

**East Reef Abandoned Mine Project**  
**Cultural Resource Evaluation**



**Prepared by  
Dames & Moore, Inc.**

**Submitted to  
Utah Department of Natural Resources  
Division of Oil, Gas and Mining**

# **East Reef Abandoned Mine Project**

## **Cultural Resource Evaluation**

**Prepared by  
Everett Bassett  
Dames & Moore, Inc.  
127 South 500 East, Suite 300  
Salt Lake City, Utah 84102-1959**

**Submitted to  
Utah Department of Natural Resources  
Division of Oil, Gas and Mining  
1594 West North Temple, Suite 1210  
Salt Lake City, Utah 84114-5801**

**PRIVILEGED – DO NOT RELEASE**

This report may contain sensitive information about the location of archaeological and historical sites. Such information is to be distributed on an as-needed basis in order to prevent vandalism of these sites.

**November 1999**

**SECTION 106 COVER PAGE**  
Must accompany all Project Reports  
Submitted to Utah SHPO

**Project Name:** East Reef Abandoned Mines Cultural Resource Survey

**State Proj. No.:** U-99-DH-0367-b,p      **Report Date:** November, 1999

**Principal Investigator:** Everett Bassett      **Field Investigator:** Everett Bassett

**Acreage Surveyed:** none

**7.5' Series USGS Map References:** Hurricane; Harrison Junction, Utah

| <b>Sites Reported</b>                                  | <b>Count</b> | <b>Smithsonian Site</b>          |
|--|--------------|----------------------------------|
| Numbers  |              |                                  |
| Archaeological Sites                                   |              |                                  |
| Revisits (no inventory form update)                    | 1            | 42Ws3167                         |
| Revisits (updated IMACS site form attached)            | 1            | 42Ws2395                         |
| New Recordings (IMACS site inventory form attached)    | 2            | 42Ws3903<br>42Ws3905             |
| Total Count of Archaeological Sites                    | 4            |                                  |
| Historic Structures (USHS 106 Site info form attached) | 0            | n/a                              |
| Total National Register Eligible Sites                 | 3            | 42Ws2395<br>42Ws3903<br>42Ws3905 |
| (Possibly Eligible-Untested)                           | 0            | n/a                              |

**Checklist of Required Items-** All included

## TABLE OF CONTENTS

|  |    |
|--|----|
| Introduction                                     | 1  |
| Project Description                              | 1  |
| Regulatory Setting                               | 2  |
| Class I and Archival Research                    | 5  |
| Class III Methodology                            | 7  |
| Silver Reef Mining Historic Context              | 9  |
| Silver Reef's Early History                      | 9  |
| Silver Reef's Boom Years                         | 11 |
| Silver Reef's Decline Years                      | 15 |
| Geology of Silver Reef                           | 18 |
| Prospecting                                      | 20 |
| Mining Claims and Patents                        | 21 |
| Mine Development                                 | 23 |
| Mining Companies                                 | 24 |
| Evaluation Criteria                              | 26 |
| Mines  | 27 |
| Non-Mine Features                                | 28 |
| Artifact Scatters                                | 28 |
| Site Designation                                 | 29 |
| Assessment of Impacts and Effect Recommendations | 33 |
| References                                       | 35 |

## Figures and Tables

|   |    |
|---|----|
| Figure 1: Overview of East Reef   | 3  |
| Figure 2: Overview of Silver Reef   | 3  |
| Figure 3: Relationship Between Silver Prices, Mining Claims and Silver<br>Production at Silver Reef, Utah | 17 |
| Table 1: East Reef Mine Openings Not Recorded as Part of Archaeological Sites                             | 30 |

## Appendices

|  |
|--|
| APPENDIX 1: Sample AMP Mine Site Inventory |
| APPENDIX 2: IMACS Forms                    |
| 42Ws3905                                   |
| 42Ws3903                                   |
| 42Ws2395 (addendum)                        |
| APPENDIX 3: Map Packets                    |
| East Reef Project Area                     |
| 42Ws3905                                   |
| 42Ws2395                                   |

## **INTRODUCTION**

This report was prepared at the request of the Utah Division of Oil, Gas and Mining to provide evaluations of the historic values of approximately 260 abandoned mines. These properties are located in the vicinity of the town of Leeds and southeast of the historic Silver Reef, Utah townsite and require significance evaluation as well as assessments of potential impacts from reclamation activities. The study is being conducted in compliance with Section 106 of the National Historic Preservation Act of 1966.

National Park Service (1982) guidelines indicate that site evaluation criteria are most successfully applied in the context of the overall pattern of regional cultural development. However, no overall context has ever been developed for hard-rock mining in southern Utah. For that reason a historical context of mining in the Silver Reef Mining District, which incorporates the project area has been included here. This allows the properties in question to be evaluated carefully, and for appropriate recording and mitigation procedures to be implemented.

## **PROJECT DESCRIPTION**

The East Reef Project Area is located in Washington County, Utah, mostly south and east of Leeds, and approximately 15 miles north of St. George, Utah (see Appendix 3, project area map). Since the East Reef Project is adjacent to the previously recorded Silver Reef Abandoned Mine Project to the west and north, several clusters of mining activity are included here that are peripheral to and not included in that earlier survey. Although this study area is larger, incorporating approximately 15 square miles, mining activity was much less intense and much of the area contains no mining-related features at all. Most of the openings are along East Reef, a north-south trending ridge located between Grapevine Wash to the west and Sandstone Mountain to the east. Other clusters are located both to the east and west of Leeds as well as around the old townsite of Harrisburg on the west side of I-15. Overall, the silver bearing reefs in this area form a horseshoe shape, open at the south end. At the north end, near Leeds, mining properties in the East Reef project are only separated from those to the west by I-15. At the south end, three miles separate the two ends of the horseshoe.

The average elevation of the East Reef project area is approximately 3,500 feet, but the region exhibits considerable range; to the west are the Pine Valley Mountains, which rise to a height of 10,324 feet. Even within the project area there is considerable variation. Ancient anticlines have had their domes eroded, leaving prominent hogbacks dissected by perennial streams and seasonal washes. While much of the project area is barren, communities of oak, juniper, sagebrush, and blackbrush can be found and riparian communities flourish along Grapevine Wash and Quail Creek. The areas where most of the mining activity occurred along East Reef is almost identical in appearance to that along White Reef in the main part of the Silver Reef Mining District (Figures 1 and 2).

Although the East Reef project area is fairly isolated, the area has seen a recent upsurge, both in tourists and in year-round residents. For this reason, the Division of Oil, Gas and Mining has initiated a program of closing open mines that are considered hazardous. Approximately 261 such mines have been targeted within the project area for evaluation and possible closure.

The purpose of this cultural resource inventory was threefold. First, each of the mines were to be inventoried, recorded, and evaluated for significance, and assessments of impacts were to be made of the proposed closings. Second, all other cultural resources in the project area were to be recorded and evaluated and assessed for possible indirect impacts. And third, mitigation measures were to be recommended to avoid or minimize impacts to significant resources.

While most of the mines are located on private land, many are located on public land administered by the Bureau of Land Management.

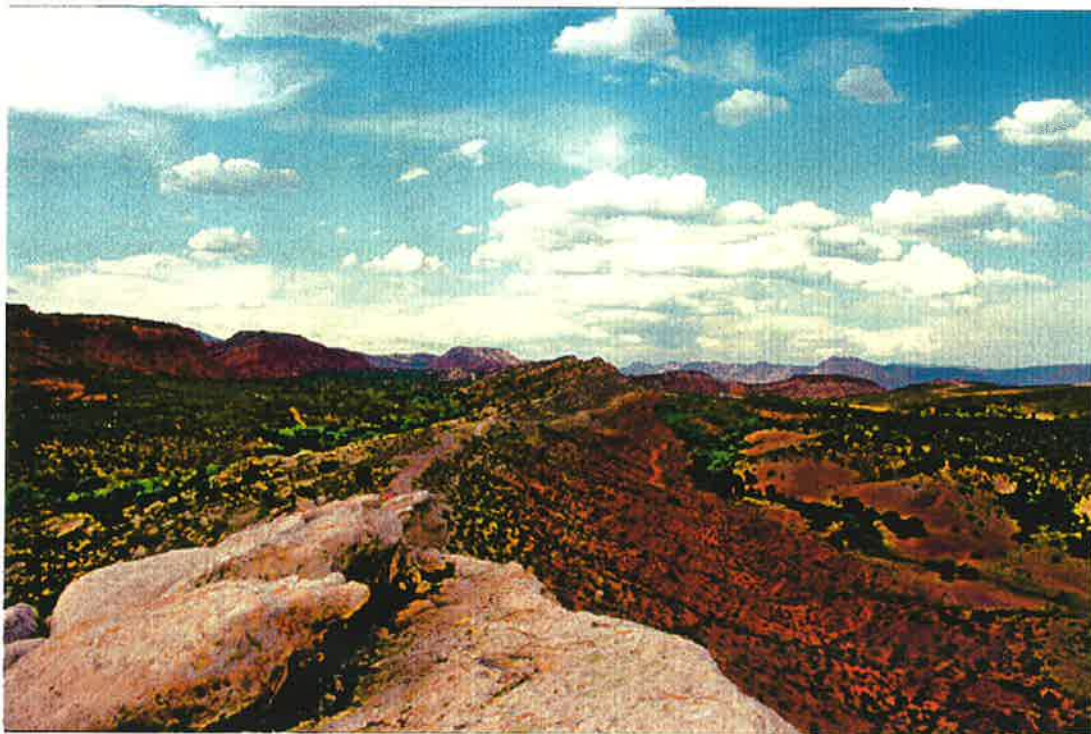
## **REGULATORY SETTING**

The National Environmental Policy Act of 1969 (42 U.S.C. 4371 et seq) establishes a federal policy of preserving not only the natural aspects, but also the historic and cultural aspects of our national heritage when undertakings regulated by federal agencies are planned. Implementing regulations (40 CFR Part 1502.16[g]) issued by the Council on Environmental Quality stipulate that the consequences of federal undertakings on historic and cultural properties be analyzed. While the intent of the legislation is preservation of our heritage, it does not mandate that no significant





**Figure 1** Overview of East Reef. View to the south.



**Figure 2** Overview of Silver Reef. View to the south.

impacts should occur. Instead, it requires that impacts be recognized and if possible minimized or mitigated.

Additional requirements for protecting historic properties are identified in the Antiquities Act of 1906; the National Historic Preservation Act (NHPA) of 1966, as amended (80 Stat. 915; 94 Stat. 2987; 16 USC 490), the Archaeological and Historical Preservation Act of 1974 (PL 86-523, as amended by PL 93-29 1; 16 USC 469-469C), the Archaeological Resources Protection Act of 1979 (93 Stat. 721; 16 USC 470) and the American Indian Religious Freedom Act of 1978 (P.L. 95-431).

The cornerstone of current heritage preservation legislation is the National Historic Preservation Act of 1969 (NHPA), as amended (most recently in 1992) (16 U.S.C. 470 et seq). The NHPA defines historic properties as districts, sites, buildings, structures, or objects included in or eligible for inclusion in the National Register of Historic Places (NRHP), as well as artifacts, records, and remains related to such properties. Regulations for "Protection of Historic Properties (36 CFR Part 800), which primarily implement section 106 of the NHPA, define the key regulatory requirements. These regulations define a process for consulting with State Historic Preservation Offices (SHPOs), the Federal Advisory Council on Historic Preservation (ACHP), and other interested parties to ensure that historic properties are duly considered as federal properties are planned and implemented. The steps in the "section 106 consultation" process involve:

- identifying cultural resources that may be affected by a proposed undertaking
- assessing the significance of those resources; that is, determining whether or not they are National Register eligible
- assessing the potential effects of the undertaking on significant properties
- consulting with SHPOs, the ACHP, and other appropriate concerned parties to determine ways to avoid or reduce any adverse effects if such are identified
- if necessary, providing the ACHP a reasonable opportunity to comment on the proposed undertaking and effects on historic properties
- proceeding with the undertaking under the terms of a memorandum or agreement or in consideration of ACHP comments if required



From the perspective of the NHPA, the term "historic properties" is used to refer specifically to cultural resources that are eligible for listing on the National Register. Thus, by definition, historic properties are "significant". "Cultural resources" is a more general term and is used here to refer both to historic properties and to other resources that may not have been formally evaluated as being National Register-eligible. To be determined eligible for inclusion in the National Register, properties must be important in American history, architecture, archaeology, engineering, or culture. They also must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet at least one of four criteria:

- a) are associated with events that have made a significant contribution to the broad patterns of our history
- b) are associated with the lives of persons significant in our past
- c) embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant distinguishable entity whose components may lack individual distinction
- d) have yielded, or may be likely to yield, information important in prehistory or history  
(36 CFR Part 60.4)

Archaeological sites, as opposed to standing structures, are generally eligible under criteria "d" when valuable data can be recovered. Mine workings however, are rarely eligible on the basis of their information content unless they also have associated artifact assemblages, facilities or habitations. In general, historic features are much more likely to be eligible under criteria "a", "b", or "c". However, the property must be "important" and must convey the "design, feeling etc." of the associated event, person or style.

