BELMONT MILL, MILL
(Nevada Belmont Mill)
Humboldt-Toiyabe National Forest
Approximately 7 miles south of U.S. Route 50 on USDA Forest
Service Road No. 623
Ely vicinity
White Pine County
Nevada

HAER NV-46-A
HAER NV-46-A

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

HISTORIC AMERICAN ENGINEERING RECORD

BELMONT MILL,
MILL

HAER No. NV-46-A

Location:	Approximately 7 miles south of U.S. Route 50 on USDA Forest Service Road No. 623, Ely vicinity, White Pine County, Nevada. U.S. Geological Survey, Seligman Canyon, Nevada, 7.5 Quadrangle (1992), Township 16 North, Range 57 East, Section 1. UTM Zone 11, Easting 2060754.38, Northing 14266875.35 (southeast corner of building) (NAD 83). Humboldt-Toiyabe National Forest Feature No. F1.
Present Owner/Occupant:	United States Department of Agriculture (USDA) Forest Service, Humboldt-Toiyabe National Forest.
Present Use:	Abandoned.
Significance:	The Tonopah Belmont Development Company (TBDC) was one of the most important companies created during Nevada's early twentieth-century mining boom. As ore deposits in its central Nevada mines were depleted, the company sought new claims to resurrect its fortunes. In 1926 TBDC built the Belmont Mill near Hamilton to process lead and silver ore from its recently acquired claims in the White Pine mining district of eastern Nevada. The small pilot mill employed the most recent advances in table concentration and flotation mineral processing techniques, and the company erected numerous other buildings and structures, including boardinghouses and an aerial tramway, to support the mining and milling work. Although largely abandoned by TBDC after a few years, later owners used the mill for smaller operations. Today, although most of the equipment has been removed, the Belmont Mill site is one of the only intact early twentieth-century mill complexes in eastern Nevada. As such, it is a tangible reminder of the decline and failure of a once-powerful company and, thereby, of the boom and bust cycle so common in the mining industry. The subsequent modification and reuse of the mill for small-scale

operations typifies the ceaseless hum of optimism that sustains the mining industry.

Historian: Anne Oliver, Principal, Oliver Conservation Group. Fieldwork for the project was conducted in the fall of 2010. Project documentation was accepted by HABS/HAER in 2011.

Project Information: This project was completed by a team of private contractors at the request of the USDA Forest Service, Humboldt-Toiyabe National Forest (HTNF), in consultation with the Nevada State Historic Preservation Office. When the property came under the purview of the HTNF several years ago, the agency recognized the historic significance of the site and sought to fulfill its obligations under Section 110 of the National Historic Preservation Act by documenting and stabilizing the buildings. The project contract was awarded to ajc architects of Salt Lake City under an indefinite delivery/indefinite quantity contract between Region 4 of the USDA Forest Service and the firm. The project historian was Anne Oliver, a historic preservation consultant with Oliver Conservation Group (Salt Lake City) and sub-contactor to ajc; she was responsible for all aspects of the historical report and would like to thank Eric Stever, Archaeologist, HTNF Ely District, and Peter Fleischmann, Civil Engineer, HTNF, for their assistance. Matt Wallace, Intern Architect with ajc architects, was responsible for the architectural measured drawings and completed all fieldwork and final drawings with the assistance of Oliver Smith Callis, Draftsman. The photography was produced by Steve Tregeagle Photography (Salt Lake City), a subcontractor to ajc, under the direction of Steve Tregeagle and with the assistance of Heath Brown.

PART I. HISTORICAL INFORMATION

A. Physical History

1. Date of construction: 1926. Title records document that, in April and August 1926, TBDC president Clyde A. Heller located the four unpatented mill site claims (Nevada Nos. 3 through 6).[1] Construction was underway by mid-April, formwork for the foundations was in place by mid-May, and the concrete foundations poured by the beginning of June.[2] Original plans called for a small, 50-ton capacity mill, but one designed to allow for additions "if the company desire to treat custom ores" from nearby mines. "The new mill will comprise rotary grinders, concentrating tables, cyaniding and flotation, and is being designed especially for the treatment of the ores of that district."[3] After only four short months of work, the Belmont Mill was given its initial run on Friday, August 20, 1926, making it the first reduction plant to operate in the White Pine mining district since 1892.[4]

2. Architect/Engineer: Tonopah Belmont Development Company. No references were made to the specific architect or engineer responsible for the design of the Belmont Mill. However, in 1910-11, TBDC staff had designed and built a 500-ton silver cyanide reduction mill at Tonopah (called the Tonopah Belmont Mill).[5] Detail drawings and construction were supervised by the engineer Otto Wartenweiler, and he may also have been involved with the Belmont Mill design.[6]

3. Builder, contractor, suppliers: Tonopah Belmont Development Company. The superintendent of construction was initially L. O. Bastian, who became ill and was replaced in mid-May by W. I. Cowsert, "who erected the Belmont Mill at Tonopah."[7] The Tonopah mill was being dismantled at the time, and rails and

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[1] White Pine County Records, Book 96, p. 599-600; Book 102, p. 89.

[2] Ely Daily Times, April 16, May 19 and June 2, 1926.

[3] Ely Daily Times, April 16, 1926.

[4] Ely Daily Times, August 12 and 20, 1926.

[5] Jay A. Carpenter et al., The History of Fifty Years of Mining at Tonopah, 1900-1950 [University of Nevada Bulletin XLVII (1), Geology and Mining Series No. 51. Reno: Nevada Bureau of Mines, 1953], 50, 62-64. A paper on the construction and operation of the Tonopah mill was presented at the American Institute of Mining Engineers meeting in San Francisco in 1915. See A. H. Jones, "The Tonopah Plant of the Belmont Milling Co.," in Transactions of the American Institute of Mining Engineers, vol. LII (New York: American Institute of Mining Engineers, 1916), 95-122.

[6] Wartenweiler opened an office in the Van Nuys Building in Los Angeles in 1914 and had designed at least two other large mining and milling plants by that time; see Steam Vol. XIII No. 1 (January 1914), 26. Given his past association with TBDC he may have been involved in the design of the Belmont Mill but there is no direct evidence of this.

[7] Ely Daily Times, May 19, 1926.

machinery from that mill were hauled to the new mill site by truck and by a six-horse team. Lumber was hauled from Ely.[8]

During the construction period about forty men were employed at the property, some at the mine but many as construction hands. The men were initially housed in Hamilton, about four miles away, but in June some of them moved into the newly erected boardinghouse (NV-46-I), which was the first building completed on the mill site.[9]

4. Original plans: No original plans for the mill were located during the research phase of this project, but TBDC undoubtedly prepared architectural and engineering drawings for the mill (and probably for many of the other buildings on the site as well) and also a milling flow sheet, similar to those prepared for the company's mill at Tonopah.[10] The documents might be included in TBDC's corporate records, if these still exist and can be located in the future.

5. Alterations and additions: The mill underwent two main periods of alteration, the first shortly after original construction and the second in the 1940s or 1950s, when the site changed ownership and the ore concentration process was modified and reduced greatly in scale. The first round of changes involved the construction of a mezzanine on the south end of Level 5, presumably to provide floor space for a flotation unit; the massive, reused timbers used for the floor framing may have been leftover elements of the aerial tramway. It also appears that work and storage rooms were constructed under the sloping sides of the ore bins on the north half of Levels 4 and 3 at about this time. The theory that these rooms aren't original is supported by differences in window and door treatments and in the supplier of the corrugated metal siding (originating in San Francisco rather than Pittsburgh, as for the rest of the building). However, the high quality and compatibility of the alterations indicate an early date and an organized and well-financed owner.

Alterations dating to the 1940s or 1950s center around changes made to the ore concentration process. Beginning at the top of the mill, an opening was created at the north end of the west wall to provide access to a new wood ramp leading to the north ore bin on Level 2. On Level 5, a mineral jig was constructed at the base of ore chute and then material was routed through a modified screen classifier. A second screen classifier to the south was disused, although it appears that slimes were directed, on a modified course, to original Wilfley tables on

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[8] Ely Daily Times, March 17 and April 22, 1926. TBDC was simultaneously investing in "Camp Belmont," its new Arizona lead-silver property, including mine development work, well drilling, building construction, telephone line construction, and machinery installation; some of the latter was doubtless salvaged from the Tonopah mill as well. See "Tonopah Belmont Opens Mine in Arizona," in Engineering and Mining Journal-Press vol. 121: 22 (May 29, 1926), 896.

[9] Ely Daily Times, June 3, 1926.

[10] Jones, "The Tonopah Plant of the Belmont Milling Co.," 98-99.

Level 5. The flotation unit on the mezzanine, however, was not used. A new launder was then installed along the north side of the mill leading from the modified screen classifier to a rake classifier on Level 6. Various troughs and launders were cut into the floor of the mill to serve the new process. According to oral accounts, no cyanidation was used at the mill during this period and the Dorr thickening tank and settling tank at the southwest corner of the mill may have fallen out of use at this time.[11] One addition is the wood platform built against the south wall of Level 6. The purpose of the platform is unclear; it was not present in ca. 1940 photographs and therefore was associated with the modified mill process dating to the 1940s-1950s.

B. Historical Context:

See the Narrative Overview in HAER No. NV-46 for a complete discussion. In summary:

The Belmont Mill and most of its associated buildings and structures were designed and constructed by the Tonopah Belmont Development Company (TBDC) in 1926. The mill site is located in the White Pine mining district of east-central Nevada, at the northern end of the White Pine Mountains. The mill itself sits at an elevation of about 7,500 feet near the mouth of McEllen Canyon, which lies between Pogonip Ridge and Mount Hamilton immediately to the west and Babylon Ridge to the east. The once-renowned town of Hamilton lies on the opposite side of Babylon Ridge about four miles to the southeast, just north of Treasure Hill.

The White Pine mining district, about 16 miles square, was organized in 1865 with the discovery of ore on the west slope of Mount Hamilton, but intense development began only after rich silver chloride deposits were discovered on Treasure Hill in 1868.[12] The ensuing rush resulted in the creation of Hamilton and several nearby towns. In 1869-70 there were 197 mining companies and an estimated population of 25,000 people in the district as a whole. The boom ended abruptly in 1870 and it has been described as "one of the most, intense, and shortest, mining booms in the American West."[13] Hamilton and the adjacent towns were largely depopulated during the course of the 1870s but were not completely abandoned until the 1930s: oral histories document that about 100

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[11] Interview with Hal (Rod) Jensen, Jr., 1 October 2010.

[12] The creation of the White Pine district was only part of the general frenzy of activity in White Pine County, which saw the establishment of more than a dozen new mining districts in 1869 and six more in the 1870s. See Steven R. James (ed.), Prehistory, Ethnohistory, and History of Eastern Nevada: A Cultural Resources Summary of the Elko and Ely Districts, Cultural Resource Series No. 3 (Reno: Bureau of Land Management, 1981), 254-55.

