D-421
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E.O. 11593

LCS #232354

DETERMINATION OF ELIGIBILITY NOTIFICATION
National Register of Historic Places
National Park Service

FINAL

Name of property: Bluebird Dam

Location: Boulder County **State:** CO

Request submitted by: DOI/NPS Jack W. Neckels

Date received: 7-18-84 **Additional information received:**

Opinion of the State Historic Preservation Officer:

☒ **Eligible** ☐ **Not Eligible** ☐ **No Response**

Comments:

The Secretary of the Interior has determined that this property is:

☒ **Eligible** **Applicable criteria:** C ☐ **Not Eligible**

Comments:

The Bluebird Dam, completed ca. 1923, is locally significant to Boulder County as an intact example of an early 20th century concrete arch dam that documents an important engineering achievement in that its completion represented an early successful solution to the logistical difficulty of high altitude dam construction in the region.

☐ **Documentation insufficient**
(Please see accompanying sheet explaining additional materials required)

Carol D. Shull
Keeper of the National Register

Date: 12-19-84

WASO-28

NAME

The National Park Service, Rocky Mountain Region, requests a Determination of Eligibility for the Bluebird Dam, Rocky Mountain National Park, Boulder County, Colorado. The original name for the dam is Arbuckle #2. Bluebird Dam, located on Ouzel Creek, 1.25 miles north of the south park boundary, and 6.75 miles west of Allens Park, Colorado, is owned by the City of Longmont, Colorado. Located in the southeast quadrangle of Rocky Mountain National Park in Section 26, T 3 N, R 74 W, it is owned by the City of Longmont. The structure was identified and inventoried in the 1977 Inventory of Colorado's Front Range Mountain Reservoir by Robert Aukerman, William Springer, and James Judge of Colorado State University, Fort Collins, Colorado.

LOCATION

Bluebird Dam, located on Ouzel Creek approximately 1.25 miles north of the south boundary, and 6.75 miles west of Allens Park, Colorado, is drained by the North St. Vrain Creek. The dam is at a mean elevation of 10,978 feet. With the exception of three dams constructed before the establishment of the park, one of which is Bluebird, the area shows little evidence of man. Access to the dam is by foot trail or helicopter. The Wild Basin Ranger Station, picnic grounds, and campground are located along the North Fork of St. Vrain Creek about 5 miles below Bluebird Dam.

DESCRIPTION

The drainage area into Bluebird Reservoir covers an area east of the Continental Divide between Mahana mountain on the north and Ouzel Peak on the south. All the area is mountainous, with various forms of granite surface conditions. About 10 percent of this small drainage basin is covered with trees and small brush. The elevation ranges from 11,000 to 13,000 feet.

Information on basin size and hydrology is unavailable, as is information on spillway hydraulic design. The spillway alone is apparently inadequate to pass floodflows under design storage conditions, as there are indications that the dam has been overtopped in the past.

The valley immediately downstream from the dam consists of a rectangular channel about 30 to 40 feet wide with near-vertical rock slopes extending for some distance downstream. The slopes above the valley are covered by pine trees and brush.

Bluebird Dam is a concrete arch structure 146.7 feet long, abutting granite rock on the north side and a 49.5-foot-high concrete gravity abutment on the south side. The average radius of the extrados is 96 feet, the centerline is 94 feet, and the intrados is 92 feet.

The structural height of the dam is approximately 58 feet and the hydraulic height is approximately 55 feet. The slope of the upstream face is approximately 1:24. The downstream face of the arch slopes at 1:24 for 25 feet below the crest and 5:24 for the remaining height. The downstream face of the gravity section was specified with slopes of 1:24 for 6 feet below the crest and 1:2 for the remaining height. The arch thickness at the top is approximately 3.5 feet and at the base is approximately 13 feet.

Horizontal and vertical reinforcement was provided in the upper 32.5 feet of the upstream face of the dam. Vertical reinforcement in the upper 32.5 feet and horizontal reinforcement in the upper 5 feet of the downstream face were specified and may or may not have been installed. All reinforcement consists of 1-in^2 twisted steel bars placed 12 inches center to center. Clear cover of the reinforcement was required to be between 6 and 12 inches. The gravity section of the dam is unreinforced.