## **CLASS I AND ARCHIVAL RESEARCH**

A program of archival and oral historical research was undertaken to determine the histories of the mines at East Reef as well as to develop a broad historical context for the project. First however, a records search was undertaken at the Division of State History to determine which of the historic properties may have been previously recorded, or whether any class III surveys had been carried out within the project area.

A total of 42 archaeological sites have been recorded within one mile of the project area. Twenty-three of these had been identified during surveys for Interstate-15, which runs through the west side of the East Reef project area. Two of these sites are prehistoric artifact scatters (42Ws2366 and -2372); fourteen are historic residential or agricultural sites associated with the town of Leeds (42Ws2369, -2373, -2385, -2386, -2387, -2388, -2389, 2390, -2393, -2398, -2400, -2401, -2402 and -2403); three are small mining locations (42Ws2396, -2397 and -2399); and three are associated with the Leeds Civilian Conservation Corp facility (42Ws2391, -2392 and -2394). In addition to the I-15 sites, eleven sites, all small prehistoric artifact scatters, are located in the flats in the northeast quarter of section eight, east of Leeds. Three sites, all historic, are located near the historic townsite of Harrisburg (42Ws503, -866, and -1559). Another three sites, all historic house foundations are found along the east side of East Reef and are probably associated with the mining there or with the town of Babylon or with the Stormont millsite (42Ws1740, -1741 and -1742).

Three additional sites are directly associated with or adjacent to mine openings identified for this project. 42Ws408 is a prehistoric rock art panel located within a cluster of mine openings on East Reef. It is unevaluated but is certainly eligible for listing on the NRHP. 42Ws3167 is a small, ineligible site consisting of three of the mine openings and a small scatter of prehistoric artifacts. 42Ws2395 encompasses all of Leeds Hill, west of Leeds and includes 27 of the mines included in this study. It has been determined eligible for listing on the NRHP.

In addition to these archaeological sites, several additional historic properties have been identified within a one-mile radius of the project area. Three of these are presently listed on the NRHP. These are the Leeds Civilian Conservation Corp Camp Historic District, the Leeds Tithing Office and the Silver Reef Wells Fargo & Co. Express Building. One structure, the Sterling House in Leeds, has been placed on the Utah State Register and another 6 properties have been identified as potentially significant, but requiring further research. These are the Leeds Creek Charcoal Kiln; the Harrisburg Cemetery; the William Sterling and Charles Wilkinson Houses and the Stormont Mill, all in Leeds; and the Silver Reef townsite. None of these historic properties is close enough to the project area to be affected by either direct or indirect impacts.

The history of the mines in the Silver Reef Mining District was researched through a variety of sources. The most valuable of these were the mineral surveys and surveyors' field notes located in

the Public Room of the Bureau of Land Management (BLM). General Land Office maps and homestead and townsite records at the BLM were also checked. Claim Location, Mine Patent and Proof of Labor records as well as land ownership and mine abstract were located at the Washington County Recorder's office. Newspaper and mining journal accounts, state and federal reports on mine development, and personal biographies were also utilized.

The general history of Silver Reef was collected from a variety of sources. The most useful of these were *Silver Sinners and Saints* (Proctor and Shirts 1992), *Historical Study of Silver Reef Southern Utah Mining Town* (Stucki 1966) *Geology of Silver Reef (Harrisburg) Mining District* (Proctor 1953), and *Saga of Three Towns* (Mariger no date). The *Silver Reef Miner*, the *Washington County Spectrum*, the *Pioche Record*, the *Salt Lake Mining Review* and the *Mining and Engineering Journal* were also consulted. General information on hard-rock prospecting and mine development was mostly derived from Young's *Western Mining* (1970), an especially good source, but also from Brown (1979), Browne (1992), Copp (1908), Cox (1918), Gunther (1932), King (1977), Pearl (1973), von Bernewitz (1938), and Young (1967). In addition, an overview of the northwestern portion of the Silver Reef Mining District was previously produced by Bassett (1994).

### CLASS III METHODOLOGY

For the class III survey, each mine area was surveyed using 20-foot transects. Where mines were combined to form a single site, all areas within the site boundary were likewise walked in 20-foot transects, usually parallel to the reef. Everett Bassett did this work on various dates in June, July and August.

Once a mine was located, it was compared to any descriptions that may have been made earlier by the Division of Oil, Gas and Mining. An inventory form was filled out and photographs taken of each mine, building, road, or other large feature. Several feature types were recorded on the maps but not assigned a feature number or otherwise described. These included small mines and prospects that were not being considered for closure, cairns, and isolated spoil piles or rock alignments unassociated with any other feature. No attempt was made to enter the mines since this was determined to be unsafe by the Division of Oil, Gas and Mining. For the most part, surface visibility was good. Each feature and spoil area was located on maps with a scale of one inch equals one

hundred feet. This data was transferred to Dames & Moore's autoCADD system and are included here in Appendix 3.

The recording procedure used on the East Reef Project deviates from the way cultural resources are often dealt with in Utah. Normally, IMACS (Intermountain Antiquities Computer System) forms are filled out for each cultural resource and then significance evaluations are made. However, the IMACS form was originally designed as a tool for managing prehistoric sites. It can be cumbersome as well as redundant when used in addition to the evaluations required by law for these mines. The Abandoned Mine Program inventory reports quantify the size and shape of the mine, (including the dangerous interior of the adit), construction techniques, and the amount and nature of the spoil (see sample form, Appendix 1). Essentially, these are mines being evaluated by mining experts; we have found that in most of the cases, this is sufficient.

What these engineering reports do not adequately cover is the presence of associated archaeological materials, especially the less obvious trash scatters or tent platforms. The experiences gained from past projects allow us to recommend a system by which the more complex sites can be thoroughly recorded by archaeologists while the "holes in the ground" can be recorded on the shorter format, by mining engineers. Archival and/or oral historical research are done for all mine locations even where they are not recorded on an IMACS form. As a result, the majority of the mine openings were recorded as archaeological sites, but not all. This procedure has been developed in consultation with the Utah State Historic Preservation Office.

No survey or recording was done outside of the project area. However, adjacent areas that possess cultural resources include the towns of Silver Reef, Bonanza Flats, Helltown, Babylon, and Leeds, and the Stormont, Barbee and Walker, Christie, Western Gold and Uranium Inc., and Buckeye Mills. Ideally, these could all be included in the future as a single historic district. Other sites in the vicinity that are closely associated with Silver Reef include Harrisburg, the charcoal beehive ovens on Leeds Creek, flumes and skid roads designed for bringing logs down from the Pine Valley Mountains, and other processing mills built along the Virgin River and Ash Creek to the east.

## **SILVER REEF MINING HISTORIC CONTEXT**

National Park service guidelines (1982) suggest that sites must be considered relative to some context that allows us to understand how unique or important they are. A formal state or regional historic context has yet to be developed for the types of sites encountered here. However, other state or regional contexts have been written so as to more effectively evaluate western mining sites. These include Barker and Huston (1990), Francaviglia (1991), Hardesty (1990), Keane and Rogge (1992), Noble and Spude (1992), the South Dakota State Historical Society (1987), and Bassett (\*\*\*)

### **Silver Reef's Early History**

The Silver Reef Mining District is located in an area that was originally settled by Mormon farmers from Saint George who were anxious to utilize Leeds Creek and Quail Creek for irrigation. Their first settlement, in 1859, at the confluence of Quail Creek and the Virgin River, lasted only a year. The following year, many of these same settlers returned to found the small community of Harrisburg three miles up the creek and three miles south of Silver Reef. Although the land here was rocky, water was available and the site was located along the main north-south road in the territory. The Harrisburg Ditch was soon constructed by diverting water from Leeds Creek north of Silver Reef to the head of Barbee Gulch and then down through the study area to the townsite. By 1864 Harrisburg had a population of 128 with 38 acres under cultivation (Proctor and Shirts 1991:1-2).

In 1867, because the irrigable land at Harrisburg was inadequate, the settlers gained permission to move to Round Valley to the north where the town of Leeds was founded. Eventually, most of Harrisburg would move to the new location after relinquishing their land and water rights in the older community. The Leeds Ditch, a new main branch of the Harrisburg Ditch, was diverted to the east, across what was to become Silver Reef City, across Bonanza Flat and into Leeds. Leeds would eventually develop into a stable, if small, agricultural community.

The early residents of the Silver Reef area were probably unaware of the adjacent mineral riches. However, even if they had been, it is unlikely they would have done much about it. Mormons were strongly discouraged from prospecting by Brigham Young who reasoned that, were a bonanza to be discovered, the resulting flood of Gentiles would threaten the Mormons' isolation and way of life (Stucki 1966:9). However, the mostly California-raised nonMormon soldiers stationed at Fort



Douglas near Salt Lake City felt no such restrictions. From this locus, and encouraged by their commanding officer, Colonel Connor, they spread out across the landscape prospecting and developing small mines. Their success encouraged other prospectors to enter the territory and eventually some reached southern Utah.

John Kemple, a prospector most recently from Montana, is most often credited with the discoveries at Silver Reef. During the winter of 1866-67 he stayed with Orson Adams in Harrisburg and undoubtedly prospected the area (Stucki 1966:11). Although he found some silver float, he failed to locate the source rock and in the spring he moved on to Nevada. He must have suspected riches were to be had here, however, for he returned to Harrisburg in 1868 and resumed prospecting. In 1868 he discovered high-grade silver ore west of Harrisburg at the southern end of White Reef and, in 1871, Kemple and others organized the Union Mining District. Some of the 16 claims located at that time are located near some mine openings near Harrisburg that are part of the East Reef project area.

Many of Kemple's partners in this venture included Mormon leaders of Harrisburg and St. George, including E.G. Wooley and Erastus Snow, an apostle of the LDS Church (Harrisburg Mining District Record Book A). Snow's views on mining were well known and he stated more than once "that for the future, he wished any man that would go to the western mines as a miner to be cut off from the Church" (Bleak Annals n.d.: 196). It is probable that his involvement at Silver Reef was an attempt to tie up the claims so as to prevent Gentiles from moving in. Later, Snow and others would attempt this same strategy at Pioche, Nevada where the local newspaper criticized their actions:

... and in order to get the balance of power in the district they (the Mormons) suddenly turned miner, and Erastus Snow the Mormon high priest of Southern Utah came from St. George, accompanied by a host of "Saints" and proceeded immediately upon their arrival to locate the country ... and thus crowd out the Gentiles (*Pioche Record* 12/10/1876).

Although the strategy failed at Pioche, it was apparently effective at Silver Reef, at least for the first five years. However, these original claims were well south of the main ore bodies, were probably never worked and were soon abandoned. In 1874 Kemple again returned to Harrisburg and reorganized the old Union Mining District. The new district, officially called the Harrisburg Mining District, but more commonly known as the Silver Reef District, encompassed 144 square miles, including all of the present study area. Twenty-two new claims were recorded under the new federal mining law of 1872. Again, these were mostly staked by Mormon farmers or their wives, but this

time they extended north to include the more valuable mineral lands of East Reef and the northern portion of White Reef (Harrisburg Mining District Record Book A).