[13] Donald L. Hardesty, "Managing Historic Properties in the White Pine Mining District," (unpublished report prepared for Humboldt National Forest, 1993), 1.

people lived in the area in 1917, and there were 56 registered voters residing in Hamilton in 1928.[14]

The White Pine mining district is broken into three distinct sections: a copper belt on the west slope of the White Pine Mountains centering around Monte Cristo, a silver-lead belt on the east side of the range centering around McEllen Canyon, and a silver belt further east centering around Hamilton and Treasure Hill. The lead-silver belt deposits were discovered shortly after the silver deposits at Treasure Hill, and some of the mine claims associated with the Belmont Mill may have been established at that time. Early attempts to smelt the ores were unprofitable due to crude methods and high transportation costs. However, it was reported that, in the 1880s,

> … when mining had been abandoned on Treasure Hill, attention was again directed to [the lead deposits]. More favorable market conditions made it profitable to export the best grade of these ores to Salt Lake and San Francisco for reduction, and from these mines have since come the ores that have employed, for more than 20 years, the small remaining population of the district.[15]

But generally the district was very quiet. Accounts of the district in Mineral Resources between 1905 and 1924 indicate that lead-silver ores remained the principal product but that typically only 300 to 500 tons of ore were produced each year, most of it of high enough quality to be classified as shipping grade. Exceptions were the years during World War I, when increased demand for lead made it economically viable to treat lower grade ore at concentration mills; about half the ore was milled while the other half was of shipping grade. But the White Pine district would have one last flurry of activity in the mid-1920s, spurred by the investments of TBDC and the construction of the Belmont Mill.

The second great wave of mining in Nevada was ushered in by the discovery of silver ore deposits near Tonopah Springs in 1900, in the central part of the state, and by 1905 the bustling town of Tonopah was established. Two great mining companies arose during this boom, the Tonopah Mining Company and the Tonopah Belmont Development Company. Both were fully industrialized in the modern sense, defined by a highly structured organization, the existence of owners and financial backers in distant urban areas, an elaborate division of labor (wage earners, shift workers, managers, technicians, engineers, financiers), and

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[14] Jen Huntley-Smith, "Documentary Report for Archaeology of Treasure Hill," p. 6, as cited by Hardesty, "Managing Historic Properties in the White Pine Mining District," 4.

[15] W. S. Larsh, "Mining at Hamilton, Nevada," in Mines and Minerals (June 1909), 523.

the construction of large reduction facilities, offices, and residential infrastructure close to the mines.[16]

A group of Philadelphia capitalists arranged to buy the original Tonopah claims in 1901, creating the Tonopah Mining Company and naming Arthur Brock, a wealthy Philadelphia businessman, as president. In May 1902 either Arthur or John Brock arrived to inspect the new holdings and at that time negotiated the purchase of adjacent claims and a tunnel.[17] By December the tunnel property had been combined with several other holdings and was incorporated in New Jersey as the TBDC. "These two companies accounted for 60% of the district's total production ($146,336,102) from 1901 through 1940;" the estimated profits of TBDC alone were $39 million.[18]

TBDC initially shipped ore to the Comstock mills in Virginia City and to California but soon decided to build a 60-stamp mill at Millers, about thirteen miles west of Tonopah; A. H. Jones was named mill superintendent.[19] The opening of a rich new vein prompted the construction, between 1910 and 1911, of a new 500-ton cyanide mill in Tonopah itself, adjacent to the shaft.[20]

Clyde Heller was named president of the company at this time, a position he would retain until his death in 1937.[21] The company prospered under his direction between 1911 and 1915, producing 5.66 percent of the silver in the United States and returning profits from the Tonopah mines of $2 to 3 million.

> Similar to all prospering mining companies, President Heller [stated] in his [1914 annual] report "the examination of other mining properties has continued with a view to purchase, and negotiations are being conducted for one." This was the start of

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[16] See Martha H. Bowers and Hans Muessig, History of Central Nevada: An Overview of the Battle Mountain District, Bureau of Land Management Cultural Resources Series No. 4 (Reno: Bureau of Land Management, 1982), 39.

[17] David Fairall, in "The Tonopah Belmont Development Company: Its Beginning and Formation," in Nevada Historical Society Quarterly 40 (Fall 1997), 301-02, states that Arthur Brock visited Tonopah while Loren Chan, in Sagebrush Statesman: Tasker L. Oddie of Nevada (Reno, University of Nevada Press, 1973), 28, states that John Brock visited. Whichever the case, it is clear that the in the early days the two companies had close ties, often with overlapping officers and boards of directors.

[18] Fairall, "The Tonopah Belmont Development Company," 290, and Bowers and Muessig, History of Central Nevada, 35.

[19] "Archie" Jones became general superintendent of milling at Tonopah in 1918; he was not technically educated but had milling experience in Colorado and was promoted rapidly through the company; he resigned in 1920. See Carpenter et al., The History of Fifty Years of Mining at Tonopah, 87.

[20] Ibid., 50, 62-64.

[21] By the 1920s, the TBDC corporate office address was given as 500 Bullitt Building, Philadelphia, with a mine office in Tonopah. It appears that Heller lived in Tonopah. See Walter Harvey Weed, The Mines Handbook, vol. XV (Tuckahoe, NY: The Mines Handbook Co., 1922), 1350.

> many years of search, the taking over of many properties, and an over-all high capital loss.[22]

Heller had of course anticipated the eventual depletion of the company's holdings and indeed, beginning in 1916, the tonnage extracted from the Tonopah mines began a steady decline. High silver prices enabled profits of about $1 million for the next two years but the drop in mine tonnage led to the closing of the mill at Millers in 1918, after eleven years of continuous operation.[23]

Profits in 1918 dropped to below $500,000 and the early1920s were dismal years: the Tonopah mill was closed in 1923 due to insufficient ore supply and the TBDC's leases at Tonopah were forfeited.[24] Profits were below $200,000 by 1924, deriving mainly from the Surf Inlet mines, and the company continued to search for new properties to revive its fortunes. In 1925, TBDC exercised an option on a lead-zinc mine near Hamilton, in the White Pine district of Nevada.[25]

By early 1926, title records confirm that TBDC owned all of the individual claims comprising the Nevada Group in McEllen Canyon. Initial explorations proved promising, and on March 4, 1926, the Ely Daily Times heralded,

> The Tonopah Belmont Development company, will build a small pilot mill at Hamilton this spring, in which to conduct tests on the ore in the property the company is developing on the lead belt, west of Treasure Hill. Clyde A. Heller, president of the company stated that material for the mill will be assembled and construction started just as soon as the snow goes off and condition of the roads will permit trucking.
>
> …Previous reports from Charles Mayotte, [mine] superintendent, showed the property to be opening up in a gratifying manner and that there is already developed sufficient ore to justify the construction of a small mill.

Later in the month, P. W. Racey, TBDC's general superintendent for Nevada operations, issued a statement describing the new workings in the mine and noted, "The Belmont mill at Tonopah is being dismantled and considerable amount of the machinery will be shipped to Hamilton and used in the new test mill."[26]

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[22] Carpenter et al., The History of Fifty Years of Mining at Tonopah, 83.

[23] Ibid., 85-86.

[24] Walter Harvey Weed, The Mines Handbook Vol. XVI (Tuckahoe, NY: The Mines Handbook Co., 1925), 1506.

[25] Carpenter et al., The History of Fifty Years of Mining at Tonopah, 87-90.

[26] Ely Daily Times, March 17, 1926. TBDC was simultaneously investing in "Camp Belmont" (the old MacNeill lead-silver mine outside of Wickenburg, Arizona), including mine development work, well drilling, building construction, telephone line construction, and machinery installation; some of the latter

To facilitate the initial relocation of machinery, future trucking of ore, and winter access to and from the mill site, Racey asked the White Pine County commissioners to construct a seven mile stretch of road "across the flat" to connect the old Hamilton road near the mouth of McEllen Canyon with the Lincoln Highway (U.S. Route 50) to the north, just west of Antelope Summit. The county agreed to the proposal in early May and the road was completed about two months later; it is the same graded dirt road that provides access from the highway today.[27]

Title records document that, in April and August 1926, Clyde Heller located the four unpatented mill site claims (Nevada Nos. 3 through 6).[28] Construction was underway by mid-April under the supervision of L. O. Bastian. Original plans called for a small, 50-ton capacity mill, but one designed to allow for additions "if the company desire to treat custom ores" from nearby mines. "The new mill will comprise rotary grinders, concentrating tables, cyaniding and flotation, and is being designed especially for the treatment of the ores of that district."[29]

Rails and machinery were hauled from Tonopah to the mine site by truck and a six-horse team; lumber was hauled from Ely.[30] At about this time, W. I. Cowsert, "who erected the Belmont Mill at Tonopah," replaced the ailing Bastian as construction supervisor.[31] Work progressed apace and, in early June, TBDC could report that

> the concrete [mill] foundation has been poured and piles of lumber and machinery are decorating the flat at the mill site. A reservoir for water storage [NV-46-S] has been built and several miles of pipe are now on the ground. Timber for the tramway is also on the ground and the survey has been completed from the mill site to the Cornell property.[32]

At this time, about forty men were employed at the property and their prospective new residence, the boardinghouse (NV-46-I), was reported to have "nine bedrooms, a kitchen, lobby, and bath room, and [was] comfortably equipped."[33] The activity in McEllen Canyon created hope for a revival of the White Pine

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was doubtless salvaged from the Tonopah mill as well. See "Tonopah Belmont Opens Mine in Arizona," in Engineering and Mining Journal-Press vol. 121: 22 (May 29, 1926), 896.

[27] Ely Daily Times, March 29, May 3, June 2, and August 4, 1926.
[28] White Pine County Records, Book 96, p. 599-600; Book 102, p. 89.
[29] Ely Daily Times, April 16, 1926.
[30] Ely Daily Times, April 22, 1926.
[31] Ely Daily Times, May 19, 1926.
[32] Ely Daily Times, June 2, 1926.
[33] Ely Daily Times, June 3, 1926.

district in general, and indeed stimulated new work in both the lead and silver belts by area claim and patent holders that summer and fall.[34]

In early May, TBDC had expanded its holdings with the purchase of the Cornell Group (just north of the Nevada Group). To move the ore, TBDC proposed a 9,200-foot aerial tramway (the two tramway towers on Forest Service property are described in NV-46-C) to connect the Cornell with the mill in the canyon bottom. Rather than construct a new tram, a disused Bleichert-type double-rope tramway was purchased from the owners of the Chollar mine in Virginia City, Nevada.[35] The dismantled tram was shipped to Ely by train and then trucked to the site.[36]

An Ely Daily Times article dated June 19, 1926, provides one of the only descriptions of the type of equipment originally installed in the mill:

> … [The] new plant will be equipped with a… Blake type crusher, a Marathon rod mill, Dorr classifier, flotation tanks and a Dorr thickener. It is expected that the mill will treat 75 tons per day, and that this tonnage can be easily augmented by the installation of new units…
>
> A 55 h.p. full Deisel [*sic*] engine will furnish the power to operate the mill. The tramway will be equipped with 30 500-pound ore buckets, and will be operated primarily by gravity, the 15 loaded buckets furnishing the gravity to pull back the empties.

Further valuable information regarding both mine workings and infrastructure is provided in an article from July:

> The discovery of two good veins that contain from 18 inches to three feet of ore assaying 16 oz. of silver and 33 percent lead in the Cornell mine… has elated Supt. P. W. Racey… The ore is of higher grade than the product of the company's adjoining Nevada property and of slightly different character.
>
> Construction of a power plant [NV-46-B] and concentrating mill has been completed and the 9000-foot aerial bucket tramway is about finished except for stringing the cable, which is on the ground… [Delay] in receiving three miles of three-inch pipe for

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[34] Ely Daily Times, April 16, May 15, and June 2, 1926.

[35] Ely Daily Times, May 3, 1926. The Chollar was located in 1859 and became the fifth most productive mine on the Comstock, producing as much as $17 million in silver ore. In 1887 the Nevada Mill was built near the mine to process low grade ore and the tram, "said to be one of the largest and best constructed tramways in the state," may have been built at that time. After years of decline, the Chollar was closed in the 1940s. See www.nevada-landmarks.com/st/shl209.htm (accessed December 8, 2010).

[36] Ely Daily Times, June 9, 1926.