The original design of the dam was apparently based on the thin wall cylinder formula for a maximum developed stress of 23,962 lb/ft^2 or 166 lb/in^2. Apparently, the purpose of the reinforcing bars was primarily to limit cracking due to tension in the top center extrados of the arch and, secondarily, to add an element of strength.

The static and dynamic stability of the structure, recognizing existing conditions, will be evaluated and discussed in the analysis portion of this report.

Concrete in the structure was batched by volume. Mix proportions in the arch were 1:2-1/2:5 (cement, sand, gravel). Cement content in the gravity section was reduced, with mix proportions being 1:3-1/2:6. Plum stones were permitted in sections over 2 feet thick, with maximim size of one-half the thickness of the section. Clear cover over the plum stones was to be a minimum of 4 inches. A thin mortar coat was specified for exposed concrete.

Lift thickness was specified to be 1 foot maximum, but the dam may have been constructed with thicker lifts. A concrete cutoff with minimum dimensions of 2 feet wide and 2 feet deep was provided under the dam with the exception of the upper right portion of the gravity section. The abutment contacts were required to be shaped such that the bearing face was at an angle greater than 80° with the centerline of the dam. All loose material was to be removed from the foundation.

Bluebird Dam is situated in the outlet of a glacial lake lying in a cirque between Mahan Peak and Copeland Mountain. The dam is founded on, and abuts, Precambrian metamorphic and igneous bedrock composed primarily of schist and granite. Bedrock is not exposed in the stream channel; however, the stream follows structural control such as faulting or fracturing.

The spillway consists of an approximately 1-foot-deep, 46.5-foot-wide depression in the crest of the gravity section.

Two outlets are provided in the dam. The lower outlet, located near the toe of the left abutment, was placed in an excavated cut such that the bottom of the conduit was approximately 6 feet below the original stream channel. The centerline of the conduit is approximately 56 feet below the crest of the dam.

The outlet consists of a 24-inch-diameter No. 10 gage riveted steel pipe controlled on the downstream face of a 24-inch gate valve. The pipe and valve body are embedded. The embedment concrete is apparently unreinforced.

The second opening is an upper level outlet located near the center of the dam approximately 25 feet below the crest. This outlet consists of 36-inch-diameter No. 10 gage riveted steel pipe through the dam, controlled by a 40- by 41-inch cast iron slide gate on the upstream face. The conduit is approximately 9.5 feet long.

Bluebird Reservoir has a total capacity of 991 acre-feet.

EXISTING CONDITIONS

An onsite examination of Bluebird Dam was performed July 20, 1982. At the time of the examination, the water surface was approximately 42.2 feet below the crest of the dam, or approximately 14 feet deep at the lower outlet, using elevations given in design drawings.

Concrete in the dam shows considerable deterioration. A thin mortar coat applied to the faces and crest has spalled off extensive areas of the dam. Lift lines are distinct and probably unbonded. Lift thickness appears to be approximately 4 feet. There is significant concrete erosion on the downstream face along the lift lines.

Concrete in the structure reveals poor construction practice even for the time when the dam was constructed. Rock pockets in the concrete are distinct in numerous locations. One accessible pocket in the upstream face of the gravity section was approximately 21 inches deep, and when probed with a geologist's pick, revealed little indication of cementatious material. Plum stones in this area were numerous and apparently closer to the face than allowed by specifications.

Reinforcement is exposed in areas of the upstream face. The largest area of exposed reinforcement is near the maximum section of the dam. The most extensive concrete deterioration noted in the dam is also located in this area. The maximum depth of concrete erosion noted during the examination was approximately 2-1/2 feet below the average surface of the face, at a lift line in the above-noted area just above the water surface.

Since a minimum of 6 inches of clear cover over reinforcement was required by the specifications, the general surface of the face at this lower elevation may have eroded to such a depth.

The spillway is an integral part of the dam and reflects the same problems as the remainder of the dam.

As previously noted, the lower outlet was inundated and could not be examined. Rocks were present in the inlet channel to the low level outlet. Water depth at the outlet was measured as 5.5 feet, which is approximately 8.5 feet less than would be expected from the elevations given on design drawings. Such a water depth may reflect a buildup of material near the inlet. The City of Longmont representative in the examination party indicated that Longmont personnel visit the dam once a year to clean the outlet.