One curious aspect of these early years was the relationship between Kemple, a nonMormon clearly interested in developing mineral resources, and the local Mormons. Stucki (1966:10-12) has argued that the Mormons were only interested in holding off the Gentiles. However, many Mormons recorded claims in their wives' names, perhaps to deflect criticism from the Church and many of these men would later develop mines here. Arrington (1960:336) has argued that the prohibition on mining has been exaggerated, and that mine development by Mormons was allowed in situations where it could be shown to church leaders that the lifestyles of the miners wouldn't be severely tested. At any rate, most of the Mormon claims at Silver Reef were later abandoned or restaked, overstaked, jumped, sold to or otherwise taken over by nonMormon miners (Proctor and Shirts 1990:34).

### **Silver Reef's Boom Years**

The real development of Silver Reef can be traced to 1875 when mining interests in Salt Lake City and in Pioche, Nevada became aware of the area's potential. This recognition may have been slow in coming because of the unusual nature of the ore. It was well known during this period that mineral-bearing ores could not be present in sandstone, a prejudice which would continue to limit development at Silver Reef.

The first moneyed interests to become aware of Silver Reef's potential were the Walker Brothers of Salt Lake City who had received samples of ore. In 1875 they sent their agent, William Tecumseh Barbee to scout the area. Barbee would eventually locate 22 claims and return to Salt Lake City with enthusiastic descriptions of the area (*Salt Lake Tribune* 8/9/1875). However, after consulting with mining experts who doubted that silver in sandstone could be anything but a fluke, the Walkers sold out to Barbee. Eventually, Barbee would become one of Silver Reef's most efficient boosters, writing many letters to the *Salt Lake Tribune* extolling the virtues of the mining camp. In November of that year he noticed horn silver in a wagon skid on the north end of Buckeye Reef and established his fabulous Tecumseh Mine there (Pendleton 1930: 106). Later, his Barbee and Walker mine at the north end of White Reef became one of the most consistent producers in Silver Reef history.

Shipments of ore to Salt Lake City that winter were valued at \$17,000 and a later shipment to Pioche where milling costs were lower amounted to \$23,000 (Rolker 1880:25-26). This later shipment undoubtedly set off the great "Pioche Stampede" to Silver Reef. Miners, gamblers, merchants and camp followers streamed to the area. In this sense, Pioche became the "mother camp" of the Silver Reef District bringing many of its customs and mining practices. For example, claim jumping was a common practice at Pioche so at Silver Reef, many miners camped out on their claims rather than in town.

Barbee, ever the entrepreneur, had a town platted in the flats at the base of Tecumseh Hill which he named Bonanza City. However, he apparently set the price of the lots too high, and the new residents refused to settle there. Later, in 1876, Hyman Jacob, a merchant from Pioche had a new town site surveyed in the rocky area northwest of Bonanza City (*Pioche Record* 11/15/1876). This he christened Silver Reef City, the first known use of that name, although many locals continued to refer to it as "the rock pile".

The new town grew quickly. In less than a year there were approximately 1500 inhabitants, a large hotel (the Harrison House), restaurants, saloons, lodging houses, barbers, billiard halls, bakers, shoe shops, furniture stores, tobacco shops, drug stores, lumber yards, butchers, hardware stores, groceries and even a nursery offering trees, shrubs and other landscaping plants. In addition, the town boasted several assay offices. A few lawyers, "the curse of the mining camp", hung out their shingles to help resolve claim litigation. A newspaper, the *Silver Reef Miner* with its strident anti-Mormon editorials also served the community. Many of the residents of Silver Reef were Irish and this set it apart from other mining camps in Utah where English and Cornish miners dominated. By 1879 a Catholic Church and hospital had been built administered to by five nuns of the order of the Holy Cross (Stucki 1966:3 1-36).

The Irish were not the only residents of the new town. A Chinatown sprang up and many of the 100 residents ran laundries, restaurants and betting parlors. Along with a Catholic and Protestant cemetery, a Chinese cemetery was established and, after Silver Reef was abandoned, a Sam Gee of San Francisco exhumed each of these burials, packed them in tea chests and sent them back to China. In addition, the native Southern Paiute Indians camped north of town and many took day jobs, such as carrying water to the miners (Stucki 1966:31-36).

While many prospectors camped on their claims to protect their investments, a residential area developed in Silver Reef as well. Within the town, most of the buildings were temporary ones, crudely constructed of milled timber and canvas; many others were built of the local tabular sandstone and had wooden roofs. Like most mining towns, Silver Reef was susceptible to fires and three separate ones almost totally destroyed the town in 1879. Large amounts of money were being invested however, and the town was quickly rebuilt. Local Mormon communities maintained a brisk business providing meat and produce, teams of horses, and day labor (Stucki 1966:31-36).

The mines flourished during this period and new claims continued to be recorded, mostly by miners from the Pioche and Lincoln Star Districts of Nevada. By 1880, six hundred and forty claims had been recorded in the Harrisburg Mining District, although only one hundred and fifty were still being worked and even fewer had ever been patented (Harrisburg Mining District Record Book B). These included mines on White Reef, Buckeye Reef, and Paulmar Hill as well as the outlying portions of the district. Along East Reef, only a single claim was patented during this period, an indication of the low quality of the ores in this area. This was the Requa (Lot 60) patented in 1879.

Of the mines on the east side of the district, only the Duffin, the Vanderbilt and the Tocquerville produced much marketable ore. In April, 1877, J.W. Wright and T.P. Hale recovered some ore from the Duffin and hauled a wagonload to the Condor Mill in Pioche, Nevada. The Duffin became the most productive mine on the east side and at one time had 30 men, mostly "chloriders" (leasees) working it. Through October 1881, \$80,000 worth of silver from the Duffin had been run through the nearby Stormont Mill, which did custom work (Butler 1920:93). Still, this is only a miniscule amount compared to that taken from the main part of Silver Reef. The Duffin mine was probably named after Isaac Duffin the "Tocquerville Healer" who, while on a mission to Manchester England, healed a child of a withered arm. He owned the Emporium in Leeds and may have grubstaked the original claimants. In 1951, F.S. Larny and Sons of Hurricane pulled another \$5,000 in copper and silver ore out of the Duffin in what they termed "operation wheelbarrow" (Mariger n.d.:47). Presently, the Duffin is sealed but is surrounded by large piles of spoil and some bulldozer damage. It is located on the Requa Claim south of structure 9 on site 42Ws3905.

The two other mines, the Vanderbilt and the Tocquerville are located further north. Together, they produced only about \$40,000 in ore (Butler 1920:93). The Vanderbilt, in particular, held great promise but was so broken up by faulting that mining there was difficult. The Tocquerville Mine appears to be AMP #3411317VO1, now within site 42Ws3903. The Vanderbilt mine was 1400 feet to the north and appears to be no longer open. Extensive workings were also identified to the south on what would later be the Maud claim. Butler (1920:157) suggests that shipments of sorted ore from the south adit and Maud incline never exceeded 1,000 tons. This was almost certainly from the heavily worked area around 3411330IO12. The south end of East Reef was not patented until 1925 when Harry Lapidaire, Gertrude Getz, and Sadie Alexander patented five claims: the Arizona, the Maud, the Rough Rider #2, the Nevada, and the Utah. Although they claimed improvements aggregating over 747 feet (3 cuts, 2 tunnels, 4 drifts, and 6 incline shafts), there are no artifacts present from this period and they may have taken advantage of earlier improvements on unpatented claims. They certainly never developed these properties or shipped ore. It appears that the heavy prospecting activities seen in the East Reef project area is less a function of the amount of marketable ore to be found there than it is of the number of miners present in the area and their expectations for success based on associated, nearby deposits.

For the most part the mines dug in the Silver Reef District were "poor man's mine's", ones that could be worked quickly with very little capital by excavating the surface "icing" of silver ore. However, since Silver Reef had no railroad, the ore had to be hauled in wagons to Pioche or else stockpiled to await the arrival of the mills. Several small, horse-powered grinding mills or arrastras were built, but these proved inadequate for the large quantities of ore being removed at Silver Reef.

By 1879 most of the surface ore at Silver Reef had been removed and the remaining ore had to be located deeper and at fewer locations. Such deep mines required more capital than these early miners had and by 1880 many of the claims had been bought up. After this date only four companies were doing most of the serious mining in the district: the Barbee and Walker; the Leeds; the Christy; and the Stormont Mining Companies. These corporations were able to mine ore for approximately \$16.00 per ton. Smaller operators, with less overhead, were able to extract ore for approximately \$10.00 per ton but had fewer mining options (Stucki 1966:89). None of the mines at East Reef or elsewhere in the East Reef project area were worked by these larger companies and it can be assumed that development at these locations had mostly ended by then.



Each of these companies built their own mill, although they also ran piece work for some of the smaller mine owners and leasees. The first successful mill in operation at Silver Reef was the Old Maggie, a ten stamp steampowered mill hauled in from Pioche and erected on the Leeds Mining company's property in late 1876. Later, the Christy Mining and Milling Company built a mill southeast of the town of Silver Reef and William Barbee obtained financial assistance from the Walker Brothers to build the Barbee and Walker Mill near his mine on White Reef. To take advantage of the strong water flows on the Virgin River, the Stormont Company ran a mile-long millrace at Babylon, about four miles from Leeds and at the south end of East Reef. None of these milling efforts were ever very efficient and newspaper reports from the period suggest they were broken down most of the time. Inappropriate or old machinery, unskilled labor, and inefficient communication and freighting systems seem to have been the main culprits, although poor management seems to have also played a part (Proctor and Shirts 1990:159-191).

### **Silver Reef's Decline Years**

By the early 1880s Silver Reef's fortunes had already begun to decline. Part of the district's problems were geological, part sociological, and part economic. As the remaining Silver Reef ore became scarcer, it had to be extracted from increasingly greater depths and usually contained smaller percentages of silver. Most of the juniper trees in the vicinity had been cut for fuel and operating the steam hoists and pumps became increasingly expensive. In addition, the mines on the eastern side of the Reef began to fill with water, requiring expensive pumping operations. The mills, none of which had ever operated efficiently, were subject to constant breakdowns and transportation costs continued to be high.

As if this weren't enough, labor troubles hit Silver Reef. For mining of this type, labor was a company's greatest cost and reducing it just a little could reap high profits. In 1881, when miners at the Stormont and Barbee and Walker properties had their wages reduced from \$4.00 to \$3.50 a day, they promptly struck. Both companies shut down and, as a result, three fourths of the labor force in the district was without work; many miners left Silver Reef for employment elsewhere and never returned. When the strike was eventually broken, local Mormons filled many of the positions.

Meanwhile, the price of silver continued to drop. Between 1877 when production began and 1888 when the Christy Company quit Silver Reef, prices fell from \$1.20 to \$0.93 an ounce. There was also a corresponding drop in production. During the first six years of production, more than \$5,000,000 worth of silver bullion was produced, representing one-sixth of Utah's total output. Production reached a peak of \$1,150,000 in 1879. However, during the next 18 years, only \$2,500,000 worth of silver was produced and between 1890 and 1900 production averaged less than \$30,000 a year (Stucki 1966:99-100). Figure 3 illustrates the relationship between silver prices, mining claims filed and silver production in the Silver Reef Mining District during the years 1871-1910.

Following the collapse of the larger mining concerns, very little additional work was done at Silver Reef. Some independents continued to lease and work the mines or the old tailings and their low overhead allowed them some measure of success. By 1888, the St. George mercantile firm of Wolley, Lund and Judd had leased most of the properties under their subsidiary, the La Virgin Company, which subleased the mines to smaller operators. When enough ore had been gathered, a mill run was made. In 1893 they converted the Barber and Walker Mill to waterpower at a cost of \$25,000. However, this proved to be unprofitable, and they were never able to recoup their investment (*Salt Lake Tribune* 1/1/1890).

