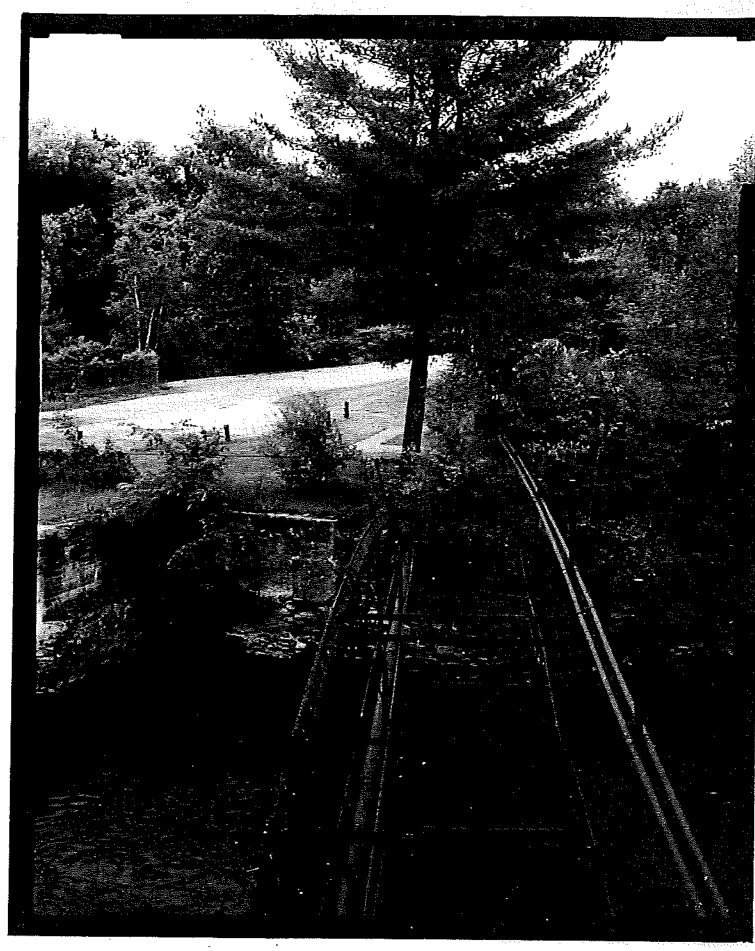
MH·724-12

NH·224-13



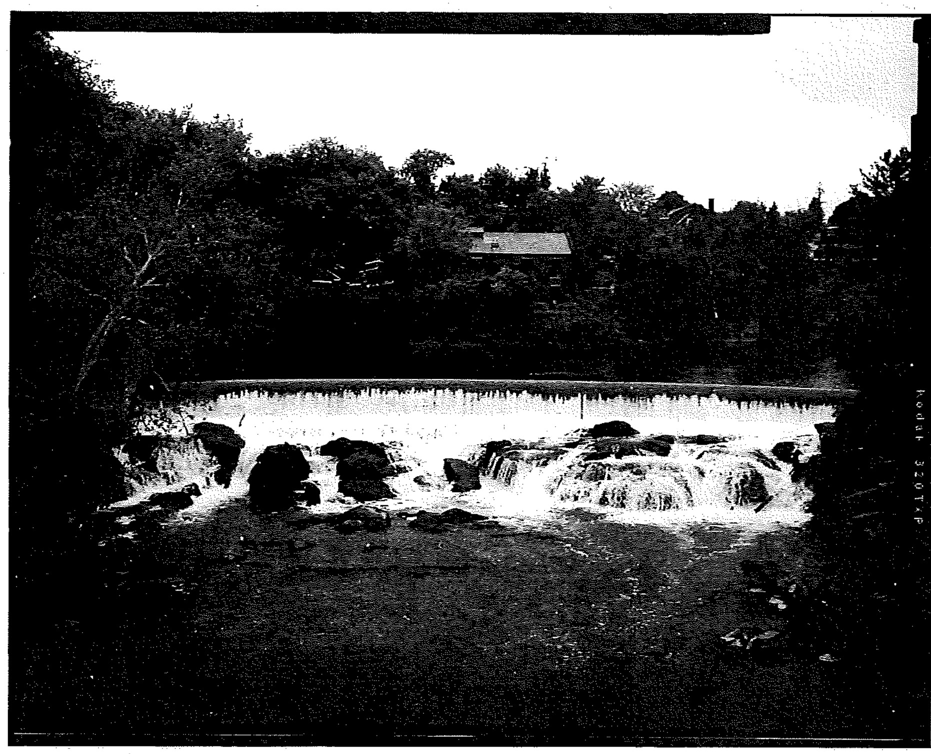
MH·724·14

MH·724·15



MH-224-16

NH-724-17



MH·724·18