The valve on the lower outlet has been reported as inoperable in the past (State of Colorado, 1974). The extent of valve opening could not be verified.

The upper outlet was above water surface and readily accessible. The cast iron slide gate and stem are intact. The gate operator, pedestal, and drive gear are present, but the drive gear, shaft, and crank assembly have been removed. The gate is apparently hanging from the gate operator. Some concrete cracking was noted under the gate pedestal.

The steel conduit is intact through the dam. The conduit extends 3 feet beyond the downstream face. The upper portion of this extension has been crushed so that the outlet end of the conduit is only about half of its original height.

Bluebird Dam has been determined by others to be an unsafe structure and unsuitable for its intended water storage function. The State of Colorado indicated this formally in 1967, although the reservoir was used under partial storage conditions for some time after that. Presently, both outlets are left open, and the reservoir elevation is determined by the amount of inflow in relation to the capacity of the outlet works.[1]

SIGNIFICANCE

The Rocky Mountain Region of the National Park Service feels that Bluebird Dam may have local significance under Criteria C.

CRITERIA A - resources associated with events that have made a significant contribution to the broad patterns of our history.

Bluebird Dam was evaluated for possible significant contributions to the settlement and development of the area. See accompanying overview of water systems in the Wild Basin, Boulder/Larimer Counties of Colorado.

1. original reason for filing by Arbuckle's was for use at ranch resort--filed in 1902--two years later sold reservoir to Longmont businessmen. original use--not important

2. importance of reservoir to Longmont's water system development
   a. original irrigation/water system developed by Chicago-Colorado Colony ca. 1871. Any resources from this period would be potentially eligible.

b. City of Longmont bought 129 acres surrounding Copeland Lake in 1913. Same year the city filed on a reservoir and a dam was built. The dam was washed out in 1934, but was replaced with another dam. Longmont receives water from Copeland Lake via Button Rock Reservoir (1960s) and another diversion dam 6 miles above Lyons. Bluebird Dam was one of a number of sources of water for the City of Longmont. The city had also bought Pear Lake and Sandbeach dams.

3. Bluebird Dam is not or has not been a significant contribution to the development of Rocky Mountain National Park. It becomes a part of the park's administrative history in the fact that it existed before the park's establishment and it, as well as all other reservoirs or water diversions have been the subject of many park actions and attention.

CRITERIA B - persons "significant in our past" means individuals whose activities have been importnat within sifnificance theme in national, state, or local history

Criteria B does not apply. Mrs. Emma Arbuckle's husband may have local significance in Denver in business and politics, but he had been dead 6 years before she filed and she only had ownership of the property 2 years before it was sold. The existing reservoir was built 12 years after Mrs. Arbuckle sold the property.

CRITERIA C - embodies the distinctive characteristics of a type, period, or method of construction, or that represents the work of a master, or that posses high artistic values or that represents a significant and distinguishable entity whose components may lack individual distinction.

Bluebird Dam may be significant at a local level because it represents a difficult task in the early 20th Century of building a dam at a high elevation with a very short construction period.

CRITERIA D

Criteria D does not apply to Bluebird Dam.

Criteria A. The construction of Bluebird Dam and how it related to the development and settlement of a locality or community is typical of water projects in the front range area of Boulder and Larimer Counties and the entire State of Colorado.

In an area where rainfall is usually less than 16 inches a year, it did not take the settlers long to develop irrigation systems. As early as the 1860s the building of reservoirs and diversion canals were standard practice in Colorado. However, along the front range in northern Colorado, one of the most significant early irrigation projects was the method developed by the colony system. Initially, people interested in farming in Colorado bought membership in the colony. Large tracts of land were purchased and irrigation ditches were constructed from their members' money. Each member received a plot of land for a house in the colony and a tract of land for farming in the country. Thus, a large area organized by the colony had a developed irrigation system. The founding of Union Colony (Greeley) in 1869 was followed by the Chicago-Colorado Colony (Longmont) on the St. Vrain River in 1871. In 1873, on the Cache la Poudre River another colony was founded at Fort Collins. The organizers of the colony system realized the need for irrigation and by the mid-1870s, these northern Colorado communities were surrounded by fertile, irrigated fields. [2]

As more people settled in the state, particularly in eastern Colorado, demands for water laws tailored to the arid West were brought before the State Constitution in 1875. The newly formed state constitution included a section on water and it laid the groundwork for future water laws. The old riparian system based on the Riparian System of English Common Law, was abandoned in favor of the Colorado System of water rights. Under the Colorado System, "The right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied. Priority of appropriation shall give the better right."[3] The new water law stated that certain uses of water had greater priority over other uses. The order of priority is domestic use, agricultural use, and manufacturing use. The system divided the state into 70 water districts corresponding to geographical watershed. (Bluebird Dam is in Water District #5, the St. Vrain Creek Drainage.)