In 1898, the Brundage Company of Cleveland, Ohio bought out Wolley, Lund and Judd. They planned to revive the camp whose population had dwindled to less than 100 persons, but the low price of silver stymied their plans (Stucki 1966:103). In 1908, the last mill run was made, by which time Silver Reef was a ghost town. However, the sudden availability of building materials from the old town proved to be a great economic bonanza for the nearby Mormon communities. Cannibalized timbers were used to build the new town of LaVerkin; the Catholic Church became a recreation hall in Leeds; a boiler was used as a heating plant for Dixie College in St. George; and the smokestack from the California Mine became an irrigation flume at Santa Clara Wash (Stucki 1966:105-106).

In 1916, Alec Colbath purchased most of the important properties at Silver Reef for \$160,000. In the late 1920s he sold a controlling interest to the American Smelter and Refining Company which performed extensive testing and developmental work. This included excavating the ASARCO Shaft on White Reef and tapping the bottom of, and draining the water from, the old California Mine

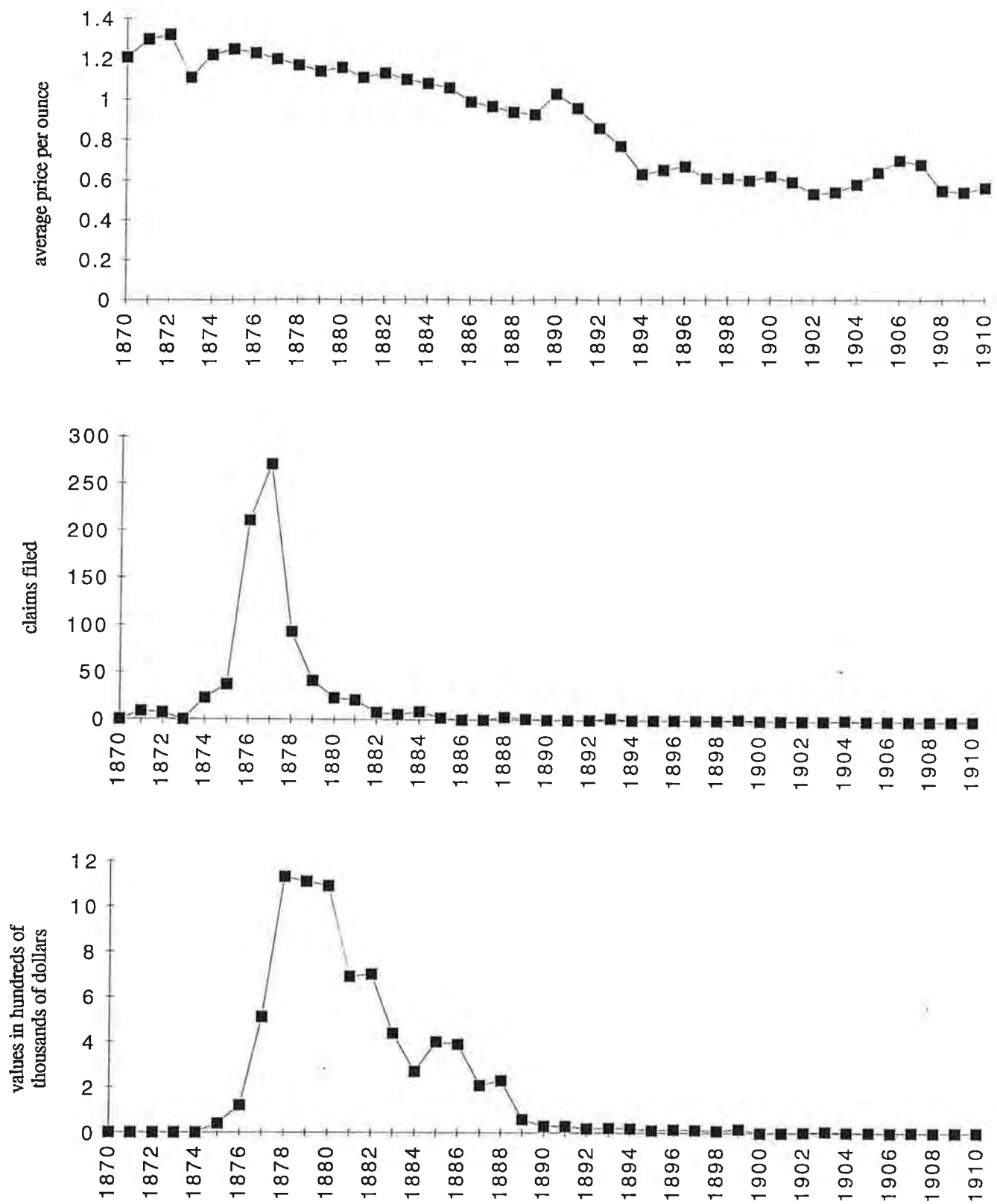


Figure 3

Relationship Between Silver Prices, Mining Claims and Silver Production at Silver Reef, Utah

workings. This work was abandoned in 1929 when the stock market crashed and the price of silver fell to \$0.26 an ounce (Stucki 1966:103).

In 1950 Western Gold and Uranium, Inc. purchased much of Silver Reef, built a mill, and shipped out a considerable amount of uranium ore and silver concentrate. Although they discovered two new silver-uranium ore bodies on Paulmar Hill, the company ceased operations in 1958 (Stucki 1966:103-1064). Some of the small mine openings near Leeds appear to date to this period or were reworked at that time. In 1960 the 5-M Company purchased most of Silver Reef, and in 1979, constructed a 50,000-ton capacity leach pad in Barbee Gulch. During this period manipulations in the silver market caused prices to skyrocket and 5-M made plans to rework the old mines and tailing piles. With the collapse of the silver market, these plans were dropped (Proctor and Shirts 1990:193-194). Later, portions of the old Silver Reef town site were subdivided and, although water rights issues continue to plague the residents, many new houses have been built.

Changes to the Silver Reef mining landscape have been closely tied to the technological advances that occurred during these years. In the early developmental phase, excavation was done by hand, mostly underground, using hand held drill bits and controlled blasting. Effects to the surface mostly consisted of roads, shafts and small spoil piles. Exceptions included the areas around Tecumseh Hill and the Buckeye Mine, as well as certain portion of East Reef where shallow surface mining caused the ground surface to look like a "rock quarry" within two years of its discovery. Operations at Silver Reef since the 1920s, when heavy equipment and strip mining were introduced have had a much greater impact on the landscape. In one week, a single bulldozer operator can move more rock than a hundred men could in a year. The only portion of East Reef similarly disturbed is the area around the Duffin Mine, adjacent to the road, which crosses a pass in the reef.

### **Geology of Silver Reef**

The Silver Reef mining area is the only known occurrence of a commercial body of silver ore in sandstone in the United States, and one of the few in the world. This unique geology has had a profound affect on the history and landscape of the region.

The topography of the area is dominated by the huge Virgin Anticline, formed when the earth's crust folded upward. Through time the dome of this anticline has eroded away leaving protruding ribs

called reefs. Silver-bearing sandstone is found only in association with these reefs, with the richest ores being found on White and Buckeye Reefs and with lesser amounts on East Reef and Butte Reef to the east. Traces of low grade silver ore have been found along the Virgin Anticline up to and past St. George, twenty miles to the south.

The ore-bearing Silver Reef sandstone has been subdivided into the Leeds sandstone to the west and the Tecumseh sandstone to the east. Leeds sandstone gives White Reef its name, as it weathers to a white or buff color. Fossil rushes, reeds and petrified logs to a length of 30 feet are found within the formation. The sandstone varies in thickness, up to 60 feet, and interbedded shales are found throughout. When freshly struck these show a glistening luster which the miners at Silver Reef called 'soapstone'. Tecumseh sandstone is lavender-colored and has fewer fossils. It reaches its greatest thickness of 35-40 feet on Tecumseh Hill (Proctor 1953:25-29). Despite these differences, speculation took hold that Buckeye Reef was faulted from White Reef and, because the Christy Company's mines in particular were all located on Buckeye Reef, many felt that their production would end abruptly when the fault was reached. This created many difficulties for the Christy Company when they attempted to obtain additional capital (*Silver Reef Miner* 9/22/1880).

The geology of Silver Reef was the subject of a brief period of national attention as leading mining experts debated the possible origins of silver in sandstone. Charles Rolker (1881:21-33) suggested the most popular theory, that metal solutions, in the form of hot springs, percolated up from below, depositing the metals in the already-existing sandstone. J.S. Newberry (1880:269) suggested that metallic solutions precipitated from above as the sandstone was being formed. A Mr. Cazin suggested that the metal was from another source, away from the Reef and was deposited on the sandstone beds by streams running over it (Balch 1882:224-227).

In 1953, Paul Dean Proctor suggested a variation on Cazin's explanation, fortified by extensive fieldwork: metallic constituents of the original Triassic volcanic tuffs were dissolved and/or mechanically transported by streams. These were later deposited within the sandstone and shales of Silver Reef and concentrated there by solution from circulating ground water. Concentrations also occurred by precipitation through contact with entombed plant debris and associated bacteria in the more permeable buried stream channels. Folding, erosion and exposure of the ore horizon resulted in secondary enrichment of the ore (Proctor 1953).



## Prospecting

Many resident of Silver Reef engaged in prospecting full time or between jobs. This was especially true in the early bonanza years. Prospecting was a peculiar combination of common sense, modern geology and medieval superstition. Once a prospector had determined a likely location for exposed minerals, he would search the Silver Reef sandstone hillsides and gully bottoms for "float", pieces of the original lode that had been eroded and carried away some distance. Upon finding float, how far he had to search for the vein would depend on its condition: if smooth and round, the float had been heavily abraded and was a long distance from its point of origin; if rough or blocky, the lode was nearby.

Often it was possible to follow float uphill to its logical point of origin. At other times it was necessary for the prospector to excavate numerous 'gopher holes' by trenching, or digging and then washing the soil to track the path of the float. The Cornish word 'costean' is descriptive of this type of work. Experienced prospectors, by triangulating, could determine the float's apex, or point of origin even if it was deeply buried.

The discovery of silver-bearing ores at Silver Reef were undoubtedly the result of John Kemple recognizing the green and blue copper carbonates which are often associated with the presence of precious metals. Nevertheless, many folk tales developed about the discovery. One had a stranger visiting a farmer in Harrisburg and noticing beads of pure silver sweating out of the sandstone fireplace. Another story had merchants in Pioche testing the skills of a notoriously optimistic assayer with a piece of broken millstone and running him out of town when the rock turned out to be high in silver. Of course the millstone came from the area of Silver Reef.

Prospecting at Silver Reef had several unique aspects. The first was that the prospector had to reject many previous notions about where silver could and could not be found. As Barbee pointed out, "It is the last place a miner would ever look for mineral and yet here it is in abundance" (*Salt Lake Tribune* 8/9/1875). The second aspect was that once the source of the ore was determined, it was found to be fairly limited in scope, easy to recognize, and rarely covered by soil, snow or vegetation. Thus, the area actively prospected at Silver Reef is much less dispersed than at many other mining districts. The third aspect was that even though the source of the ore was well known, the amount of

silver present in it was variable, and, unlike hard rock ores, could not be adequately evaluated by visual means. Potential ores had to be stockpiled until they could be adequately assayed, an expensive burden for many small mine owners.

Once the point of origin of the float was determined, a prospect hole or trench was dug to expose the face of the vein. Often this vein would be too thin to be profitably mined or would be nonexistent, having been totally eroded by surface elements into float. In these cases the prospect would be abandoned. Where a seemingly profitable vein existed, a rough field assay would be made. This would allow the prospector a rough appreciation of how much the silver would "go" to the ton of vein rock. If the prospector felt he had millable ore, he would stake his claim, measure the width of the vein, and, with a poll-pick, knock off a representative sample of ore from across its face for analysis by a professional assayer. At this point, some early Silver Reef prospectors ran into trouble as insulted assayers refused to test "worthless sandstone" (*Silver Reef Miner* 10/29/1878). Once he had his location notice and a professional assay in hand, the prospector had the option of working his claim or selling it.