> the water line probably will postpone milling operations until the middle of [August]...
>
> The mill is at the base of the mountain and is connected with the Cornell tunnel by the long bucket tramway. The Nevada property, first purchased by the company, is still higher up and the Cornell tunnel is being extended to connect with No. 5 level of the Nevada…
>
> It was first intended to build a 25-ton pilot mill but the purchase of the Cornell mine, which has a lot of ore in sight, and a great improvement in the Nevada property on No. 5 level, induced a change of plans. The plant just finished will have a capacity of 50 to 75 tons per day and will employ both table concentration and flotation. Ore from the Nevada mine is in a crushed zone and very little of this mine product will require crushing. The reject from the tables will be sulphidized and passed to the flotation cells.
>
> Power for the operation of the mill and other machinery will be supplied by a 55-h.p. Ingersoll-Rand PO oil engine which has been set on its foundation. A 200-ton bin has been built at the head house of the tramway and a 100-ton bin is being constructed at the mill.[37]

After only four short months of work, the Belmont Mill was given its initial run on Friday, August 20, 1926, making it the first reduction plant to operate in the district since 1892.[38] President Heller arrived from New York, en route to Tonopah, for the inaugural run and expressed his "entire satisfaction," noting only the need for minor adjustments to the tram (which delayed operations for at least a week) and stating that the company expected to double the capacity of the mill at no distant date.[39] The beaming optimism was perpetuated a month later in the comments of M. B. Cutter, a director of TBDC and resident of Minneapolis, Minnesota, who predicted that the mill would be increased to 200-ton capacity within six months, noting that "there is already enough ore in sight to keep a hundred-ton mill in continuous operation for several years."[40]

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[37] Ely Daily Times, July 14, 1926. Another article cited the TBDC's belief that the ore "will concentrate without crushing if the coarse material is first removed by screening," which helps to account for the relative dearth of crushing equipment (or the machine mounts for it) at the mill. See "Tonopah Belmont Developing Mine and Installing Small Mill," in Engineering and Mining Journal-Press vol. 121: 20 (May 15, 1926), 819.

[38] Ely Daily Times, August 12 and 20, 1926.

[39] Ely Daily Times, August 21 and 27, 1926. It was later noted that the increase from 50 to 100 tons could be effected by "providing for increased power and the possible addition of another rod mill and more tables" (The Ely Record, September 17, 1926).

[40] The Ely Record, September 17, 1926. An Ely Daily Times article from December 27, 1926, provides Mr. Cutter's place of residence.

Milling of the lead ore proceeded throughout the fall of 1926 and with such promising results that the mill's capacity was indeed expanded, although only to 100 tons per day. In October, Superintendent Racey visited the site from Tonopah, noting that work would be completed by early November and that "the final flow sheets will be partly table work and partly flotation…"[41] The first report on mill production dates to this time, when a carload of lead concentrates was taken to Kimberly (the railhead on the Nevada Northern Railway along Route 50, just west of Ely) and thence to a Utah smelter.[42] In December both high grade ore and concentrates were shipped from the mill, and indeed it was noted, "The success of the Belmont mill, and the new treatment that is being given the ores of the camp, it is believed will lead to the erection of other reduction plants in the district" to process lower-grades ores otherwise made unprofitable due to transportation and smelting costs.[43] In four months of operation in 1926, the mill processed 3,588 tons of ore, resulting in a gross yield of $63,697.[44]

Nevertheless, the Belmont Mill was closed as of January 5, 1927, due to unpredictable operations during the cold weather."[45] The Ely Daily Times surmised that a number of needed improvements would be made to the mill pending spring activity, although no official statement was made regarding the resumption of milling.[46]

The TBDC mine and mill were not completely abandoned. Although the winter continued severe through February, it was reported that TBDC and two other mining companies were "working small forces and waiting for spring."[47] But a declining lead market and low extraction seems to have halted any immediate resumption of mining and milling, and the company's net income for 1927 was a dismal $14,868.[48] In both 1927 and 1928 work at Belmont was confined to assessment work, development, and maintenance of the main haulage tunnel; there were no reports of mill operation.[49]

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[41] Ely Daily Times, October 6, 1926. The expansion work reportedly consisted of the construction of a flotation unit under the supervision of Bastian (Ely Daily Times, December 2, 1926). Newspaper accounts make it unclear if this was an additional flotation unit or the first unit at the mill, although the former seems more likely given earlier reporting on the use of both table concentration and flotation at the mill.

[42] Ely Daily Times, November 8, 1926; and The Ely Record, December 10, 1926.

[43] Ely Daily Times, December 22, 1926.

[44] B. Couch and J. Carpenter, Nevada's Metal and Mineral Production (1859-1940, inclusive (Reno: Nevada State Bureau of Mines, 1943).

[45] Ely Daily Times, January 14, 1927.

[46] Ely Daily Times, January 5, 1927.

[47] The Ely Record, March 11, 1927.

[48] Wall Street Journal, April 11, 1928, and Carpenter et al., The History of Fifty Years of Mining at Tonopah, 90.

[49] V. C. Heikes, "Gold, Silver, Copper, Lead and Zinc in Nevada," in U.S. Bureau of Mines Mineral Resources, 1928 (Part I) (Washington: U.S. Government Printing Office, 1931). The mill closure, or at least the TBDC's lack of interest in processing custom ores, is supported by the fact that a new table

In 1929, TBDC "ceased mining on its own account in favor of leases given to miners."[50] The lessees extracted "considerable high-grade lead-silver ore" from the mine (referred to as the Nevada Lead property) in 1929, and for three months, until operations were suspended once again due to the low price of silver and lead, lower grade ore from the mine was processed at the mill.[51] Again in 1930, "first class smelting ore" was produced from the mine.[52] But the onset of the Great Depression in the 1930s brought work almost entirely to a halt. Between 1931 and 1939 very little activity was reported at the mine or mill, or in the district as a whole, particularly in the early part of the decade.[53] Demand for base metals increased steadily beginning in the mid-1930s and there was some renewed activity. In 1939, following repairs to the aerial tramway and the milling equipment, a combination of TBDC employees and lessees began processing ores from the mine claims once again.[54]

But in September 1940, the failing TBDC finally sold both the mine and the mill site claims to Captain Arthur A. deMelik of Ely.[55] After one year he sold them to Ely resident Byron (or Bryon) F. Snyder.[56] After 1942, Snyder's permanent address was given as Fort Lauderdale, Florida, and it appears he worked the property for only two years before moving there.[57]

Three of the only historic photographs located of the mill site date from about this period (see Figures 4, 5, and 6 in HAER No. NV-46).[58] The first was taken from the hillside east of the Boardinghouse and facing roughly due north, providing a view the south and east sides of the mill, two thickening or conditioning tanks near the southwest corner of the mill (only tailings and a few wood members

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concentration mill for processing lead-silver ore was constructed at the nearby Roosevelt mine (Ely Record, February 10, 1928).

[50] Carpenter et al., The History of Fifty Years of Mining at Tonopah, 90.

[51] V. C. Heikes, "Gold, Silver, Copper, Lead and Zinc in Nevada," in U.S. Bureau of Mines Mineral Resources, 1929 (Part I) (Washington: U.S. Government Printing Office, 1932).

[52] V. C. Heikes, "Gold, Silver, Copper, Lead and Zinc in Nevada," in U.S. Bureau of Mines Mineral Resources, 1930 (Part I) (Washington: U.S. Government Printing Office, 1933).

[53] The only reported activity in the district in 1931 was a cyanide leaching operation on old mill tailings at Eberhardt. See Smith, A. M. and J. Carpenter, "Hamilton-Eureka-Austin," unpublished report on field trip, 1931 (Reno: University of Nevada, Nevada Bureau of Mines and Geology mining district files, Document No. 52900001).

[54] White Pine County Records, Book 114, p. 474.

[55] White Pine County Records, Book 121, pp. 291, 293, and 310; Book 129, p. 204.

[56] White Pine County Records, Book 121, p. 306-07.

[57] White Pine County Records, Tax Receipts, 1942-48.

[58] East Ely Railroad Museum archives, no negative numbers or accession numbers. The photos appear to be prints made in February 1975 (as indicated by a date stamp on the prints) from older negatives. A prospective date of ca. 1940 is derived from the condition of the buildings and structures, the style of an automobile and the clothing of the man and woman in the photos, the presence of one or two residences behind the mill, and the likelihood that photographs would have been taken at a time when ownership of the mill changed.

remain), a smaller wood tank behind the mill (probably used for reclaimed water from the milling process and no longer extant), and a wood trestle leading from the highest level of the mill (the aerial tramway terminal) to the water tank. The second photograph was taken from the hillside south of the mill and depicts its south side (including the two upper tanks and another thickening tank east of the mill, near the road), and the water tank (NV-46-S). The third photograph was taken just south of the mill, providing a detailed view of the two upper thickening/conditioning tanks, the south side of the mill, and the trestle that led from the mill to the reclaimed water tank.

Activity in 1941 was limited to the removal of 25 tons of ore from the mine. But in 1942, 2,500 tons were removed that yielded 470 ounces of silver and 17,738 pounds of lead, a reflection of the great demand for all metals that was prompted by World War II. No further activity was reported until 1949.[59] Proof of annual labor documents for the mill site claims were found for the assessment years ending in July of 1941 and 1942, but no indication of mill workings was provided in either document.[60] No account of the mine was given in the annual <u>Mineral Resources</u> reports for the 1940s although other small mines in the district were mentioned, again indicating a very low level of activity.

Snyder sold the mine and mill site claims to Don A. Jennings of the Belmont Mine and Mill Co. in June 1949.[61] It appears that activity at the mine (referred to as the "Belmont mine") continued through 1956, supported by the strong demand for base metals after World War II and through the mid-1950s. Because only a few individuals and/or lessees operated the mine rather than an industrialized organization like TBDC, annual tonnages were generally quite modest, ranging from a low of ten tons in 1949 to 194 tons in 1950.[62] Despite this, the mine was listed in the <u>Minerals Yearbook</u> as being one of the leading producers of lead in the district for 1955 and 1956, producing about 35,000 pounds each year.[63] The report states that the lead ore was shipped to a Utah smelter but does not mention that the mill was used for processing. However, the secondary system that was installed in the mill, and which remains partially in place today, most likely dates to this period. According to those who knew him, Jennings was not an

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[59] "White Pine District – Principal Mines," unpublished district summary [after 1963] (Reno: University of Nevada, Nevada Bureau of Mines and Geology mining district files, Document No. 52900082).

[60] White Pine County Records, Instrument Nos. 69775 and 71804.

[61] White Pine County Records, Book 145, p. 170-71, and Book 151, p. 165.

[62] "White Pine District – Principal Mines," unpublished district summary [after 1963] (Reno: University of Nevada, Nevada Bureau of Mines and Geology mining district files, Document No. 52900082).