During the 1880s, northern Colorado farmers along with many others in the American west pushed for protection of the watershed against unrestricted lumbering, grazing, and other potentially harmful effects. The result of the western efforts was the Forest Reserve Act of 1891, which empowered the President of the United States to create 15 forest preserves which would provide protection for the watershed. The same year, 1891, Congress passed an act which permitted the construction of reservoirs on the public domain. Farmers in Longmont, Lyons, Loveland, Greeley, and Fort Collins areas looked to the mountain drainages as water sources. Concurrently with the beginning of the U.S. Forest Service administration of the St. Vrain, Thompson, and Cache la Poudre watersheds, the northern Colorado farmers changed from growing grain crops to vegetable crops and sugar beets which required more water particularly later in the growing season. The Wild Basin area--of the St. Vrain drainage was eyed by the farmers of Longmont and Lyons. By 1911, Larimer County had the "best and largest storage system in the State." The combined storage capacity of storage basins and reservoirs in Larimer County was 10,059,410,437 cu. ft.[4] There were 28 reservoirs in the Big and Little Thompson Valleys. Nineteen reservoirs and three water diversion projects had been approved for the area that would become Rocky Mountain National Park in 1915.

WATER DIVERSION AND RESERVOIRS APPROVED BEFORE THE FOUNDING OF ROCKY MOUNTAIN NATIONAL PARK (1915 BOUNDARY)

Date Approved	System	Purpose
August 20, 1903	Eureka Ditch	Water Diversion
November 3, 1903	Milner Pass Ditch	Water Diversion
December 19, 1903	Lawn Reservoir	Irrigation
February 26, 1904	Ouzel Reservoir (Arbuckle #1)	Irrigation
February 26, 1904	Pupit Reservoir (Arbuckle #3)	Irrigation
February 26, 1904	Bluebird Reservoir (Arbuckle #2)	Irrigation
June 10, 1905	Virginia Reservoir	Power
January 29, 1906	Cairns Reservoir No. 2	Power
January 29, 1906	Cairns Reservoir No. 3	Power
December 24, 1907	Cairns Reservoir No. 1	Power
October 1, 1910	Sandbeach Reservoir	Irrigation
May 31, 1911	Deer Mountain Reservoir	Irrigation/Fishing
September 26, 1913	Glacier Reservoir No. 1	Irrigation
September 26, 1913	Glacier Reservoir No. 2	Irrigation
March 16, 1914	Green (Thunder) Lake Reservoir	Irrigation
March 16, 1914	Green (Snowbank) Lake Reservoir	Irrigation
March 16, 1914	Long (Eagle) Lake Reservoir	Irrigation
March 16, 1914	Box Lake Reservoir	Irrigation
July 2, 1914	Pear Lake Reservoir (Arbuckle #4)	Irrigation
July 2, 1914	Hutchinson Reservoir #1	Irrigation
July 2, 1914	Hutchinson Reservoir #2	Irrigation

Enacting legislation creating Rocky Mountain National Park protected the existing water rights under the Act of 1891 which also proscribed a five year deadline for completion of the water projects. [5]

Water development on park lands was a serious problem that faced the newly created National Park Service. Until Roger Toll became superintendent of Rocky Mountain National Park, little attention was paid to water rights policy. In 1923, Superintendent Toll inspected the reservoirs and obtained information of proposed reservoir status. The National Park Service forwarded the inspection report to the General Land Office, whose reply was, "This office is now taking up with a view of rapidly disposing of all the uncompleted projects. . .giving status of various grants in Rocky Mountain National Park." [6]

CRITERIA B AND C

The first fiing for Bluebird Dam was made in 1902 by Mrs. Emma Arbuckle, her son Frank, and the caretaker of her ranch resort, Jabez Billings. Mrs. Arbuckle's husband, Frank P., a prominent Denver businessman and Democratic Party leader died in New York in 1896. At the time of his death, they ran a resort 6 miles north of Lyons, on the St. Vrain River.