### **Mining Claims and Patents**

The men who prospected at Silver Reef were well aware of their obligations under mining law. These rules had evolved organically through miners' meetings during the early years of California's gold rush where they were enforceable by whipping, exile or hanging. Later they were codified by law, especially the Federal Mining Act of 1872 and the Utah Mining Law of 1899. One reason early Mormon claims at Silver Reef and Pioche were often overturned is that they were based on the square Mormon land pattern rather than the traditional rectangular mining claim (Proctor and Shirts 1990:33-34).

When a discovery was located, the prospector had to post a location notice at the discovery opening, indicating the name of the lode, the date of discovery, his name, and the distance and direction of the claim. This was usually drawn on a smooth stake with a soft pencil. In addition, he was required to mark the boundaries of the claim within 30 days. For this, he needed to know the trend of the vein, which then became the centerline of the claim, usually with the discovery being near its center. For this reason, claims at Silver Reef run parallel to the reefs, following the sandstone formation. The claim could be no greater than 1500 feet in length, and could extend no further than 300 feet on each

side of the vein. Each corner had to be clearly marked, either with a stake or a tree, and although some states required the centerlines to be staked as well, this was not required in Utah. At Silver Reef most corner markers were four inch by four-inch posts with the name of the claim inscribed on the inward facing side. Rocks were piled around the base of the stake, especially where it was built on the bare sandstone face. Remnants of some of these original claim posts are still visible.

Also within thirty days of posting the location notice, the claimant had to file, for the record, a copy of the notice of location. Originally, these were filed with the elected recorder of the mining district, but after 1880, they were filed with the county recorder at St. George, twenty miles to the south. Within 90 days of filing, the claimant was required to perform fifty dollars worth of assessment work on the claim and at least one hundred dollars annually, thereafter. However, where a single person or company had claimed a group of locations, it was not necessary to perform this work on each and every claim. It was only necessary that the aggregate expenditure exceeded one hundred dollars per claim.

Once five hundred dollars in improvements had been made upon a claim, the claimant was eligible to purchase it at a cost of five dollars per acre, provided he had a plat of the property produced and that he published his intention for sixty days. In addition, there had to be evidence that a 'prudent man' could work the mine profitably. Once approved, the land was patented and transferred to private ownership. Several 'mill sites', five acre parcels of non-mineral land near, but not contiguous to the lode, were also claimed and patented at Silver Reef. One interesting contradiction in the law was that while claims could, and often did overlap, patented surface ownership could obviously have only one owner. Thus, when a mineral survey was done prior to patenting, all of the area that conflicted with earlier patents was deleted.

Patenting a mine was not without its risks. Much litigation and arguments developed from the 'apex' concept of lode ownership. Simply put, whoever located any portion of a vein or lode owned all of it, no matter whose claim he tunneled under while following it out. The trick was in locating the lode at its apex, or where it cropped out of the ground. However, this law assumed that veins are always continuous and discrete. Clearly this was not the case at Silver Reef where almost all of the claims were connected by the same formation. By showing that a small lead on an older claim connected to a prosperous, nearby mine, financial damages could be asked for.

It has been argued that prospectors generally were not miners, knew little about mining, and didn't like it. They often were loners, liked the out of doors, and after staking a claim, would immediately sell it to an established mining company. This appears to be an accurate appraisal of prospecting at Silver Reef (Harrisburg Mining District Record Book B). Often the pattern was for a prospector to sell a claim to a small mine developer soon after it was located, who would eventually patent the mine either as a speculative investment or because he thought he could actually establish a profitable operation. Many of the small operators lost their shirts in these attempts and most small mines were sold to one of the four larger corporations after the easily excavated surface ores had been removed.

### **Mine Development**

Many of the mines investigated for the East Reef project appear to have been a relatively small ones, the result of prospecting or limited surface mining. Many probably involved only one or two miners working for several weeks. Although the techniques utilized were similar to those used on small drifts within the larger mines, less technologically advanced and capital intensive equipment was used. Generally, for small mines, the work was done in the quickest and cheapest way possible, even if this meant that some of the work would be unavailable for future use. If millable, ore could be reached quickly, the mine could be sold or outside investors could be brought in. If not, the mine would be abandoned.

Opening a lode could be accomplished either by digging a vertical shaft, a horizontal adit or an incline. Inclines were preferred in the Silver Reef District where the silver-bearing formation was exposed in a thin band at the top of the hogbacks. As these were excavated, short, vertical shafts were dug through the overlying rock for access ventilation and spoil removal. In some areas, as large expanses were excavated out or "stoped", whole portions of the reef were undermined. Despite propping with pine logs, these areas occasionally collapsed. At the base of the reefs, the silver-bearing formations continued to descend at an angle, underneath the deeply deposited soils along Barbee Gulch and Leeds Creek and, at East Reef, along Grapevine Wash. The better-capitalized operations were able to excavate deep shafts into the soil at these locations to expand their workings and remove spoil more efficiently. For shafts dug to a depth of 8 feet or less, spoil or ore could be shoveled out by hand; between 8 and 100 feet, a hand windlass could be used, but deeper than that, a horse whim or head frame was required. Traditionally, the granular spoil

excavated from vertical shafts on steep hillsides was merely dumped down the slope. However, the tabular nature of the sandstone spoil at Silver Reef allowed much of it to be used as a building material. The resulting retaining walls, roads, platforms and buildings surrounding these shafts are a unique aspect of the Silver Reef landscape.

Many of the tunnels or drifts identified during this project appear to have been only the minimum size necessary for a man to work. If an ore body of any value had been followed, the tunnels would have presumably been expanded. Progress through the tunnel was accomplished by making a series of drill holes in the face of the rock, filling them with dynamite and blasting out a section. Holes were drilled by striking the 'steels' with an eight pound jack if two men were working together (double jacking) or a four pound jack if single jacking. Shooting the face was originally done with black powder or Du Pont 'soda powder', but probably by the time the first mines were being developed at Silver Reef, dynamite, blasting caps and Bickford fuse were readily available. Once the face was blasted and the dust had settled, the resulting rubble was mucked out. Where hard rock mining was done elsewhere in Utah, these blasting episodes would remove approximately two feet of rock at a time. Clearly, in the softer sandstone blasting would have advanced much more quickly. However, Barbee's claim that a miner could pick out silver ore as "easily as a farmer digging potatoes" (*Salt Lake Tribune* 8/18/1875) was obviously an exaggeration.

Tunnels could be driven in a variety of directions. An incline was somewhere between a vertical shaft and a horizontal tunnel, a winze connected two levels and a crosscut went perpendicular to the main shaft. At Silver Reef, shafts through unconsolidated fill were supported by 8 inch-square Oregon fir timbers with 2 by 12s used for lagging. For those on a tight budget, local pine posts from the nearby Pine Valley Mountains and juniper boles were substituted. Candles, and later, carbide lights were used for illumination. The mostly dry workings and comfortable surface temperature found at Silver Reef probably greatly reduced the high tuberculosis rate found at other western mining camps.

### **Mining Companies**

As mining became more difficult at Silver Reef, and profits decreased, most of the small mine owners sold out to large, well-capitalized corporations. Eventually, just four large companies came to dominate mining in the district.



The Christy Mining and Milling Company was incorporated in 1877 with a capital stock of \$6,000,000, mostly from San Francisco investors. The company quickly bought up the Tecumseh, the Chloride Chief, the Silver Crown, the Silver Point, and the Silver Flat Mines, as well as water rights and a number of lots in Bonanza City (*Silver Reef Miner* 5/12/1887). Later, they would purchase the California, Maggie, and Manhattan mines and build a five-stamp mill southeast of town.

The privately owned Christy Company was by far the most successful mining company at Silver Reef, running more or less continuously until 1888. Their mill processed about forty tons of ore a day, producing one silver brick, worth approximately \$2,000, every two days. During this period the company employed an average of forty miners and twenty mill workers for a total monthly payroll of approximately \$8,000 (*Salt Lake Tribune* 1/1/1879).

The Stormont Silver Mining Company of New York was incorporated in 1879 with a capital stock of \$1,500,000. Initially, the company bought the Stormont Mill; a ten-stamp waterpower operated mill on the Virgin River, near the south end of East Reef. This had originally been called the Goss Mill and the small community of Babylon, consisting of 20 families was spread out around it. This large mill provided the greatest capacity to mill ore of any in the district, but the added costs of freighting the ore to the mill offset this advantage. An aerial tramway was planned but never constructed. Mines owned by the Stormont Company included the Stormont, the Buckeye, the Thompson and McNally, the Last Chance and the Savage. It is interesting that the Stormont Company never owned any of the adjacent mines on East Reef. Following the strike in 1881, the company ran into financial difficulty, and, although it continued production in a limited manner until 1887, it never really recovered (Stucki 1966:119-120).

The Barbee and Walker Mining and Milling Company was incorporated in 1879 and capitalized from New York for \$1,000,000. The company purchased the Barbee claims at the north end of White Reef, the adjacent five-stamp, steam-powered mill, and water rights from William Barbee and his partner (*Silver Reef Miner* 9/24/1879). For a while the company did very well and was known for its high-tech approach to mining. A telephone system was installed in the mine and compressed-air drills were utilized, both novelties at Silver Reef. The company continued to profit and pay out

dividends for a while after incorporation, but dwindling ores and labor strikes reduced their profit margin. By December 1882, high-grade ores on their claims were exhausted. Unable to pay its debts, the company's property was sold at a marshal's sale (*Silver Reef Miner* 12/30/1882).

The Leeds Mining Company was organized in 1877 by San Francisco investors and its property included the Stonewall Jackson and St. Johns claims in the middle portion of White Reef. In addition, the company hauled the ten-stamp Maggie Mill from Pioche and erected it on the bank of Leeds Creek. Throughout its operation, the Leeds Company was plagued by an unreliable mill that continued to break down and by high concentrations of copper in the ore that hindered milling operations. Although the company identified several valuable ledges of ore, they were unable to mill it successfully. By 1882, the company was bankrupt and was sold at a marshal's auction (Proctor and Shirts 1990:171-175).

## EVALUATION CRITERIA

The Silver Reef Mining District is a significant resource for several reasons. First, it was an extremely important mining center which produced more than eight and one half million dollars of silver in slightly less than ten years. Second, as a market for produce and as a source of wage labor, it greatly affected the economies of southern Utah, aiding the development of St. George, Leeds, and other Mormon communities. Third, and most important, it is the only place in the world where precious metals have been successfully extracted from sandstone. This is not just a geological oddity. Miners working in steep or inhospitable terrain face two difficult problems: disposing of spoil and providing access and level areas for working. The ability to use the spoil and overburden from the mining process as props, retaining walls, roads and building blocks has created a unique mining landscape at Silver Reef.

Clearly not all features identified contribute equally to the landscape. Many are extremely small mine workings not associated spatially with others. This characterizes many of the mines in the East Reef project area. Others are more recent, dating to the 1950's through 1960's uranium boom. Still others may be old but have been heavily damaged by more recent heavy equipment activities.

For this reason, each of the 261 mine openings considered for closure or possible closure was evaluated on the basis of its contribution to the overall Silver Reef mining landscape. These were assigned to either category I, II, or III, based on cultural sensitivity, with category III being the most significant. Age was considered in assigning rankings, with features dating from the 1870s to 1890s era given greater weight than those features dating from either the 1920s era or the 1950s to 1960s era. However, aspects of a feature that were not visible or were inaccessible were not considered when assigning rankings. For example, a deep mine with many underground workings would be assigned the same sensitivity as a shallow mine if the surface manifestation and contribution to the overall landscape were similar.