[63] L. E. Davis and W. C. Fischer, "The Mineral Industry of Nevada," in US Bureau of Mines <u>Minerals Yearbook Area Reports, 1955</u>, vol. III (Washington: US Government Printing Office, 1958), 715; and L. E. Davis et al., "The Mineral Industry of Nevada," in US Bureau of Mines <u>Minerals Yearbook Area Reports, 1956</u>, vol. III (Washington: US Government Printing Office, 1958), 761.

experienced miner or mill operator but he did attempt to use the mill to process ore.[64]

In April 1957, Jennings sold a lease and option to purchase the mill site claims to the Hamilton Land Co.; the agreement was to be valid through August 1962.[65] No activity at the mine was reported in the Minerals Yearbook for 1958, no doubt because of the major depression that had hit Nevada's mineral industry the year before. In fact, the weak market for lead forced the closure of much larger mining operations in the state.[66]

Jennings signed another lease and option to purchase agreement in April 1959 to be valid through January 1969, this time with Belmont Lead, Inc.[67] The new company worked on rehabilitating the mine, pipelines, and housing and conducted exploratory activities. A total of 232 tons of ore was extracted and some was even shipped before Belmont Lead ceased operation in late 1960; the remainder of the ore was stockpiled.[68] Subsequent records suggest that neither the mine nor the mill was ever really worked again. In Nevada, "continued low prices prohibited operations of many mines… and it was evident that it would be many years before lead-zinc… returned to the scene." This slump in the market, combined with aging infrastructure and lack of substantial investment to repair and maintain it, brought an end to the working days of the Belmont mine and mill. As noted elsewhere, "Mines are not pipelines that may be turned on and off at will, but are more like pieces of machinery that require constant maintenance," and the Belmont was an aged machine.[69]

Several past and present Ely residents recall life at the mill site in the 1960s. Hal (Rod) Jensen, Jr., worked claims in the area between 1966 and 1969 with his father and often stayed in the boardinghouse (NV-46-I) in the summer, which was overseen by the site's caretaker, Ermyl Dowd, and used by miners working nearby claims. Ron Jordan, an Ely resident who worked for the county road maintenance department in the late 1960s and early 1970s, often stopped at the boardinghouse to visit and use the telephone. As Jordan remembers it, the mill was used fitfully in the late 1960s but little or not at all after 1967. He attributed

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[64] Interview with Hal (Rod) Jensen, Jr..

[65] A copy of the lease and option document could not be found; however, it was referenced in a notice of no-liability that Jennings filed in June 1957 (White Pine County Records, Instrument No. 107450).

[66] Joseph V. Tingley, Robert C. Horton, and Francis C. Lincoln, Outline of Nevada Mining History, Nevada Bureau of Mines and Geology Special Publication 15 (Reno: University of Nevada, 1993), 33.

[67] Again the actual lease and option document could not be found, but it was referenced in a notice of non-liability that Jennings filed in May 1959 (White Pine County Records, Book 218, p. 186).

[68] L. E. Davis et al., "Nevada," in US Bureau of Mines Minerals Yearbook Area Reports, 1960, vol III (Washington: US Government Printing Office, 1961), 661; and "White Pine District – Principal Mines," p. 3.

[69] Tingley et al., Outline of Nevada Mining History, 29 and 33.

this to a lack of material to put through the mill, but also recalled that in some years there was insufficient water from the California Mill springs to operate it.[70]

Both Jensen and Jordan stated that a great deal of equipment remained in the mill in the 1960s. The tram still had six or seven ore buckets on the cable, although it was unclear if the system was operable. (These buckets are visible in a historic photograph of the mine buildings; see Figure 7 in HAER No. NV-46). Wilfley concentration tables were present on the fifth level of the mill (estimates varied between four and six), and Jordan believed they were moved to the Lackawanna Mill when the Belmont was finally closed. Other equipment may have been moved to Eureka. Both men recall a large jaw crusher that sat at the base of the off-loading ramp and chute (NV-46-D) west of the mill, and Jensen recalled a 40-horsepower Ingersoll Rand oil engine in the power house (NV-46-B) with associated smaller engines on concrete mounts around the perimeter of the room. One smaller engine had powered the electrical system and there was also a compressor that was used to start the main engine.[71]

Beginning in the 1970s, the ownership history of the claims is complicated, but essentially Phillips Petroleum Co. leased the Belmont claims from Jennings. The claims were simply brought under the corporation's umbrella and then forgotten, and the property was subsequently shuttled between large corporations for about thirty years.

The departure of Mrs. Dowd in the late 1970s marked the abandonment of the Belmont Mill site and the beginning of its new status as a mining relic, hunting camp, and tourist attraction. At this time or earlier, some of the remaining pieces of milling equipment described by Jensen and Jordan may have been sold, including the Wilfley tables, the engine, and the jaw crusher. Two photographs taken in about 1980 document that the mill site buildings were largely intact, although the two tanks at the southwest corner of the mill had been removed and a shed-roofed building (NV-46-T, now collapsed) across the road from the assay office was still standing (Figures 8 and 9 in HAER No. NV-46). In the ensuing years, visitors to the site have occasionally removed boards from the buildings for campfires, removed smaller pieces of equipment for souvenirs, broken windows, and enacted other minor vandalism, while lack of maintenance and exposure to harsh weather conditions have taken an even greater toll.

In 1999 and 2002, the claimholder failed to meet annual requirements and all claims were deemed forfeited. In 2007 the Belmont Mill site was relocated but the buildings and surface structures are now considered to be under the purview of the Humboldt-Toiyabe National Forest. Without any type of maintenance

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[70] Interviews with Hal (Rod) Jensen, Jr., and Ronald Jordan, 29 September 2010.
[71] Interviews with Hal (Rod) Jensen, Jr., and Ronald Jordan.

since at least 1980, the mill has fallen into disrepair but remains in remarkably good condition.

PART II. ARCHITECTURAL INFORMATION

A. General Description:

1. Character: This small mill is a good, compact example of industrial mining design from the early twentieth century. Typically, it is sited on the side of hill to take advantage of gravity in the milling process, with broad expanses of shed roof covering the open floor plan. The mill was built in six levels, with Level 1 (the aerial tramway terminal) the highest and Level 6 (the drying floor) the lowest. The mix of traditional and modern construction materials – heavy wood framing members and trusses, wood floors, multi-paned wood windows, poured concrete for foundations only, corrugated metal siding and roof - date it to the transition period between the more traditional mills of the nineteenth century and modern mills of the later twentieth century.

2. Condition of fabric: Despite the absence of maintenance for at least forty years, the building remains structurally sound. The building envelope is in good condition due to the inherent durability of the primary building materials (heavy timber and galvanized, corrugated metal) and the dry climate, although heavy snow loads have damaged limited areas of roofing. The wood windows are in poor condition – the frames and muntins are damaged or missing and nearly all the glazing is gone – while the wood doors that weren't originally faced with corrugated metal are also damaged or missing. The wood staircase on the west side of the building that provides access to the tram terminal is in poor condition, with missing treads and cracked stringers. On the interior nearly all of the original equipment has been removed, although concrete mounts provide some clues to original equipment type and location. The interior condition is generally good, although the floorboards are damaged and missing in some areas and the makeshift ladders, stairs, and catwalks that were added later to provide access to the secondary processing system are in fair to poor condition.

Many of the structures associated with the mill that were visible in the ca. 1940 photographs are in very poor condition or are absent altogether. These include the three tanks (two near the southwest corner of the building and one to the east), a wood trestle leading to what was presumably the reclaimed water tank west of the mill, the water tank itself, the track extending north from Level 6 of the building to the waste rock pile (NV-46-E), and at least three chutes and flumes extending down slope from the building that may have been ore launders and other means of removing tailings.

B. Construction:

1. Overall dimensions: 72' (east-west) x 53' (north-south). The building is roughly rectangular in shape and is built in six levels, with Level 6 (the concentrate drying floor) being the lowest and Level 1 (the aerial tramway terminal) the highest.

2. Foundations: Newspaper accounts from 1926 reported that the mill's foundations were of poured concrete. Today these are visible in only a few areas, specifically on the mill interior on the west side of Level 5 where concrete forms both a retaining wall against the hillside and a foundation for the base of the ore bins on Level 4. Poured concrete may have been used more extensively but is now obscured by fill or, alternatively, was only used in critical areas.

3. Walls: The wood-framed walls of the mill are of heavy construction. Posts measuring 6" x 8" are used at critical locations in Levels 5 and 6, in particular at corners and to support the ends and joints of roof trusses. These are cross-braced with 4" x 6" diagonal members. Horizontal 2" x 6" boards are used for lateral stability between the posts and also as nailers for the exterior cladding. The exception is the small wing that extends from the east side of the mill, which has 2" x 4" studs with horizontal 2" x 4" members.

The west walls of Levels 5 and 6 are treated differently because they are retaining walls rather than exposed exterior walls, and also form the foundations for the levels above. On Level 6, the west wall comprises 8" x 8" timber posts that are backed with 9" x 1-3/4" horizontal shoring boards. At its center, the wall is cross-braced with 6" x 6" members. On Level 5, the west wall comprises two sections of concrete poured in 11-1/2" lifts. The north section projects 7" further to the east than the south section and the north wall is about 4' higher in order to meet the raised floor height on the north half of Level 4. Two U-shaped gaps along this wall top provide access to the crawl space under the north half of Level 4.

The small room on the south side of Level 4 and the two small rooms on the north side of Levels 3 and 4 (constructed beneath the sloping west side of the ore bins) also have 2" x 4" studs with horizontal 2" x 4" members. The massive wood ore bins comprise most of Level 3 and their exposed north and south sides also form the exterior walls. Levels 2 and 1 are a mixture of heavy posts and beams (some on Level 1 measure 5-1/2" x 7-1/2") that are also associated with supporting the ore bins and the tramway machinery. These are interspersed with 2" x 4" studs separated by horizontal members for both lateral stability and to provide nailers for the exterior cladding.

All finished exterior walls of the mill are clad in galvanized (or tin-plated), corrugated sheet metal. The sheets measure 26-1/2" wide with a 24" exposed width and a 110" exposed length. The sheets are nailed to the framing about every 30-40" vertically and every 5-1/2 " horizontally. On most of the mill, two different manufacturer's marks were identified, the first (on the northeast corner of the small shed wing on the east side of the mill) reading "AMERICAN SHEET METAL, TRADEMARK PATENTED, BEST BUY, PITTSBURGH, KEYSTONE, COPPER STEEL" and the second (on the south interior wall of Level 4) "AMERICAN SHEET AND TIN PLATE CO., APOLLO BEST BLOOM, TRADEMARK REGISTERED, PITTSBURGH, KEYSTONE, COPPER STEEL." Many of the sheets have also been hand painted in black with the words "Tonopah Belmont Development Co., Hamilton [or sometimes East Ely], Nevada." This is not painted on every sheet and it's likely that the marked ones were the top sheets of bundles that were shipped to the site; in effect, shipping labels.

Several of the corrugated panels in the Level 4 north room are stamped with "U.S.S.P. San Francisco," an indication that this area may have been enclosed after the original period of construction. Differences in window and door treatments further support this possibility.

4. Exhaust stack: A single stack is located in the southeast corner of Level 6. It is a large steel pipe with an 8" inside diameter but is no longer connected to any piece of equipment on the interior of the mill. It penetrates the roof through a crudely cut opening in the corrugated metal and probably served as the exhaust for machinery used in the drying phase.

5. Openings

a. Doorways and doors: Two main types of doors are present on the mill, side-hinged man doors and sliding doors, all of which have simple wood casings. The man door on the south side of Level 6 was found inside the mill; it is a five-panel wood door measuring 33" wide x 80" high with pegged wood stiles and rails and plywood panels; it was originally painted red, then white.

There are four man doors on the west side of the mill: one accessing the south room of Level 4, two the north room of Level 4, and one the north room of Level 3. The south door has been removed but rests inside the room while the other three remain in place. All are of similar custom construction: vertical wood planks with three wood cross-braces, faced with corrugated metal, mounted on metal coil hinges and opened with a simple latch. The three north doors were custom-sized to fit between the existing framing, indicating that the doors are not original. However, the care and quality of the alterations indicate that they were an early modification. The doorway at the top of the west exterior staircase leading to Level 2 once had a door; a metal strap hinge is all that remains.