After a dry summer in 1902, she filed on five reservoirs in the Wild Basin. Only Bluebird (Arbuckle #2) and Pear Lake (Arbuckle #4) were built. Two years later, Mrs. Arbuckle, her son, and Mr. Billings sold the reservoirs to a group of Longmont businessmen, The Arbuckle Reservoir Company.[7]

A 9 foot earthern and rock dam was constructed in 1904.[8]

In 1913, the state engineer approved the plans for a concrete dam with an estimated cost of $1,500 ($880 for 55 cu. yds. of concrete, $170.00 for excavation, $200.00 for sluice and pipe and $250.00 for incidentals).[9] During the summer of 1913, the survey crews

> packed in with two mules, . . . The rodman threw together a raft of sorts to measure the depth of the lake. The engineer in charge declined to board but the two boys put to sea, their soundings showing a depth of 50 feet in one place. the country was so rough Neeley wore out three pairs of shoes in eight days, and came out in a September blizzard with wet, cold feet.[10]

The construction of the dam, located above timber line at about 11,300 feet above level, presented many problems for the contractor and workers. The construction season was very short, usually mid-July to mid-September and quite often snow remained in spots. Beside the very short construction period, the freezing weather caused the mountain trails to be very dangerous. All supplies had to be packed in by mule for a distance of 6 miles up mountainous trails. Each mule carried 2 bags of cement at a time. Each of the three years of construction about 2,000 bags of cement. There was no sand source onsite, so the contractor crushed the abundant local granite for use as a substitute for sand. It took the men three days to dismantle a rock crusher, drive the laden mules to camp and reassemble the rock crusher. An old automobile engine which was transported in the same manner as the rock crusher, was used to power the rock crusher. All of the 1-inch twisted steel reinforcing bars were chained in bundles to the axle beam between two wagonwheels, one end left dragging on the ground. The driver balanced on the axle and urged four horses up the narrow trail.[11] All other tools, lumber, and gasoline were transported using the mules. Some of the equipment remains onsite.

Different accounts state different completion dates, however, the engineer in charge of construction wrote in an article for the April 23, 1923, Engineering News-Record that "work. . . progressed each year as much as the difficult location and the short working season permitted. It is expected that the work will be finished in 1923, after 400 cu. yds. of additional concrete are placed."[12]

The following list was compiled by the United States Committee on Large Dams in 1958. The original intent was to include only those dams having large dimensions in height or large volume content. However, the committee recognized the need to include other structures which might involve important engineering features, either because of the nature of the structure, its location, or conditions under which construction took place, or functional use.

For the purpose of this determination, only dams in the Cache la Poudre, Big Thompson, and St. Vrain Creek drainages are listed. These dams were constructed between 1900 and 1920.

NAME	DRAINAGE	DATE BUILT	TYPE
Black Hollow	Cache la Poudre	1918	no data
Boulder & Larimer	Little Thompson	n.d.	no data
Boyd Lake	Big Thompson	1902	earthen
Cache la Poudre	Cache la Poudre	1902	earthen
Cobb Lake	Cache la Poudre	1919	no data
Douglas	Cache la Poudre	1901	no data
Foot Hills	St. Vrain Creek	n.d.	earthen
Fossil Creek	Cache la Poudre	1901	earthen
Long Draw	Cache la Poudre	n.d.	earthen
Long Pond	Cache la Poudre	n.d.	no data
Marion	Big Thompson	n.d.	earthen
Halligan	Cache la Poudre	1906	concrete arch 13

Bluebird Dam was not the only concrete arch dam built in this area. Halligan Dam, built in 1906 is 94 feet in structural height, 340 feet in crest length, and has a reservoir capacity for 6,400 acre feet. Note that Bluebird was not included in the above list.

END NOTES

1. "Seed Report on Bluebird Dam, Pear Dam, Sandbeach Dam, Glacier No. 1 Dam, Sprague Lake Dam Located Within the Boundary of Rocky Mountain National Park," National Park Service. 1982. pp. 9, 10, and 11.

2. Patrick McKnight, "The Water Rights of Rocky Mountain National Park, A History." unpublished manuscript. Chapter 5, no page number.