Sensitivity rankings were assigned based on the following criteria:

**Category I** Features included in category I singularly contribute the least to the Silver Reef mining landscape. These include subsidence areas and adits or shafts that possess no cultural elements other than the opening itself and its associated spoil. If artifacts were found associated with such openings, but by themselves would have been considered an isolate rather than a site (i.e. a nail, a few scraps of lumber), the opening was assigned to category I. 224 openings, or 86% of the total, were assigned to category I. Category I sites by themselves were not recorded on IMACS forms and were not assigned site numbers. While singularly unimpressive, *in toto*, category I features form the major part of the Silver Reef District landscape.

**Category II** Features included in category II contribute additionally to the Silver Reef landscape by virtue of their associated cultural features. These mostly include mine openings with associated spoil pile retaining walls, stone or wood shaft collars, notches utilized to support head frames, timbers or debris on the interior, and small loading platforms, machinery mounts or sorting areas. In addition, mines exhibiting scatters of mining debris, ash or clinkers, or domestic artifacts were included in category II. For the most part, these features contribute little under criteria "d", but make up an important part of the Reef's visual landscape and help tell the Silver Reef 'story'. All category II sites were recorded as part of archaeological sites. 29 mines, or 12% of the total were assigned to category II.

**Category III** These are mine openings identified as having special qualities and therefore were singled out for particular mitigation efforts to preserve these qualities. These often include massive

or well-built retaining walls, standing headframes or other structures, or obviously associated mine administrative or residential buildings. Only eight mines, or 3% of the total are included in category III.

### **Non-Mine Features**

Very few cultural resources were identified within the project area that did not appear to be directly mining-related. Most were either prehistoric artifact scatters or residences, probably, but not necessarily, associated with mining activities. These features were described on the IMACS forms and recorded on the site maps if they were identified within a recorded archaeological site. Two prehistoric components and eleven structures were recorded in this way.

In addition to these features, several stone fences and corrals were mapped which were clearly designed for holding livestock. Although these may date to the period of the silver boom, most appear to be more recent, having been partially constructed from material salvaged from abandoned miners' residences. Several of these are small and appear to have held sheep rather than horses and so probably date to the period around World War I when a sheep industry flourished in southwestern Utah. Most of these features are located on the west flank of Leeds Hill.

### **Artifact Scatters**

Like most industrial sites that have seen heavy use, artifacts are ubiquitous across the project area, and mostly consist of debris associated with mining. These include fragments of milled timber, pieces of cable, hardware, pane glass, and fragments of iron, usually too small to identify. However, with the exception of, drills, shovels and powder cans, the artifact assemblage is not especially evocative of an active mining environment and can not compare to the amount of debris identified on Silver Reef proper. Other features consist of scatters of wood ash, clinkers, or sorted ore that are associated with specific mines.

Artifact assemblages are much different at the domestic sites identified within the project area and include bottle fragments, hole-in-cap cans, nails and bits of hardware and wood. Only a few very small domestic scatters were identified during the East Reef project area survey, in contrast to the Silver Reef project area, which included many domestic sites.

## SITE DESIGNATION

One hundred and sixty-four of the total 261 mine openings were included within four separate archaeological sites. These are included as Appendix 2. The 97 additional mines not included as sites were all assigned to category I. All are small and many appear to be less than 50 years old, dating to the uranium exploration period. These are listed on Table 1.

One hundred and nine openings, nine structures and two prehistoric artifact scatters were included as site **42Ws2905** which makes up most of East Reef proper. This site is recommended as eligible for listing on the National Register of Historic Places on the basis of criteria “a”, “c”, and “d”. While much smaller and less complex, 42Ws2905 is similar in appearance and feel to the main area of Silver Reef to the west which was previously identified as a Historic Mining Landscape.

**42Ws2903** includes 25 mine openings and two structures on a small isolated reef north of East Reef. This site is recommended as eligible for listing on the National Register under criteria “a” and “d”.

**42Ws2395** was previously recorded as part of the Interstate-15 survey and determined to be eligible for the NRHP under criteria “a” and “c” and “d”. It includes 27 mine openings as well as rock fences, wagon roads, sandstone quarries and some trash scatters. It encompasses most of Leeds Hill and includes some trash scatters and features that are clearly agricultural or residential rather than mining-related. A new IMACS form was not filled out for this site but an addendum and GPS-formulated site map are included in Appendices 2 and 3. We concur with this eligibility recommendation.

**42Ws3167** is a small site, including just three mine openings planned for closure: 3411308 IO2, -VO1, and -VO2. This site also includes approximately 18 prehistoric lithic flakes, apparently limited to the surface. This site was determined to be ineligible for listing on the NRHP in 1997, a determination we concur with. Since this site is small and was adequately recorded, we have not re-recorded or amended it.

# East Reef Mine Openings Not Recorded as Part of Archaeological Sites

| Tag No      | Twp Rge |    |     | USGS Quad | UTM Coord (GPS) |           | Land Status | Opening Dimensions |       |       | Proposed Reclamation                            |
|-------------|---------|----|-----|-----------|-----------------|-----------|-------------|--------------------|-------|-------|---|
|             | S       | W  | Sec |           | Northing        | Easting   |             | height             | width | depth |   |
| 3411305HC1  | 41      | 13 | 5   | Hurr.     | 4124333.593     | 291771.06 | Private     | 0                  | 0     | 0     | none  |
| 3411305PT1  | 41      | 13 | 5   | Hurr.     | 4124467.261     | 292529.7  | Private     | --                 | --    | --    | --  |
| 3411307HO1  | 41      | 13 | 7   | Hurr.     | 4124088.131     | 291679.28 | Private     | 7.5                | 6.5   | 15+   | bfb   |
| 3411307HO2  | 41      | 13 | 7   | Hurr.     | 4124177.533     | 291492.41 | Private     | 3.5                | 7     | 20+   | bfb 10 cy; wall 4x6                             |
| 3411307HO3  | 41      | 13 | 7   | Hurr.     | 4124190.357     | 291496.92 | Private     | 5                  | 5     | 15    | bfb 4 cy  |
| 3411307HO14 | 41      | 13 | 7   | Hurr.     | 4123840.545     | 290543.01 | Private     | 1                  | 4     | unk   | bfb 1 cy  |
| 3411307HO15 | 41      | 13 | 7   | Hurr.     | 4124032.834     | 290881.39 | Private     | 3                  | 3     | unk   | bfb 10 cy                                       |
| 3411307HO16 | 41      | 13 | 7   | Hurr.     | 4124031.965     | 290905.07 | Private     | 2                  | 1.5   | 5     | bfb 1 cy or none                                |
| 3411307HO19 | 41      | 13 | 7   | Hurr.     | 4124125.133     | 291438.83 | Private     | 5                  | 4     | 30+   | wall or gate 5h x 4w                            |
| 3411307VO2  | 41      | 13 | 7   | Hurr.     | 4124052.764     | 290904.82 | Private     | 6                  | 4     | 25    | bfb 25 cy                                       |
| 3411307HC2  | 41      | 13 | 7   | Hurr.     | 4124034.597     | 290910.26 | Private     | --                 | --    | --    | none  |
| 3411307VC6  | 41      | 13 | 7   | Hurr.     | 4124003.36      | 290836.32 | Private     | 10                 | 10    | 3     | none?   |
| 3411307VC7  | 41      | 13 | 7   | Hurr.     | 4124042.36      | 290856.23 | Private     | 6                  | 6     | 2     | none  |
| 3411307VC8  | 41      | 13 | 7   | Hurr.     | --              | --        | Private     | 10                 | 10    | 5     | none  |
| 3411307P1   | 41      | 13 | 7   | Hurr.     | 4124094.341     | 291680.15 | Private     | --                 | --    | --    | --  |
| 3411307P2   | 41      | 13 | 7   | Hurr.     | 4124229.663     | 291603.21 | Private     | --                 | --    | --    | --  |
| 3411307P3   | 41      | 13 | 7   | Hurr.     | 4124152.476     | 291617.41 | Private     | --                 | --    | --    | --  |
| 3411307P8   | 41      | 13 | 7   | Hurr.     | 4124054.413     | 290921.64 | Private     | --                 | --    | --    | --  |
| 3411307P9   | 41      | 13 | 7   | Hurr.     | 4123741.078     | 290551.33 | Private     | 4                  | 5.5   | 8     | --  |
| 3411307P10  | 41      | 13 | 7   | Hurr.     | --              | --        | Private     | --                 | --    | --    | --  |
| 3411307P11  | 41      | 13 | 7   | Hurr.     | --              | --        | Private     | --                 | --    | --    | --  |
| 3411308HO1  | 41      | 13 | 8   | Hurr.     | 4123240.634     | 292759.60 | Private     | 5                  | 5     | 20    | wall 5'h x 5'w, bf 15 cy, gate iffy- check ribs |
| 3411308HO2  | 41      | 13 | 8   | Hurr.     | 4123142.632     | 292705.48 | Private     | 5                  | 6     | unk   | bfb   |
| 3411308HO3  | 41      | 13 | 8   | Hurr.     | 4123122.219     | 292703.41 | Private     | 8                  | 6     | 40    | wall 8h x6w                                     |
| 3411308HO4  | 41      | 13 | 8   | Hurr.     | 4124208.401     | 292344.52 |             | 5                  | 4     | 20+   | bfb 10cy  |
| 3411308HO5  | 41      | 13 | 8   | Hurr.     | 4124305.22      | 291773.02 | BLM         | 5.5                | 4.5   | 30+   | wall or bf                                      |
| 3411308HO6  | 41      | 13 | 8   | Hurr.     | 4124254.462     | 291792.07 | --          | --                 | --    | --    | --  |
| 3411308HO7  | 41      | 13 | 8   | Hurr.     | 4124170.237     | 291792.27 | --          | --                 | --    | --    | --  |
| 3411308HO8  | 41      | 13 | 8   | Hurr.     | 4124013.71      | 291769.37 | --          | --                 | --    | --    | --  |
| 3411308HO9  | 41      | 13 | 8   | Hurr.     | 4123343.956     | 292474.85 | BLM         | 5                  | 5     | 8     | bf 8cy  |
| 3411308HO10 | 41      | 13 | 8   | Hurr.     | 4123157.77      | 292583.30 | BLM         | 4                  | 7     | 50+   | --  |
| 3411308HO11 | 41      | 13 | 8   | Hurr.     | 4123244.346     | 292417.64 | BLM         | 5                  | 10    | 15    | bfb 25 cy                                       |
| 3411308HO12 | 41      | 13 | 8   | Hurr.     | 4123262.927     | 292419.28 | BLM         | 3.5                | 5.5   | 5     | bfb 4 cy or none?                               |
| 3411308HO13 | 41      | 13 | 8   | Hurr.     | 4123271.387     | 292426.76 | BLM         | 5                  | 6     | 40+   | bfb or gate                                     |
| 3411308HO14 | 41      | 13 | 8   | Hurr.     | 4123365.758     | 292625.67 | BLM         | 5.5                | 5     | 8     | bfb 10 cy                                       |
| 3411308HO15 | 41      | 13 | 8   | Hurr.     | 4123374.376     | 292280.21 | BLM         | 1                  | 8     | 8+    | bfb 1 cy  |
| 3411308HO16 | 41      | 13 | 8   | Hurr.     | 4123063.85      | 292111.58 | --          | 1.5                | 4     | 15+   | bfb 25 cy; muck out existing fill               |
| 3411308HO17 | 41      | 13 | 8   | Hurr.     | 4123056.28      | 292144.02 | --          | 4                  | 8     | 17    | bfb 20 cy                                       |
| 3411308IO1  | 41      | 13 | 8   | Hurr.     | 4123021.849     | 292568.45 | BLM         | 4.5                | 4     | 30+   | bfb, wall, gate                                 |
| 3411308IO3  | 41      | 13 | 8   | Hurr.     | 4123243.815     | 292404.73 | BLM         | 10                 | 12    | 30+   | bfb or gate                                     |
| 3411308IO4  | 41      | 13 | 8   | Hurr.     | 4122875.89      | 292634.67 | --          | 3                  | 9     | 10    | bfb 7 cy or none                                |
| 3411308IO5  | 41      | 13 | 8   | Hurr.     | 4123076.19      | 292089.9  | --          | 4                  | 6     | 25    | wall/gate 5'h x 6'w at 4'd; bfb or bfb          |
| 3411308VO3  | 41      | 13 | 8   | Hurr.     | 4124016.078     | 291970.98 | BLM         | 6                  | 4     | ~60   | bf or grate                                     |