The three interior-mounted sliding doors were of identical construction; one was in the north wall of Level 6 and one each in the north and south walls of Level 5. Only the door on Level 6 remains in place; it measures 73-1/2" wide x 82" high and comprises a rectangle of wood stiles and rails that are slotted to hold panels of corrugated sheet metal. The panels are braced at the center by a horizontal wood rail with molded edges. Steel plates reinforce the door at the top, where it is mounted to a steel track that is in turn bolted to a heavy timber above the door lintel. On Level 5, the sliding track and mounting hardware remain in place but the doors are missing. In the west wall of Level 1 is a fourth sliding door that provided access to the wooden trestle leading toward the reclaimed water tank. This exterior-mounted, wood-framed door is faced with corrugated metal panels.

Level 1 also had two pairs of side-hinged doors in the south wall for the incoming and outgoing tram buckets; the west pair remains in place while the east pair has been removed. Each trapezoidal door is wood-framed, faced with corrugated metal, and mounted to metal strap hinges that allowed it to be opened outward. Holes just above the doors allowed the tramway cables to pass through. A crude opening at the north end of the west wall probably dates to the 1940s or 1950s modifications. It appears that siding was removed here to allow access to the area where ore was dumped directly into the north ore bin on Level 2 via a short ramp.

b. Windows: The window treatment at the mill is very uniform, typically consisting of six-over-six-light wood windows with an operable bottom sash, grouped singly and in pairs. A single window has an exterior opening measuring 33-1/2" x 54". Lintels are formed by the 2" x 6" boards that were used in the wall framing as nailers for the siding. Typically, exterior trim consists of nominal 1" x 4" boards with metal flashing, a canted 2" x 6" sill, and a 1" x 2" board as an apron. These windows are found on Levels 1, 5 and 6.

The windows on Levels 2, 3, and 4 are somewhat different, typically comprising a single six-light sash, turned on its side and either fixed or sliding. These windows lack exterior trim and the corrugated metal was apparently cut with metal shears to create the openings. These are additional indications that the small rooms under the north end of the aerial tramway may not have been original to construction, but they do appear to be early modifications.

6. Roof system:

a. Framing: On Levels 3 through 6, the sloped roof of the mill is framed with an orderly system of Howe trusses (right triangles under the shed-roofed areas and isosceles triangles under the gable-roofed areas). From north to south, each floor level has five trusses. These typically comprise a 6" x 8" bottom chord with 6" x 6" top chords and diagonal web members; iron tie rods are used for the vertical web members. At connections, the members are notched, spliced, and/or bolted rather than fixed with metal gusset plates. The trusses support 2" x 6" purlins (interspersed with 4" x 6" at about every fifth purlin) that are notched over the top chords of the trusses.

The roof framing in Level 1 comprises massive, re-used (from the Chollar aerial) rafter plates and joists that support newer 2" x 6" rafters. The rafters are spaced with short board lengths, many reused, that also serve as nailers for the roof covering.

b. Shape, covering: The mill roof is a combination of shed roofs and gable roofs. The massive expanse of shed roof spanning Levels 5 and 6 is one of the most impressive features of the mill. On the south half of Level 5, the shed roof returns at the west end to form a gable roof. The small room on the south end of Level 4 forms a cross-gable. Level 1 also has a gable roof, and there is a smaller shed roof at the north end over Level 2. All roofs are covered with corrugated metal panels identical in dimensions and manufacture to that used for the wall cladding.

c. Eaves: All roofs are finished with wood eaves except the south room of Level 4 (which has no eaves). Projecting rafter tails are typically boxed with a plain fascia and soffit on horizontal eaves. Along the diagonal elements of shed and gable roofs, the projecting ends of purlins are finished with a plain 2" x 6" fascia; board lengths of the same dimension are used between the purlins as frieze boards to finish the wall top. All eave elements were originally painted white. The building has no roof drainage system.

7. Stairs: The stairway along the west exterior wall provides access from grade at Level 4 to Levels 3 through 1. The stairway comprises two continuous stringers with nailers on their interior faces; the stair treads are set on these and measure 1-1/2" thick x 11" deep x 36" wide. Where the corners of the treads originally projected beyond the stringers, they have been beveled; there are no risers. The stringers themselves are supported by three projecting horizontal boards that are attached to the interior wall framing and the posts for the trestle overhead. The simple handrail on the west side of the stairway is composed of 2" x 4" boards. A low board platform or landing at the base of the stairs measures 5'-0" north-south and 6'-0" east-west.

8. Platform and trestle: A wood platform was built against the south wall of Level 6, with the top of the platform level with the bottoms of the windows. It measures

15'0" east-west and 10'-8" north-south and was massively constructed, with 7-1/2" square posts and joists supporting 3" x 11-1/2" decking. The purpose of the platform is unclear; it was not present in ca. 1940 photographs and therefore was associated with the modified mill process dating to the 1940s-1950s.

The remains of a wood platform and trestle extend southwest from the west side of Level 1. Ca. 1940 photographs show that it extended towards the reclaimed water tank (no longer extant) on the hillside west of the mill. The trestle may have been used to deliver custom ore or ore from dumps not served by the aerial tramway into the top of the mill for processing.

C. Description of Interior:

1. Floor plan: The mill has an open floor plan that is divided into six levels. Levels 6 and 5, at the base of the mill, can be accessed by doors in the north and south walls and are connected by an interior stairway. Most of the ore processing occurred in these large spaces, including size classification, grinding, table concentration, flotation, and drying. Level 5 has two mezzanines, one extending from the southeast over Level 6 and the other in the northwest corner. The former appears to be an early addition, perhaps added to provide space for the flotation unit. The latter is not a true mezzanine but rather equipment mounted on a series of raised platforms and connected by stairs, ladders, and catwalks. Much of the latter appears original, although it has been altered to provide access to the equipment and machinery used in the modified ore processing system.

Level 4 is discontinuous, with a nearly free-standing south room and a small north room built under the sloping ore bins. The former played some role in the cyanidation or sulfidization of slimes while the latter was apparently a storage and workspace, and may have contained fire-fighting equipment (hoses remain in the room). Both rooms are accessed at grade from the west exterior side of the mill. Level 3 is a small, triangular attic space above the north room of Level 4 and is accessed from the west exterior stairway.

Level 2 provides access to the tops of the ore bins while Level 1 forms the bottom terminal of the aerial tramway. Level 2 is accessed by the west exterior stairway and Level 1 is accessed by passing through Level 2 and continuing up a short interior stairway in the northeast corner of the room.

2. Stairs: There are two main sets of interior stairways: one connecting Levels 6 and 5 and the other connecting Levels 2 and 1. Both are very similar in construction to the west exterior stairway, comprising solid stringers with nailers supporting heavy treads (30" wide by 11-1/2" deep) that have beveled front corners, and simple handrails constructed of 2" x 4"s. The first stairway is a straight run of fourteen stairs while that beginning on Level 2 is L-shaped, with two stairs leading to a small landing and five stairs leading to Level 1.

Short runs of steep stairs are also present in the north mezzanine of Level 5 and are similarly constructed. These provided access to machinery in the area, including screen classifiers and a bucket elevator.

3. Flooring: All floors are of wood, although varying in the weight of construction. Levels 6 and 5 have double-layered floors of 1" x 12" boards; both layers run east to west but the lower layer is offset by half a board width. The east end of the floor on Level 5 is intentionally sloped to drain into a launder constructed along the east lip of the floor. The Level 5 south mezzanine is framed with massive, reused beams (14-1/2" x 8") under the south half of the floor and lighter framing under the north. Correspondingly, the south half has a double layer of floorboards while the north half has a single layer. This would indicate that any heavy machinery would have been located on the south half of the mezzanine.

On Level 4, the south room has a floor of nominal 1" x 8" boards running north to south. In the north room, the floor is discontinuous and makeshift, with a few 1" x 12" boards running north to south. The same holds true for Level 3, another indication that this area postdates the original mill construction period. The floors of Levels 2 and 1 comprise 2" x 12" boards running east to west.

4. Wall and ceiling finish: None of the walls or ceilings are finished and the framing system is exposed in all areas.

5. Mechanical equipment and furnishings:

a. Power system: Power to run many of the mill operations was generated in the power house (NV-46-B), located just north of mill on Level 6. The Ingersoll Rand engine moved a large driveshaft that exited the power house and entered the mill at about truss height on Level 6. Numerous smaller shafts, belts, and pulleys were driven by the main shaft. Obvious connections remain to the screen classifiers on Level 4 and the Dorr rake classifier on Level 6.

b. Lighting and electric: Electricity was originally generated in the Power House and was supplied to the mill by knob-and-tube wiring. The porcelain knobs remain in most areas, including on the head frame for the Dorr thickener east of the mill. All of the wiring has been removed and no fixtures remain.

c. Plumbing: Numerous pipes remain in the mill, although most lines have been disconnected and it is difficult to discern their original purpose. Systems included at least a fresh water supply line, a return water line from the pump (probably housed in the small wing on the east side of

Level 6) to the return water tank at the end of the trestle west of the mill, and perhaps a steam line to drive machinery.

d. Processing equipment: An original bucket elevator on the north side Level 5 and was used to move material from the main floor to the mezzanine. The elevator is housed in a wood-planked cabinet; a rubberized fabric belt, mounted with small scoops, is routed around pulley wheels at the top and bottom that are ultimately driven by the main driveshaft of the mill. This area of the mill was modified and it is difficult to determine the exact configuration of the original process. Presently it appears that the buckets retrieved fine material that passed through the screen classifier and transported it to a Y-shaped wood classifier or distribution box, which directed material via pipes to the four Wilfley tables.

On the north half of Levels 4 and 3 are three wood ore bins. The large north bin measures 14'-4" x 7'-8-1/2" (2,078 cubic feet) and the middle and south bins measure 5'-10-1/2" x 7'-8-1/2" (852 cubic feet) each. These are roughly triangular, with bottom sides sloping parallel with the hillside. All have walls composed of 11-1/2" x 1-3/4" vertical boards on three sides (horizontal on the sloping sides) with 6" x 6" horizontal braces on the interior faces. Wood nailers on the sloping floors provide access to the bin bottoms. Across the tops of the bins are heavy beams running east to west and measuring 6" x 10". Openings at the bin bottoms allowed ore to be delivered to Level 5 for screening and grinding. The area was modified in the 1940s or 1950s by the addition of a sloping track at the west end of the north ore bin, which allowed ore delivered to Level 1 to be deposited into the bin. It appears that the two south bins were not used in the modified process.

A stationary crane is located against the north exterior wall of the mill, just west of the doorway. The vertical arm extends from grade to just beyond the eave and is similar to that used in bridge construction. It is a built-up beam composed of outward-facing lengths of channel iron connected by V-lacing of metal straps, riveted to the outside faces of the flanges. A horizontal swing arm, supported by a cable, is mounted on a hinge at about two-thirds height. The purpose of the crane is unclear but it appears original to the mill.

e. Furnishings: Furnishings in the mill are simply but sturdily constructed of wood. They include workbenches along the south wall of Level 6, the west wall of the north room on Level 4, and the west wall of Level 1. A set of wood cubbies is also present on the east wall of Level 6 and measures 56-1/4" wide x 65-1/2" high.

D. Site Layout

The mill was built on a hillside near the base of McEllen Canyon, where a smaller wash enters from the west. The hillside location allowed for six stepped levels in order to utilize gravity in the mill operations. The bottom level is just above the canyon bottom, allowing easy access from the unpaved road that approaches from the north. The road continues up the canyon bottom to the south; after about a mile, a steep side road leads to the mine, which is dramatically perched on the eastern slope of Pogonip Ridge.

The small drainage to the north of the mill allowed for the construction of an access road so that the upper levels of the mill could be approached by vehicle. Originally, four residences were arranged along this road on the hillside west of the mill while the main support buildings, including the assay office, supervisor's office, and boardinghouse, were located just south of the mill in the canyon bottom. This provided a physical separation between the living and work spaces of the mill site and also between the management (who lived in the residences) and the workers (who lived in the boardinghouse).