3. Colorado State Constitution, Section 6, Article 16, 1876.

4. Ansel Watrous, History of Larimer County, Colorado. Fort Collins, Colorado: The Courier Printing and Publishing Company, 1911, pp. 132-133.

5. McKnight, Chapter 1, no page number.

6. McKnight, Chapter 2, no page number.

7. Louise Ward Arps, and Elinor Eppich Kingery, High Country Names Rocky Mountain National Park. Estes Park, Colorado: Rocky Mountain Nature Association, 1972. p.33.

8. Letter to District Forester from H.N. Wheeler, Forest Supervisor. October 24, 1913. on file Rocky Mountain Regional Office.

9. Arbuckle #2 Water file, Natural Resources Division. State of Colorado. Denver, Colorado.

10. Arps and Kingery, p. 33.

11. Ibid, p. 33.

12. L.H. Dreterich, "Materials for Dam Transported by Burros." Engineering News-Record. April 12, 1923.

13. T.W. Mermal, Register of Dams in The United States. New York: McGraw-Hill, 1958, pp. 6-229.

UTM

Zone 13 E 444520 N 4449120

Allens Park, Colorado U.S.G.S. Quadrangle

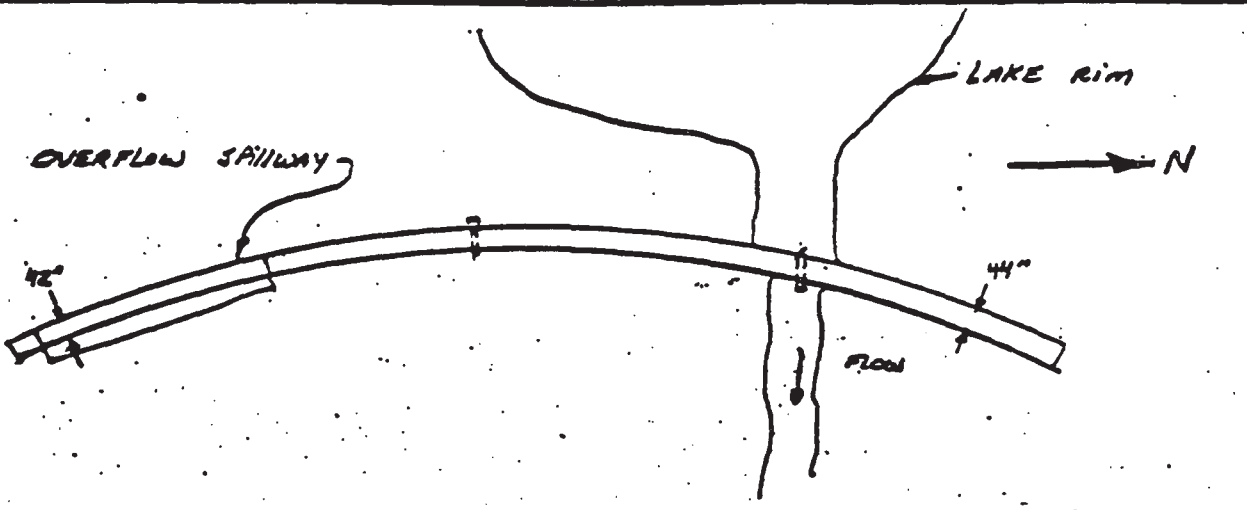
The boundary includes only the Bluebird Dam both what is exposed above the water line and what is below.