# East Reef Mine Openings Not Recorded as Part of Archaeological Sites

|             |    |    |    |            |             |           |         |     |    |      |                                       |
|-------------|----|----|----|------------|-------------|-----------|---------|-----|----|------|---------------------------------------|
| 3411308VO4  | 41 | 13 | 8  | Hurr.      | 4124346.473 | 292387.09 | Private | 6   | 6  | 30   | bfm 40 cy, 6x6 pin grate              |
| 3411308VO5  | 41 | 13 | 8  | Hurr.      | 4123277.225 | 292565.32 | BLM     | 8   | 6  | ~125 | bfm 225 cy, 6x8 pin grate             |
| 3411308VO6  | 41 | 13 | 8  | Hurr.      | 4123186.15  | 292131.19 | --      | 11  | 11 | 11   | bfh 35 cy                             |
| 3411308P1   | 41 | 13 | 8  | Hurr.      | 4123231.682 | 292765.36 | --      | --  | -- | --   | --                                    |
| 3411308P2   | 41 | 13 | 8  | Hurr.      | 4123197.392 | 292739.94 | --      | --  | -- | --   | --                                    |
| 3411308P3   | 41 | 13 | 8  | Hurr.      | 4123028.734 | 292582.09 | --      | --  | -- | --   | --                                    |
| 3411308P4   | 41 | 13 | 8  | Hurr.      | 4123019.561 | 292576.35 | --      | --  | -- | --   | --                                    |
| 3411308P5   | 41 | 13 | 8  | Hurr.      | 4123012.275 | 292564.78 | --      | --  | -- | --   | --                                    |
| 3411308P6   | 41 | 13 | 8  | Hurr.      | 4123522.705 | 292787.19 | --      | --  | -- | --   | --                                    |
| 3411308P7   | 41 | 13 | 8  | Hurr.      | 4123940.173 | 292671.30 | --      | --  | -- | --   | --                                    |
| 3411308P8   | 41 | 13 | 8  | Hurr.      | 4124037.92  | 291912.71 | BLM     | 6   | 6  | 1    | none                                  |
| 3411308P9   | 41 | 13 | 8  | Hurr.      | 4124157.366 | 292142.03 | --      | --  | -- | --   | --                                    |
| 3411308P10  | 41 | 13 | 8  | Hurr.      | 4123997.022 | 291812.06 | --      | --  | -- | --   | --                                    |
| 3411308P11  | 41 | 13 | 8  | Hurr.      | 4124034.799 | 291834.01 | --      | --  | -- | --   | --                                    |
| 3411308P12  | 41 | 13 | 8  | Hurr.      | 4124086.695 | 291825.66 | --      | --  | -- | --   | --                                    |
| 3411308P13  | 41 | 13 | 8  | Hurr.      | 4124274.072 | 291778.09 | --      | --  | -- | --   | --                                    |
| 3411308P14  | 41 | 13 | 8  | Hurr.      | 4124261.002 | 291791.67 | --      | --  | -- | --   | --                                    |
| 3411308P15  | 41 | 13 | 8  | Hurr.      | 4124020.238 | 291768.68 | --      | --  | -- | --   | --                                    |
| 3411308P16  | 41 | 13 | 8  | Hurr.      | 4124002.934 | 291762.69 | --      | --  | -- | --   | --                                    |
| 3411308P17  | 41 | 13 | 8  | Hurr.      | 4123345.191 | 292248.13 | --      | --  | -- | --   | --                                    |
| 3411308P18  | 41 | 13 | 8  | Hurr.      | 4124077.568 | 292008.86 | BLM     | 15  | 8  | 2    | none                                  |
| 3411308P19  | 41 | 13 | 8  | Hurr.      | 4123936.094 | 291888.86 | --      | 20  | 20 | 3    | none                                  |
| 3411308HC1  | 41 | 13 | 8  | Hurr.      | 4123234.638 | 292406.09 | BLM     | 2.5 | 4  |      | none                                  |
| 3411308HC2  | 41 | 13 | 8  | Hurr.      | 4123339.272 | 292628.88 | BLM     | 0   | 0  | 0    | none                                  |
| 3411308HC3  | 41 | 13 | 8  | Hurr.      | 4123381.397 | 292281.95 | BLM     | 0   | 0  | 0    | none                                  |
| 3411308HC4  | 41 | 13 | 8  | Hurr.      | 4123389.881 | 292281.06 | BLM     | 0   | 0  | 0    | none                                  |
| 3411308HC5  | 41 | 13 | 8  | Hurr.      | 4123093.94  | 292086.61 | --      | 0   | 0  | 0    | bfh 5 cy                              |
| 3411308VC1  | 41 | 13 | 8  | Hurr.      | 4124077.582 | 291994.77 | --      | 10  | 10 | 5    | bfm 20 cy, none                       |
| 3411317HO14 | 41 | 13 | 17 | Hurr.      | 4122473.16  | 292573.7  | BLM     | 5   | 5  | 30+  | wall/gate 5'h x 5'w; bfh              |
| 3411317IO2  | 41 | 13 | 17 | Hurr.      | 4121134.54  | 292742.24 | BLM     | 5.5 | 8  | 18   | bfh or bfm 20 cy; wall/gate 5'h x 5'w |
| 3411317VO3  | 41 | 13 | 17 | Hurr.      | 4121064.01  | 292752.95 | BLM     | 14  | 8  | 10   | bfm 30 cy                             |
| 3411317P4   | 41 | 13 | 17 | Hurr.      | 4121135.25  | 292787.1  | BLM     | 0   | 0  | 0    | none                                  |
| 3411317P5   | 41 | 13 | 17 | Hurr.      | 4121662.33  | 292613.68 | BLM     | 0   | 0  | 0    | none                                  |
| 3411317VC2  | 41 | 13 | 17 | Hurr.      | 4121080.87  | 292727.7  | BLM     | 6   | 4  | 1    | none or probe (hand or equip)         |
| 3411320HO7  | 41 | 13 | 20 | Hurr.      | 4120971.69  | 292576.29 | BLM     | 2.5 | 5  | 9    | bfh or bfm 3 cy or none               |
| 3411320P4   | 41 | 13 | 20 | Hurr.      | 4120978.87  | 292595.8  | BLM     | 0   | 0  | 0    | none                                  |
| 3411320PT1  | 41 | 13 | 20 | Hurr.      | 4120932.72  | 292619.69 | BLM     | 0   | 0  | 0    | none or bfm/regrade                   |
| 3411320PT2  | 41 | 13 | 20 | Hurr.      | 4120763.82  | 292406.45 | BLM     | 0   | 0  | 0    | none or bfm/regrade                   |
| 3411320PT3  | 41 | 13 | 20 | Hurr.      | 4120722.18  | 292427.49 | BLM     | 0   | 0  | 0    | none or bfm/regrade                   |
| 3411414IO1  | 41 | 14 | 14 | Harr. Jct. | --          | --        | Private | 4   | 6  | 5    | bfh 13 cy                             |
| 3411414IO2  | 41 | 14 | 14 | Harr. Jct. | --          | --        | BLM     | 6   | 6  | 50+  | gate/wall 6'h 6'w (or bfm)            |
| 3411414IO3  | 41 | 14 | 14 | Harr. Jct. | --          | --        | BLM     | 3   | 7  | 16   | bfh 15 cy                             |
| 3411414VO1  | 41 | 14 | 14 | Harr. Jct. | --          | --        | Private | 5   | 7  | 30   | bfh 40 cy or pin grate 6' x 7'        |
| 3411414P1   | 41 | 14 | 14 | Harr. Jct. | --          | --        | Private | 6   | 7  | 3    | none                                  |

# East Reef Mine Openings Not Recorded as Part of Archaeological Sites

|            |    |    |    |            |    |    |         |    |    |     |                               |
|------------|----|----|----|------------|----|----|---------|----|----|-----|-------------------------------|
| 3411422IO1 | 41 | 14 | 22 | Harr. Jct. | -- | -- | Private | 5  | 18 | 80+ | gate 5'h x 8'w at 12'd or bfm |
| 3411422IO2 | 41 | 14 | 22 | Harr. Jct. | -- | -- | Private | 3  | 5  | 10  | bfh 5 cy or none              |
| 3411422IO3 | 41 | 14 | 22 | Harr. Jct. | -- | -- | Private | 5  | 6  | 14  | bfh 20 cy                     |
| 3411422P1  | 41 | 14 | 22 | Harr. Jct. | -- | -- | Private | -- | -- | --  | none                          |
| 3411422P2  | 41 | 14 | 22 | Harr. Jct. | -- | -- | Private | -- | -- | --  | none                          |
| 3411422VC1 | 41 | 14 | 22 | Harr. Jct. | -- | -- | Private | -- | -- | --  | bfh 1 cy or none              |
| 3411423IO1 | 41 | 14 | 23 | Harr. Jct. | -- | -- | Private | 5  | 5  | 14  | bfh 13 cy                     |
| 3411423P1  | 41 | 14 | 23 | Harr. Jct. | -- | -- | BLM     | -- | -- | --  | none                          |
| 3411423P2  | 41 | 14 | 23 | Harr. Jct. | -- | -- | Private | 10 | 25 | 3   | none                          |
| 3411423PT1 | 41 | 14 | 23 | Harr. Jct. | -- | -- | BLM     | -- | -- | --  | none                          |



## **ASSESSMENT OF IMPACTS AND EFFECT RECOMMENDATIONS**

Abandoned mines can be closed in a variety of ways. Relatively shallow shafts are usually just backfilled with adjacent spoil or fill brought in from elsewhere. This can be done with power equipment (bfe) or, more commonly, using hand tools (bfh). Deep shafts can be plugged with rock, concrete, concrete foam, or polyurethane foam. Any of these plugs can then be covered with soil to provide a more natural appearance. In addition, plugs can be recessed into the shaft to preserve its appearance and allow collars, cribbing, etc., to be observed.

Adits are often sealed with a concrete or soil plug, or a bulkhead is constructed of either masonry or native stone. Occasionally, the portal is blasted with explosives or merely crushed and pulled down using heavy equipment. Permanently closing adits has proven a challenge to mining engineers, as persistent explorers are constantly reopening popular mines. Generally, the most culturally sensitive closure is a bulkhead constructed of natural stone and recessed several feet into the tunnel so that a shadow, and thereby the perception of depth, is produced. If necessary, grated windows can be built into the bulkhead so the inside can be viewed or so that bats can continue to use the interior. Such bulkheads are expensive but effective where a viewing public can easily see them.

Closure methods have been recommended for each of the mines at Silver Reef that are considered a serious hazard. These are listed on the tables included in the IMACS forms or addendum for the three eligible sites. No special protection measures are recommended for category I features, except that: 1) shafts be backfilled flush to the ground so that after settling, small depressions will allow the shaft's location to be recognized; and 2) significant features in the vicinity not be adversely impacted by the closure.

Several generic protection measures are recommended for category II features. Where only artifact or debris scatters are present, or where structural material in the mine is extremely rotted or displaced, no specific protection measures are recommended. Where walls, loading platforms, roads, machinery mounts or other features are present, these should be flagged or barricaded and the closure activities monitored. Where collars, cribbing or notches are present at the top of shafts, it is recommended that the fill be recessed at least 2 feet, and the immediate surface be cleared of excess fill. In all cases, fill will be removed from spoil piles in such a way that the pile's shape is not radically altered or subject to severe erosion.

Each of the category III mine openings have feature-specific protection measures. For the most part, these are similar to the protection measures listed for category II except that some large adits adjacent to roads are recommended for recessed bulkheads and more intensive monitoring is recommended. The overall purpose of these recommendations is to assure that while mine hazards are reduced or eliminated, the unique 1880s Silver Reef mining landscape is preserved, and not transformed into a 1990s reclamation landscape.