PART III. OPERATIONS AND PROCESS

A. Operations

The ore concentration process involves four operations that literally flow downgradient through a mill: comminution (particle size reduction through crushing and grinding), sizing (sorting of particle sizes by screening or classification), concentration (separation of ore from gangue by exploiting its physical and surface chemical properties), and dewatering (separation of solids and liquid).[72] The Belmont Mill has been altered over the years and most of the milling equipment has been removed, thus it is impossible to know for certain the exact process or machinery (or even its location) used to complete these four operations.[73] However, based on the information above, it can be surmised that the original flow sheet for the mine and mill might have involved the following (see Figure 3 in HAER No. NV-46):

COMMINUTION

1. Ore extraction at the mine.

[72] A good summary of these different processes is provided in "Shenandoah-Dives (Mayflower) Mill," HAER No. CO-91, Historic American Engineering Record, National Park Service, US Department of the Interior (2005), 27-30.

[73] TBDC undoubtedly prepared architectural and engineering drawings for the mill (and probably for many of the other buildings on the site as well) and also a milling flow sheet. The documents were not located during this project but might be included in TBDC's corporate records, if these still exist and can be located with further research.

2. Preliminary sorting of ore in a grizzly and preliminary crushing in a Blake-type jaw crusher at the mine (if necessary - there were reports that only minimal processing was required because much of the ore was found in a crushed zone).
3. Transport to the mill via aerial tramway (Level 1).
4. If necessary, further crushing of ore before sorting into ore bins (Level 1 or 2).
5. Deposition of the ore in ore bins (Level 2).
6. Grinding of ore from ore bins by Marathon rod mill (Level 5 mezzanine).

SIZING

7. Classification into sands and slimes by screen and/or rake classifiers (Level 5) with sands returned to the rod mill for further grinding.

CONCENTRATION

8. Gravity concentration of slimes on Wilfley tables (Level 5). At this point the concentrate, essentially high-grade ore, would be collected from the Wilfley tables and prepared for shipment.
9. Thickening of tailings from the tables and/or the flotation unit in a Dorr thickening tank (outside the mill to the east and/or southwest);
10. Flotation (perhaps involving sulfidization of lead carbonate ore) of tails in a flotation unit for further extraction of very small metal particles (Level 5 south mezzanine);
11. Cyanidation of the slimes, or tails, from the flotation unit in a second agitation tank to extract the silver; the tank used in this process was most likely the one east of the mill where the highest concentration of cyanide has been found in the tailings.[74]

DEWATERING

12. Concentrate drying (Level 6).
13. Water reclamation from drying process (Level 6). The reclaimed water would have been pumped back up to the water tank west of the mill (no longer extant) to create a steady head for operations. The recovery pump was most likely located in the small shed-roofed wing extending east from the mill.
14. Storage of dried concentrate in preparation for shipping to a smelter (Level 6).
15. Tailings deposition in numerous locations throughout the process, including just outside each doorway on the south side of the mill (apparently by hand or wheelbarrow), via rail to the waste rock pile (NV-46-E) north of the mill, and into the canyon bottom via tails

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[74] Kenneth Maas, On-Scene Coordinator, Humboldt-Toiyabe National Forest, electronic communication to Eric Stever, Archaeologist, re: "Was cyanide found in the soil tests," February 4, 2011.

launders to the east of the mill (visible in Figure 5 but no longer present). There is no evidence of a tailings pond but, if present, it would have been located in the canyon bottom, perhaps on the opposite side of the road. It's more likely that wet tailings were simply deposited in the dry streambed, standard practice for the time.

TBDC probably sold much of the machinery when it sold the mine and mill site in 1940. At this time or in the 1950s, the milling process was modified greatly to meet the reduced demands of a much smaller and less sophisticated operation. Remnants of this process are what remain in the mill today. Some of the machinery and equipment involved was removed at about the time the mill was abandoned in the late 1970s and it is difficult to be certain about the exact process used. In brief, based upon the physical evidence in the building and the recollections of those familiar with the site in the 1960s, it appears that flotation was eliminated from the flow sheet and that gravity concentration was used to recover the lead and silver ores. The modified flow sheet for the mine and mill might have involved the following (see drawings for flow sheet):

COMMINUTION

1. Ore extraction at the mine or from reclaimed tailings piles.
2. Preliminary sorting of ore in a grizzly and preliminary crushing in a Blake-type jaw crusher at the mine or in the Blake-type jaw crusher at the foot of the off-loading ramp and chute (NV-46-D).
3. Transport to the mill via aerial tramway or from the base of the ramp to the top of the mill (Level 1).
4. If necessary, further crushing of ore before sorting into ore bins (Level 1 or 2).
5. Deposition of crushed ore in ore bins (Level 2).

SIZING

6. Classification into sands and slimes by mineral jig and modified screen classifier (Level 5).
7. Transport of preliminary concentrate (slimes) to distribution tank by bucket elevator.
8. Transport of sands by launder to rake classifier (Level 6).

CONCENTRATION

9. Gravity concentration of slimes on Wilfley tables (Level 5). At this point the concentrate, essentially high-grade ore, would be collected from the Wilfley tables and prepared for shipment.
10. Thickening of tailings from the tables and/or the rake classifier in a Dorr thickening tank (outside the mill to the east).

DEWATERING

11. Concentrate drying (Level 6).

12. Storage of dried concentrate in preparation for shipping to a smelter (Level 6).
13. Tailings deposition in numerous locations throughout the process, including just outside each doorway on the south side of the mill (apparently by hand or wheelbarrow), and via rail to the waste rock pile (NV-46-E) north of the mill.

B. Machines

Only a few pieces of machinery remain in the Belmont mill but much apparently dates to the original 1926 milling process. Most were re-used as part of the ca. 1940s-1950s process with the exception of one screen classifier and a flotation unit.

1. Blake jaw crusher: Referenced in 1926, no longer extant. This piece of machinery would have been located either at the mine or at the head of the mill.[75] Patented in 1858, jaw crushers soon replaced stamps and arrastras in the first stage of the comminution process. The crusher functioned like a human jaw with one fixed and one moving plate of teeth. Ore from the mine was fed into the top of the crusher and discharged in about 1" chunks from the base. In the late 1960s a jaw crusher sat outside of the mill at the base of the off-loading ramp and chute (NV-46-D), although it is unclear if this was its original location. It was mounted on concrete pads and measured about 4' x 6' x 5' high, with 5' flywheels.[76]

2. Aerial tramway: The bottom terminal for the tramway is located on Level 1.[77] As noted above, the aerial tramway was originally constructed at the Chollar mine in Virginia City, Nevada, probably in the late nineteenth century. The entire system was dismantled, including the top and bottom tram terminals, the ore buckets, and the machinery, and re-erected at the Belmont site. A number of the timbers bear traces of red and white paint, probably remaining from the Chollar days, and some are also numbered, no doubt to assist in assembly (either originally in Virginia City or later at Belmont).

   The first tramway was developed by Andrew Hallidie in the 1860s to address mining transportation problems posed by high mountains and winter snows in the western United States. Hallidie's design comprised a continuous single loop of wire rope that passed around large sheave wheels at the top and bottom of the tramway, with ore buckets suspended from the rope. The

[75] An 1898 illustration of a Blake jaw crusher is provided in Donald L. Hardesty, Mining Archaeology in the American West: A View from the Silver State (University of Nebraska Press and the Society for Historical Archaeology, 2010), 68.

[76] Interview with Hal (Rod) Jensen, Jr.

[77] The top terminal, which is still intact, is located at the mine site but will not be described here because it is outside the scope of this project. The two tramway towers on the mill site claims and thus under the purview of the Forest Service are described in NV-46-C,

system was designed to run by gravity: the loaded buckets would gently descend to the mill and pull the empty buckets back to the mine.

The use of a single rope to both carry and move the buckets presented a number of problems, and two German engineers, Theodore Otto and Adolph Bleichert, invented a new system that was first used in Europe in 1874, the Bleichert double rope tramway. This system employed a track rope spanning from tower to tower that was fixed in place and over which the ore buckets coasted on hangers with guide wheels. A moving traction, or haul, rope was attached to the bucket's hanger by a mechanical clamp, or grip, and it effectively pulled the bucket along the fixed track rope.

> The grip fastening the buckets to the traction rope was releasable, permitting workers to manually push the buckets around the interior of the terminal on hanging rails and fill them at leisure without spillage...
>
> Due to superior performance, the popularity of Bleichert systems eclipsed the less expensive Hallidie tramways by the 1890s, when the use of tramways in the West surged.[78]

The tramway at the Belmont Mill is a Bleichert-type double rope system. As a loaded ore bucket entered through the south door of the bottom terminal, a worker would uncouple it from the traction rope and roll the bucket along a hanging rail, stopping it at the north end of the room and directing the ore into one of the three ore bins on Level 2, probably depending on the grade of ore. After emptying the bucket, he would roll it to the other side of the room where it was reconnected to the traction rope for return to the upper terminal.

At the Belmont Mill, the continuous loop of traction rope passes around large, horizontally oriented sheave wheels in the top and bottom terminals (6'-4" diameter). These sheaves carry tremendous loads and are mounted to heavy, and heavily reinforced, timber frames. The bottom sheave can be moved north to south along rails to adjust the tension on the traction rope. To anchor this wheel, two anchor cables or backstays (nominally 1" in diameter) extend from the terminal to the north of the building; these are about 250' long and are anchored to the ground in either bedrock or concrete. The sheave is connected by double lengths of cable to a counterweight in the form of a massive, rock-filled timber bin suspended beneath the tram terminal in the open area between the north and south rooms of Level 4. There is no braking

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[78] Eric Twitty, <u>Riches to Rust: a guide to Mining in the Old West</u> (Montrose, CO: Western Reflections Publishing Co., 2005), 129.

device at this end of the tramway and it appears that all braking functions were performed at the upper terminal.[79]

Each of the two stationary track ropes (over which the ore buckets traversed on their hangers) terminates inside the building at a large clamp that is attached to a counterweight bin by a round link chain. Thus a total of three rock-filled bins are suspended between the north and south rooms of Level 4. These measure 9'-4" wide x 4'-0" deep x 5'-3" high (north bin), 7'-8" wide x 4'-9" deep x 7'-3" high (south bin), and 3'-6" wide x 4'-0" deep x 5'-3" high (southeast bin).

In 1926, according to the local newspaper, "The tramway will be equipped with 30 500-pound ore buckets, and will be operated primarily by gravity, the 15 loaded buckets furnishing the gravity to pull back the empties."[80] By about 1970 only six or seven buckets remained on the ropes; none remain today. However, two of the rectangular metal buckets are visible in a photograph that may date to ca. 1940 (see Figure 7).

3. Mineral jig: Located on Level 5, north mezzanine. This homemade, two-chambered mineral jig is constructed of 2" x 4" wood members connected with iron tie rods and bolts, and has a steel plate/plunger in the south chamber. The jig was used in the modified ore processing system dating to the 1940s or 1950s. Jigs have low capital and operating costs and are "ideal for temporary use or to treat smaller tonnages of relatively coarse material," thus a logical choice for the scale of operations occurring in those decades.[81]

   The concept of the jig goes back to antiquity and is based on the phenomenon that if particles are jogged up and down in water, the heavy particles collect at the bottom and the lighter particles at the top.

   > This act of alternately fluidizing and collapsing a bed of particles to concentrate the denser [metal] mineral on the bottom is the essence of the jigging process. By the middle to late nineteenth century, coarse ore jigging was well developed, and by the first few decades of the twentieth century, jigs that recovered at least some fine particles… were developed.
   >
   > The downward movement of a plunger fluidizes the bed of particles on a sieve plate so that heavy particles move to the

[79] Lift Services Inc., "Inspection Report: Belmont Mill Site, Humboldt-Toiyabe National Forest," September 28, 2010.
[80] Ely Daily Times, June 19, 1926.
[81] Frank F. Aplan, "Gravity Concentration," in Maurice C. Fuerstenau and Kenneth N. Han, eds., Principles of Mineral Processing (Littleton, CO: Society for Mining, Metallurgy, and Exploration, 2003), 204.

> bottom and light particles to the top of the bed. As the plunger then moves upward, it creates a suction stroke that collapses the jig bed.[82]

The heavy ore particles can then be drawn off the bottom of the jig while the lighter gangue is washed from the surface. At the Belmont Mill, recovered ore was deposited on the floor of the mill and then routed through a bucket ladder, reclassified by size in a sieved box, and then directed onto the concentration tables on Level 5.

4. Modified screen classifier: Located on Level 5, north mezzanine. This inclined shaking table appears original to the mill and to its present location but was modified and used in the ore processing system dating to the 1940s-50s. It was constructed of wood members connected with metal rods and bolts and was powered by pulleys connected to the main driveshaft for the mill, which vibrated the table from east to west. A homemade, welded metal chute was mounted over the screened top of the table at a later date. Overflow from the mineral jig was directed into the chute and the vibration of the table beneath was used to further separate ore from gangue by particle size. Heavier particles dropped through the screen onto the mill floor, where they could then be fed into the bucket elevator and onto the concentration tables in the modified process. Lighter particles were washed into an inclined wooden tails launder that fed the Dorr rake classifier on Level 6.

5. Screen classifier: A second, unmodified screen classifier remains in its original location on the mezzanine of Level 5, just south of the modified classifier. It was not used in the modified processing system.

6. Dorr rake classifier: Located on Level 6, north end. This piece of equipment may be original to the mill although may not be in its original location. It was used in the modified milling process dating to the 1940s- 50s. The classifier consists of a rectangular metal chamber with a sloping bottom, a rake mechanism for moving sands uphill along the bottom, and ore inlets in the form of launders leading from both the Wilfley tables and the screen classifier on Level 5. Unwanted tailings exited through a metal chute at the top of the classifier and into an ore car on a short rail line, which led out to the waste rock pile north of the mill (NV-46-E). Concentrates exited through the low end of the classifier, moved through a wood launder set into the floor of the mill as part of the modified process, and were deposited into the thickening tank east of the mill.

7. Marathon rod mill: Referenced in 1926 but no longer extant, the rod mill originally would have been on Level 5. The correct particle size is crucial in

[82] Ibid., 202.

the processing of ore, and in the later nineteenth century new grinding mills were invented to provide a more uniform and fine grind, beginning with ball mills. These were large, rotating cylinders containing steel balls that pulverized the ore, and the rod mill was a later variation that employed a smaller diameter drum and metal rods rather than balls. Water would be added to the dry, crushed ore (which could be in pieces up to 2" in diameter) to form a wet slurry, or slime, which was then fed into the mill. At the discharge end, the ground slurry was passed through a screen and any large particles were returned to the rod mill for further grinding. Correctly sized material proceeded to the concentration tables and/or flotation unit. For flotation, particles were required to be of fine sand size (between 0.125 and 0.25 mm diameter).[83]

8. Concentration table equipment mounts: Located on Level 5. Four parallel sets of poured concrete equipment mounts measuring 5'-0" feet north to south, 1'-2" east to west, 3'-9" apart. These were reportedly for Wilfley tables, three of which were present in the 1960s.[84] The tables, 4-5' wide and 12-14' long, were shaken from east to west via a crankshaft on one end.[85] Arthur R. Wilfley first designed the table in 1896 and used it in his mill in Colorado; it soon became a standard piece of equipment for gravity concentration.

    > The Wilfley Table is simply a large wooden table, on top of which are a series of parallel "riffles." These riffles increased in length incrementally from the top of the table down to the bottom. The entire table is set at an angle, and the slime is poured onto it from the top corner. The heavier particles [metals] would be held up along the riffles, while the lighter particles [gangue] would roll over them. The whole table is oscillated back and forth over 200 times a minute, which works the [metal] particles down the riffles and towards the opposite end of the table. From there they are removed. The rest of the slime simply flows off the table at the opposite end and is carried away in a waste launder."[86]

    The waste launder at the mill was located along the east edge of the Level 5 floor.

9. Flotation table: Located on Level 5, south mezzanine. This manufactured piece of equipment has had its nameplate removed but was identified as an

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[83] "Shenandoah-Dives (Mayflower) Mill," HAER No. CO-91, 43.

[84] Catalog illustrations of Wilfley tables from the period are provided in Beth Sagstetter and Bill Sagstetter, The Mining Camps Speak: A New Way to Explore the Ghost Towns of the American West (Denver: Benchmark Publishing, 1998), 71.

[85] Interview with Hal (Rod) Jensen, Jr.

[86] From http://www.coppercountryexplorer.com/2007/09/mill-machines-the-wilfley-table/, accessed December 10, 2010. The website also provides a good exploded view of a Wilfley table.

early twentieth-century Denver Equipment Company flotation table.[87] Where the nameplate was originally mounted, a notation in pencil reads "180 RPM, 10 HP motor." It may be original to the mill but is not mounted to the floor in any way and may not be in its original location. The rectangular unit is constructed of wood with metal fastenings. One long side is enclosed by curving, horizontal wood staves while the other side has three open wooden chutes from which slimes can be fed into (or perhaps froth recovered from) the enclosed part of the unit.

10. Conditioning tank: Located on Level 4, in the small room below the aerial tramway terminal. This small wooden tank, which has an inside diameter of 48", is set into the floor of the room and has a metal rotating arm for mixing or agitation that is driven by a horizontal belt and pulley. The tank has an inlet at the top and an outlet at the bottom that leads toward Level 5 but is now disconnected. The purpose of the tank is unclear but it may have been used to condition slimes for either the cyanidation or sulfidization process before the slimes were pumped into one of the two tanks just outside the mill to the south.[88]

11. Dorr thickeners: One located east of the mill, Level 6, and one near the southwest corner of the mill, Level 4. A third tank without a visible agitation mechanism was also located at the southwest corner of the mill but its purpose is unclear. It may have been a leaching tank used to treat concentrates in the cyanidation or sulfidization process. The two tanks to the southwest are nearly entirely gone but portions of the east tank remain; it was constructed of wood staves 5" wide and 2-¾" deep, bound with metal straps.[89] It measured about 22' in diameter. The triangular wood head frame and metal cogs used to move the agitating arm remain in place.

    Liquid concentrates from various stages of the milling process were directed into the thickeners, which were equipped with slowly rotating blades. Solids precipitated out of the water, gradually settling on the bottom. The rotating blades gently moved this precipitate to an opening in the bottom, through which it passed as a thick slurry with most of the water removed. The thickened slime could then pass to the drying stage of the process.

12. Concentrate dryer: Located on Level 6, suspended at an incline from the massive joists of the Level 5 south mezzanine. This cylindrical piece of machinery appears to be a homemade concentrate dryer and probably dates to

[87] Interview with Hal (Rod) Jensen, Jr.
[88] Ibid.
[89] A 1912 illustration of a Dorr thickening tank is provided in Hardesty, Mining Archaeology in the American West, 90.

the 1940s or 1950s; it bears no nameplate or manufacturing marks. It is constructed of welded steel and is wrapped in asbestos.

C. Technology

At different times in central Nevada's early history, five main types of ore reduction methods were used to separate the metals from the gangue (or waste rock):

1. Gravity concentration: Historically the earliest method used, the principles of gravity concentration have been understood for over 2,000 years. It is defined as "the separation of two or more minerals, usually of different specific gravity, by their relative movement in response to the force of gravity and one or more other forces, one of which is generally the resistance to motion by a viscous fluid such as water."[90] The process has many variants but, by the early twentieth century in hard rock mining, it typically involved placing crushed ore in jigs or shaking tables (e.g., Wilfley tables) and shaking it back and forth, a process during which metals would separate from the gangue due to differences in specific gravity. The process was used on its own and in combination with other processes to maximize metal extraction.

2. Washoe pan process: Used to extract silver from ore. Ore was crushed to a fine powder, mixed with water, and fed into large pans or vats and mixed with mercury, salt, iron filings, and other materials. The water was then drained and the gold and silver, which had amalgamated with the mercury, were placed in a retort furnace and heated to separate the mercury from the precious metal, which was then cast as bullion.

3. Reese River process: A version of the Washoe process developed to treat ores near Austin. Ore was crushed and mixed with salt, then roasted in large furnaces to convert silver sulfide to silver chloride. The material could then be treated with the Washoe pan process.

4. Smelting: Crushed ore was placed in a furnace, roasted to drive off unwanted carbon or sulfur, and then combined with reducing substances (often charcoal or coke) to induce a chemical reaction and reduce metal oxides to elemental metal and waste rock, or slag.

5. Cyanide process: Developed at the end of the nineteenth century and often used after the Washoe pan process to increase efficiency and

[90] Richard O. Burt and Chris Mills, Gravity Concentration Technology (New York: Elsevier, 1984), 3.

> recovery. Also used to treat old mine tailings to extract gold and silver. Ore was crushed to a fine powder, mixed with water and placed in large wood or concrete tanks containing a solution of potassium or sodium cyanide, then agitated. The cyanide chemically separated the metals from the gangue. The metal-bearing cyanide solution was drawn off the tank and the remaining fines, or slimes, were discarded as tailings. The cyanide solution was then treated to precipitate the metals.

However, because of their high lead content, "ores of the Eureka district and other districts with similar mineralogy [including the adjacent White Pine] could not be practically reduced using amalgamation or the Reese River or cyanide processes, because of the immense amounts of mercury required. In the nineteenth century the only alternative was smelting."[91] This applied mainly to high-grade lead ore that could be economically shipped and smelted, and low-grade ore was typically bypassed.

> In nearly every mining district where lead is found to any extent, the lead in the upper or weathered parts of the ore deposits, generally above the level of the ground water, is oxidized, being usually in the form of the carbonate, and occasionally the sulphate of lead. In most of the Western States the lead carbonate is, as a rule, accompanied by silver and occasionally by some gold or copper. Much of this "carbonate" ore has been very rich, owing to natural concentration by weathering. Such ores because of their richness and their needing for the most part no roasting before smelting have contributed greatly to the development of the mines. Wherever the "carbonate" ore has been low-grade, however, preliminary concentration has been necessary. In milling such ore, serious losses in the tailings often have taken place, owing to the well-known tendency of lead carbonate to "slime" by breaking into thin flakes that float away with the gangue. The concentrates obtained by gravity concentration have usually been of good grade and in demand by the smelters. Dumps of these slime tailings abound in almost every important base-metal mining district of the western United States, and in regions where oxidation extends to any depth there are vast quantities of such low-grade ores from which the high-grade ore has been gouged out. In fact, in many districts the custom has been to mine only the ore of smelting grade and to leave the lower grade material in the mine. That ample supplies of low-grade oxidized ores of lead are available and that much of this material is being wasted cannot be doubted.[92]

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[91] Bowers and Muessig, History of Central Nevada, 49-50.

[92] Dorsey A. Lyon and Oliver C. Ralston, Innovations in the Metallurgy of Lead (Washington DC: Government Printing Office, 1918), 11-12.