We recommend that there will be “no effect” to the 97 mine openings not included as parts of archaeological sites or to the three mine openings included in the NRHP-ineligible site 42Ws3167. We recommend that there will be “no adverse effect” to the three eligible sites, 42Ws2395, -2903, and -2905, as a result of this action since mitigation measures have been designed to protect the qualities that make the sites eligible.

## REFERENCES

- Arrington, Leonard  
1960 *Great Basin Kingdom*. University of Nebraska Press.
- Balch, William Ralston  
1882 *The Mines, Miners and Mining Interests of the United States in 1882*. The Mining Industrial Publishing Bureau, Philadelphia. pp. 224-227.
- Barker, Leo R. and E. Huston  
1990 *Death Valley to Deadwood; Kennecott to Cripple Creek*. Proceedings of the Historic Mining Conference, January 23-27, 1989, Death Valley National Monument.
- Bassett, Everett J  
1994 *Silver Reef Abandoned Mines Cultural Survey*. Prepared for the Utah Division of Oil, Gas and Mining by Dames & Moore, Salt Lake City, Utah.
- Bleak, James G.  
n. d. *Annals of the Southern Utah Mission*. Manuscript on file, Washington County Library, St. George, Utah.
- Brown, Ronald C.  
1979 *Hard-Rock Miners: The Intermountain West, 1860-1920*. Texas A & M University Press. College Station and London.
- Browne, Jeanne (editor)  
1992 *The Restless Longing: A Prospector's Story*. Dakota Books. Vermillion.
- Copp, Henry N.  
1908 *Manual For The Use of Prospectors On The Mineral Lands Of The United States*. Washington, D.C.
- Cox, S. Herbert  
1918 *Prospecting For Minerals*. Charles Griffin & Company, Limited. London.
- Francaviglia, Richard V.  
1991 *Hard Places: Reading the Landscape of America's Historic Mining Districts*. University of Iowa Press. Iowa City.
- Gunther, C. Godfrey  
1932 *The Examination of Prospects*. McGraw-Hill Book Company. New York and London.
- Hardesty, Donald L.  
1990 Evaluating Site Significance in Historical Mining Districts. *Historical Archaeology*, 24(2):42-51.

- Keane, Melissa and A.E. Rogge  
1992 *Gold and Silver Mining in Arizona, 1845-1945*. Dames & Moore, Phoenix.
- King, Joseph E.  
1977 *A Mine to Make a Mine: Financing the Colorado Mining Industry, 1859-1902*. Texas A&M University Press. College Station and London.
- Mariger, Marietta M.  
n.d. *Saga of Three Towns - Harrisburg, Leeds, Silver Reef*. Washington County News, St. George, Utah.
- Noble Bruce J. and Robert Spude  
1992 Guidelines for Identifying, Evaluating and Registering Historic Mining Properties. *National Register Bulletin 42*, U.S. Department of the Interior, National Park Service, Washington, D.C.
- Pearl, Richard M.  
1973 *Handbook for Prospectors*. McGraw-Hill Book Company. New York.
- Pendleton, Mark  
1930 Memories of Silver Reef. *Utah Historical Quarterly*, vol. 3, no. 4.
- Proctor, Paul Dean  
1953 Geology of Silver Reef (Harrisburg) Mining District, Washington County, Utah. *Bulletin 44*, Utah Geological and Mineralogical Survey.
- Proctor, Paul Dean and Willis H. Brimhall  
1986 *Silver Reef Mining District Revisited*. Brigham Young University and the Utah Geological Association Publication No. 14.
- Proctor, Paul Dean and Morris A. Shirts  
1991 *Silver Sinner & Saints: A History of Old Silver Reef, Utah*. Paulmar Inc.
- Rolker, C. M.  
1881 The Silver Sandstone District of Utah. *A.I.M.E Trans.* vol. 9, pp. 21-33.
- South Dakota State Historical Society  
1987 *Proceedings of the Workshop on Historic Mining Resources: Defining the Research Questions for Evaluation and Preservation*. State Historical Preservation Center, South Dakota State Historical Society.
- Stucki, Alfred Bleak  
1966 *Historical Study of Silver Reef, Southern Utah Mining Town*. M.A. Thesis, Brigham Young University.
- von Bernewitz, Max W.  
1938 *Handbook for Prospectors and Operators of Small Mines*. Washington D.C.

Young, Otis E., Jr.

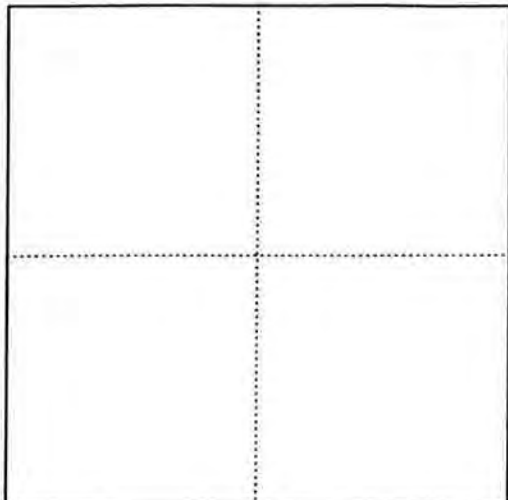
1967 *How They Dug The Gold*. Arizona Pioneers' Historical Society. Tucson.

1970 *Western Mining*. University of Oklahoma Press. Norman.

*APPENDIX 1*

*SAMPLE AMR INVENTORY SITE FORM*

Indicate location of site in section:

Tag Number 3411330 IO 11

Site Name \_\_\_\_\_

USGS 7½' Quad HurricaneUSGS 7½' Quad Code (7 character) 37113-27Township 41 N (S) Range 13 E (W)Section 30: \_\_\_\_\_ ¼ \_\_\_\_\_ ¼ \_\_\_\_\_ ¼County WashingtonCommodity Silver (Ag)Claim Name Maund

CRIB Number \_\_\_\_\_

Watershed Virgin River - 15010008

GPS File Number \_\_\_\_\_

Location/Access Directions: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Site Description: large IO with substantial cultural interest, part of major mining complex.

\_\_\_\_\_

\_\_\_\_\_

## Features Present (count):

☐ Adit (Horizontal)  
☒ Adit (Inclined)  
☐ Shaft (Vertical)  
☐ Subsidence  
☐ Caved Adit  
☐ Prospect  
☐ Trench

☐ Open Pit/Surface Mining  
☐ Highwall  
☒ Structures Wells  
☐ Machinery/Equipment  
☐ Explosives  
☐ Hazardous Materials  
☒ Mine Dump/Tailings

☐ Mill Tailings  
☐ Unstable Slope/Slide  
☐ Minewater Discharge  
☐ Impoundment  
☐ Water Quality Problems  
☐ Other Land Disturbance  
☐ Severe Erosion/Gullyng

## Site Access (check all that apply):

☒ no established trail (xc traverse)  
☐ foot trail (single track)  
☐ ATV/motorcycle  
☐ 4-WD road  
☐ 2-WD dirt road

☐ paved road  
☐ rubber-tired backhoe  
☐ crawler (track) equipment  
☐ helicopter  
☐ wilderness restrictions

Overall Site Dimensions: \_\_\_\_\_ feet x \_\_\_\_\_ feet Area: \_\_\_\_\_ acres

Site Visitation: ☐ low ☐ medium ☒ high Evidence: \_\_\_\_\_Inventoried by: C. Rohrer / B. Doolittle Date: 3/25/98

**FEATURE DESCRIPTION FORM**  
**MINE OPENING**

**EAST REEF PROJECT**  
AMR/053/904

Tag No: 3411330 ID 11

**CURRENT CONDITIONS:**

**Type of Opening**

- ☐ adit bearing: \_\_\_\_\_
- ☒ incline bearing: 135° slope ~2:1
- ☐ shaft
- ☐ trench
- ☐ open pit (l and w > 20 ft; d < l or w)
- ☐ prospect (depth < 4 ft < other dimensions)

**Access to Feature (check all that apply):**

- ☒ no established trail
- ☐ foot trail
- ☐ ATV/motorcycle
- ☐ 4-WD road
- ☐ 2-WD dirt road
- ☐ paved road
- ☐ rubber-tired backhoe
- ☐ crawler (track) equipment
- ☐ helicopter
- ☐ wilderness restrictions

**Condition of Entrance:**

- ☐ Completely collapsed, no access to workings
- ☐ Partially collapsed or backfilled at portal, mine visible but not accessible
- ☐ Partially collapsed or backfilled at portal, mine workings accessible
- ☒ Portal open for access with little or no backfill or collapse
- ☐ Obstruction at opening makes evaluation of condition impossible
- ☐ Existing wall/fence/grate (circle one)
  - ☐ intact, acceptable
  - ☐ intact, unacceptable
  - ☐ damaged, mine accessible
- ☐ Shaft collar competent (rock or cribbing)
- ☐ Shaft collar sloughing
- ☐ Signs of interior visitation (litter/graffiti) present
- ☐ Other \_\_\_\_\_

**Stability of Opening/Host Rock:**

- ☐ unconsolidated soil (unstable)
- ☐ friable (unstable)
- ☐ highly jointed, fractured (unstable)
- ☐ somewhat jointed (fairly stable)
- ☐ massive (stable, competent)

Depth to Competent Rock: \_\_\_\_\_ feet

Apparent depth of workings: \_\_\_\_\_ feet

- ☐ terminus visible
- ☐ workings extend beyond visibility limits
- ☐ crosscuts, other workings visible

**Roof or collar support present:**

- ☐ none visible
- ☐ wood props/caps (occasional)
- ☐ stulls or square sets
- ☐ box cribbing (continuous wood lining)
- ☐ log/timber cribbed shaft collar
- ☐ loose rock walls or cribbing
- ☐ concrete shaft collar or adit bulkhead
- ☐ support is failing

**Water (check all that apply):**

- ☒ no water present
- ☐ dry, but appears to have occasional water
- ☐ seep/saturated soil (no flow)
- ☐ standing water in opening
- ☐ discharge flowing from opening
- ☐ discharge infiltrates w/in 50 ft of opening
- ☐ discharge flows into intermittent stream
- ☐ discharge flows into perennial stream
- ☐ water flows through/over waste rock
- ☐ water or ground surface discolored
- ☐ wetland vegetation present

**Wildlife Observations In/Near Opening:**

- ☐ bats: roosting/flying (circle)
- ☐ birds: nesting/roosting/flying (circle)
- ☐ guano/droppings/owl pellets
- ☐ mammal tracks
- ☐ herps
- ☐ none observed

**MITIGATION/DESIGN CONSIDERATIONS:**

**Potential Mitigation Actions (check all that apply):**

- ☐ Masonry Bulkhead
- ☐ Backfill
- ☐ Bulkhead & Backfill
- ☐ Bat Gate (Standard)
- ☐ Bat Gate (CMP Culvert)
- ☐ Cable Net
- ☐ Locking Adit Door
- ☐ Shaft Grate: ☐ grade beam ☐ pinned
- ☐ PUF Shaft Plug
- ☐ Blast
- ☐ Probe for mine opening (caved adit)
- ☐ Drainage Provisions Required
- ☐ Local Site Clean-up and Regrading
- ☐ Structure Demolition
- ☐ Surface Water Drainage Control
- ☐ Cultural Features Needing Protection Present
- ☐ No Action Required
- ☐ Other \_\_\_\_\_

**Onsite Construction Material Availability:**

- ☐ Stone suitable for bulkhead (w/in 100 ft)
- ☐ Backfill
- ☐ Materials not present

**Backfill Material Source:**

- ☐ mine dump
- ☐ dig or scale down from brow/adjacent slope
- ☐ blast from rock brow or adjacent rock face
- ☐ other \_\_\_\_\_

**Mine Dump Size:**

- ☐ small (<20 cubic yards)
- ☐ medium (20 - 100 cubic yards)
- ☐ large (>100 cubic yards)
- ☐ very large (>500 cubic yards)



*APPENDIX 2*  
*IMACS FORMS*

42Ws3905  
42Ws3903  
42Ws2395 (*addendum*)