This was true of the mines in the lead belt of the White Pine district, and it was these relatively untouched deposits of complex and low-grade ore that that the TBDC sought to exploit using the most recent advance in ore processing, namely froth flotation. The first experiments on the use of flotation for processing complex ores date to 1860 in England, but the first successful commercial mill wasn't built until 1905 at Broken Hill, Australia.[93] In 1911, froth flotation was used in the United States for the first time at a reduction mill in Basin, Montana, and the process was so revolutionary that, after only three years, 42 mining companies were using the process.[94] Several districts in Nevada enjoyed revivals based on froth flotation technology, including the White Pine in the 1920s.

> What is the flotation process? Briefly, it consists in the agitation of finely divided ore in water containing bubbles of air or gas, a small amount of oil and, usually, other reagents soluble and insoluble; under these conditions the small particles of native metals… show a tendency to attach themselves to the films of the bubbles, and are thus carried to the surface of the water. The oxidized gangue minerals… either remain in suspension in the water, or sink to the bottom of the vessel. If the bubbles are sufficiently stable they can be removed, carrying their load of sulfide-mineral particles with them.[95]

TBDC sought to recover high-grade ore through gravity concentration and then recover fine particles of lead sulfides using froth flotation. The lead ore contained significant amounts of silver, and after the lead was concentrated through froth flotation, the slimes from the flotation cells could be sent through a cyanide tank to recover the precious metal. The newspaper references to cyanidation probably refer to this phase of the process.

Early methods of flotation were effective in recovering lead sulfides but required further refinement to recover metal from lead carbonates and more complex lead ore. In the lead zone where the TBDC mines were located, the primary ore material is galena, which oxidizes to anglesite, a sulfate mineral. In the presence of meteoric water carrying calcium carbonate and carbonic acid, however, the

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[93] For further information on the history of flotation, see Dawn Bunyak, Frothers, Bubbles, and Flotation: A Survey of Flotation Milling in the Twentieth-Century Metals Industry (Denver: Government Printing Office, 1998).

[94] A. J. Lynch et al., "History of Flotation Technology," in Froth Flotation: A Century of Innovation, edited by Maurice C. Fuerstenau, Graeme Jameson and Roe-Hoan Yoon (Littleton, CO: Society for Mining, Metallurgy, and Exploration, 2007), 72-73.

[95] A. J. Weinig and I. A. Palmer, "The Trend of Flotation," in Ernest Gayford, "Definition, Present Status and Future of Flotation," in American Institute of Mining and Metallurgical Engineers, Flotation Practice: Papers and Discussions Presented at Meetings held at Salt Lake City, August, 1927, and New York, February, 1928 (New York: American Institute of Mining and Metallurgical Engineers, 1928), 7.

anglesite is slowly replaced or altered to cerrusite, a carbonate mineral. "The enclosing rim of anglesite and cerrusite partially protects the core of galena from further oxidation; galena nodules surrounded with anglesite and cerrusite are common." The ore also contains silver, perhaps as argentite, as well as copper and zinc.[96]

In 1926, recovering lead from the lead carbonate required knowledge of the most recent advances in froth flotation technology. At the time, "Although enormous tonnages of sulfide lead and lead-silver ores [were] treated by flotation, the products of flotation mills treating oxidized ores of lead and silver [were] almost negligible."[97] To address the issue, much research was done and numerous patents were taken out on the process of sulfidization, by which a soluble sulfide was introduced to a pulp containing oxidized minerals (including lead carbonates) "in order to form a coating of artificial sulphide of lead on the oxidized particles."[98] Where mixed sulfide and oxidized minerals were present, it was advised that "the sulfides should be removed either by [table concentration] or primary flotation before attempting to sulfidize and float the oxidized minerals."[99] The soluble sulfide (usually sodium sulfide) could be added either during the thickening phase, when the oxidized ore was in solution in a Dorr thickening tank, or as part of the flotation process. The sulfidized carbonate minerals would float on the froth and could be skimmed off in the usual manner.

In summary, the complex ore material recovered from the Belmont mines, containing a mixture of lead sulfates, lead carbonates, zinc, and silver, required a complex milling process to extract the maximum amount of metal ore. TBDC designed the Belmont mill to employ a combination of an ancient technology (gravity concentration) for initial metal extraction, a more recent technology (cyanidation) for silver extraction, and innovative new technologies (flotation and sulfidization) for the extraction of very small particles of both lead sulfates and lead carbonates.

D. Workers

TBDC was a fully industrialized mining company and indeed a giant of its time. As such it was a highly structured organization that was typified by, among other things, an elaborate division of labor that included financiers, engineers, managers, shift workers, and wage earners. At the inception of the company in 1902, the financiers were wealthy capitalists who resided in Philadelphia and the

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[96] Ibid., 94.

[97] A. W. Hahn, "Flotation of Oxidized Lead-Silver Ores," in American Institute of Mining and Metallurgical Engineers, Flotation Practice: Papers and Discussions Presented at Meetings held at Salt Lake City, August, 1927, and New York, February, 1928 (New York: American Institute of Mining and Metallurgical Engineers, 1928), 185.

[98] Lyon and Ralston, Innovations in the Metallurgy of Lead, 84. 85-106.

[99] Hahn, "Flotation of Oxidized Lead-Silver Ores," 189.

company's headquarters, where board meetings were held, were located in that city. By 1926 at least one board member, M. B. Cutter, was a resident of Minneapolis, Minnesota.

The company's managers were headquartered in Tonopah, Nevada, and during the construction and early years of the Belmont Mill they commuted frequently from that town through Ely to Hamilton and the mill site. Based on the extensive newspaper reporting, it appears that they often stopped in Ely to provide updates on activities at the mine and mill. During TBDC's active years at the mill, management included the following:

> Clyde A. Heller, a Philadelphia native, who began as TBDC secretary-treasurer when the company was created in 1902. He was named president of the company in 1911, a position he would retain until his death in 1937.
>
> P. W. Racey, general superintendent for Nevada operations.
>
> L. O. Bastian, superintendent of construction. He became ill early during mill construction but returned in the fall to supervise the addition of the flotation unit.[100]
>
> W. I. Cowsert, construction supervisor. He "erected the Belmont Mill at Tonopah" in 1911 and replaced the ailing Bastian as construction supervisor in May 1926.[101]
>
> Charles Mayotte, mine superintendent. He and his wife Mary most likely lived at the site: a 1928 list of registered voters indicated that the couple was living in Hamilton or its vicinity.[102]
>
> Mr. Algers, position unknown (most likely a manager or technician). In the winter of 1926, he and his wife "moved to Hamilton from the Tonopah-Bellmont [*sic*] mill in order to place their children in school," an indication that at least a few wives and families were living at the mill site.[103]

Little is known about the TBDC shift workers and wage earners, including the miners, blacksmith, mechanics, machine operators, and boardinghouse cooks (one at the mine and one at the mill) who would have worked at the site. During the construction period, about forty men were employed at the property and this

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[100] Ely Daily Times, December 2, 1926.
[101] Ely Daily Times, May 19, 1926.
[102] Ely Daily Times, July 14, 1926 and October 26, 1928.
[103] The Ely Record, December 24, 1926.

number certainly decreased after construction was complete.[104] Some men may have been residents of the Hamilton area or of Ely, and some of them may have been associated with the company's Tonopah mine, following TBDC as it sought its fortune in the White Pine mining district.

After TBDC sold the mill in 1940, all subsequent owners were listed as residents of Ely, including Captain Arthur A. DeMelik, Byron (or Bryon) F. Snyder, and Don A. Jennings. Both Snyder and Jennings leased the property and moved out of state after several years of ownership (Snyder to Florida and Jennings to California). Operations at the mine and mill were considerably reduced from the TBDC days and may have involved only one or a few workers at any time. At least one owner, Jennings, worked the property himself for a few years. He was also likely responsible for converting the supervisor's office (NV-46-H) to a house for personal use, either seasonally or year-round.

Andrew Dowd and Fred Harris were mentioned as workers of the property in 1956, and they were either employed by Jennings or leased the property from him.[105] Dowd was reputedly a mining engineer and, with his wife Ermyl, had lived and worked at the Belmont Mill site as early as 1945.[106] After her husband's death, Mrs. Dowd remained at the site as a caretaker for Jennings and worked her own claims nearby until about the late 1970s.

E. End Product

The end products of the processing system at the Belmont Mill were concentrates of lead and silver ore, produced through a combination of gravity concentration, flotation and cyanidation. To move the product from the mill to the smelter, the TBDC made full use of the existing modern transportation system of highways and railroads. The only weak link was the unpaved road through Hamilton between the mill and the highway and, at the outset of its investment in the property, the company had successfully lobbied White Pine County to bypass Hamilton and construct a new road over flat terrain that connected the mill site directly to U.S. Route 50, seven miles to the north.[107] From there the concentrates were trucked about 30 miles east to Kimberly, the railhead on the Nevada Northern Railway just west of Ely. The concentrates were then transported by train through Ely and then north and east to smelters in Salt Lake City, Utah.

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[104] Ely Daily Times, June 3, 1926.

[105] L. E. Davis and W. C. Fischer, "The Mineral Industry of Nevada," in US Bureau of Mines Minerals Yearbook Area Reports, 1955, Vol. III (Washington: US Government Printing Office, 1958), 715; and L. E. Davis et al., "The Mineral Industry of Nevada," in US Bureau of Mines Minerals Yearbook Area Reports, 1956, Vol. III (Washington: US Government Printing Office, 1958), 761.

[106] Interviews with Hal Jensen and Hal (Rod) Jensen, Jr., 1 October 2010.

[107] Ely Daily Times, March 29, May 3, June 2, and August 4, 1926.

The first report on mill production dates to late 1926, when a carload of lead concentrates was taken to Kimberly and thence to a Utah smelter.[108] In four months of operation, the mill processed 3,588 tons of ore, resulting in a gross yield of $63,697.[109]

In 1942, 2,500 tons were removed that yielded 470 ounces of silver and 17,738 pounds of lead, a reflection of the great demand for all metals that was prompted by World War II. No further activity was reported until 1949 and operations were never seen on such a scale again.[110] For the remainder of its working life, the mine was operated by only a few individuals and/or lessees rather than an industrialized organization like TBDC. Annual tonnages were generally quite modest, ranging between ten and 250 tons. Despite this, the mine was listed in the Minerals Yearbook as being one of the leading producers of lead in the district for 1955 and 1956, producing about 35,000 pounds each year.[111] Again, the lead ore was shipped to an unspecified Utah smelter. The last recorded ore shipment was sent from the Belmont Mill site in 1960 by the site's lessee, Belmont Lead, Inc.[112] Subsequent records suggest that neither the mine nor the mill was ever really worked again.

PART IV. SOURCES OF INFORMATION

See HAER No. NV-46.

[108] Ely Daily Times, November 8, 1926.

[109] B. Couch and J. Carpenter, Nevada's Metal and Mineral Production (1859-1940, inclusive (Reno: Nevada State Bureau of Mines, 1943).

[110] "White Pine District – Principal Mines," unpublished district summary [after 1963] (Reno: University of Nevada, Nevada Bureau of Mines and Geology mining district files, Document No. 52900082).

[111] L. E. Davis and W. C. Fischer, "The Mineral Industry of Nevada," in US Bureau of Mines Minerals Yearbook Area Reports, 1955, Vol. III (Washington: US Government Printing Office, 1958), 715; and L. E. Davis et al., "The Mineral Industry of Nevada," in US Bureau of Mines Minerals Yearbook Area Reports, 1956, Vol. III (Washington: US Government Printing Office, 1958), 761.

[112] L. E. Davis et al., "Nevada," in US Bureau of Mines Minerals Yearbook Area Reports, 1960, vol III (Washington: US Government Printing Office, 1961), 661; and "White Pine District – Principal Mines," p. 3.