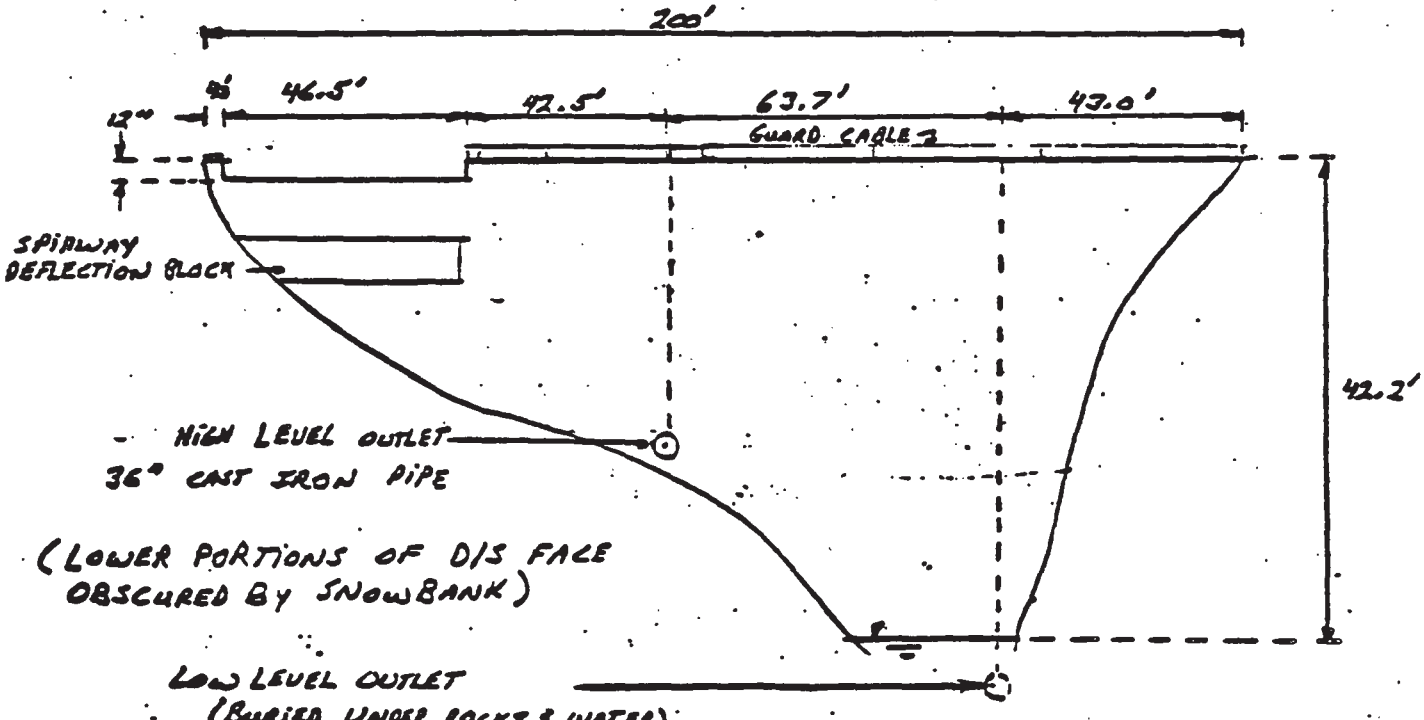
Water and Power

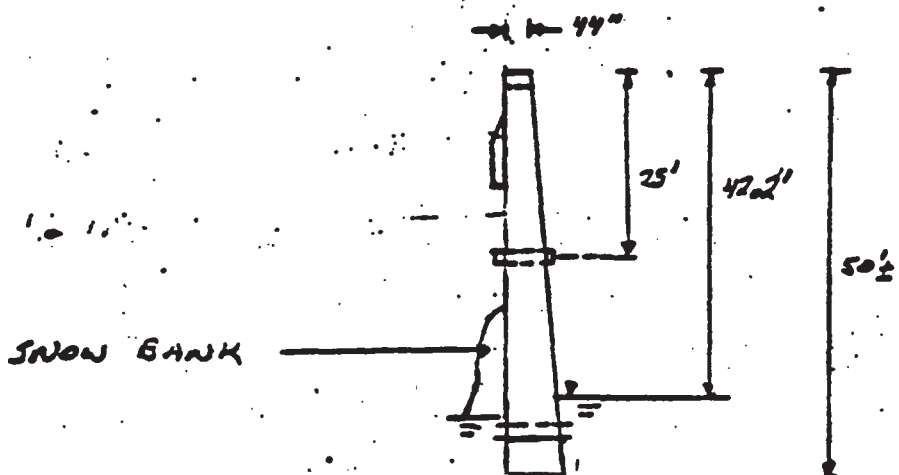
BY	DATE	PROJECT	SHEET ___ OF ___
		SEED INVESTIGATION	
CHKD BY	DATE	FEATURE	
		BLUEBIRD DAM - ROCKY MOUNTAIN NATIONAL PARK	

DETAILS

SKETCH & FIELD MEASUREMENTS (NOT TO SCALE)







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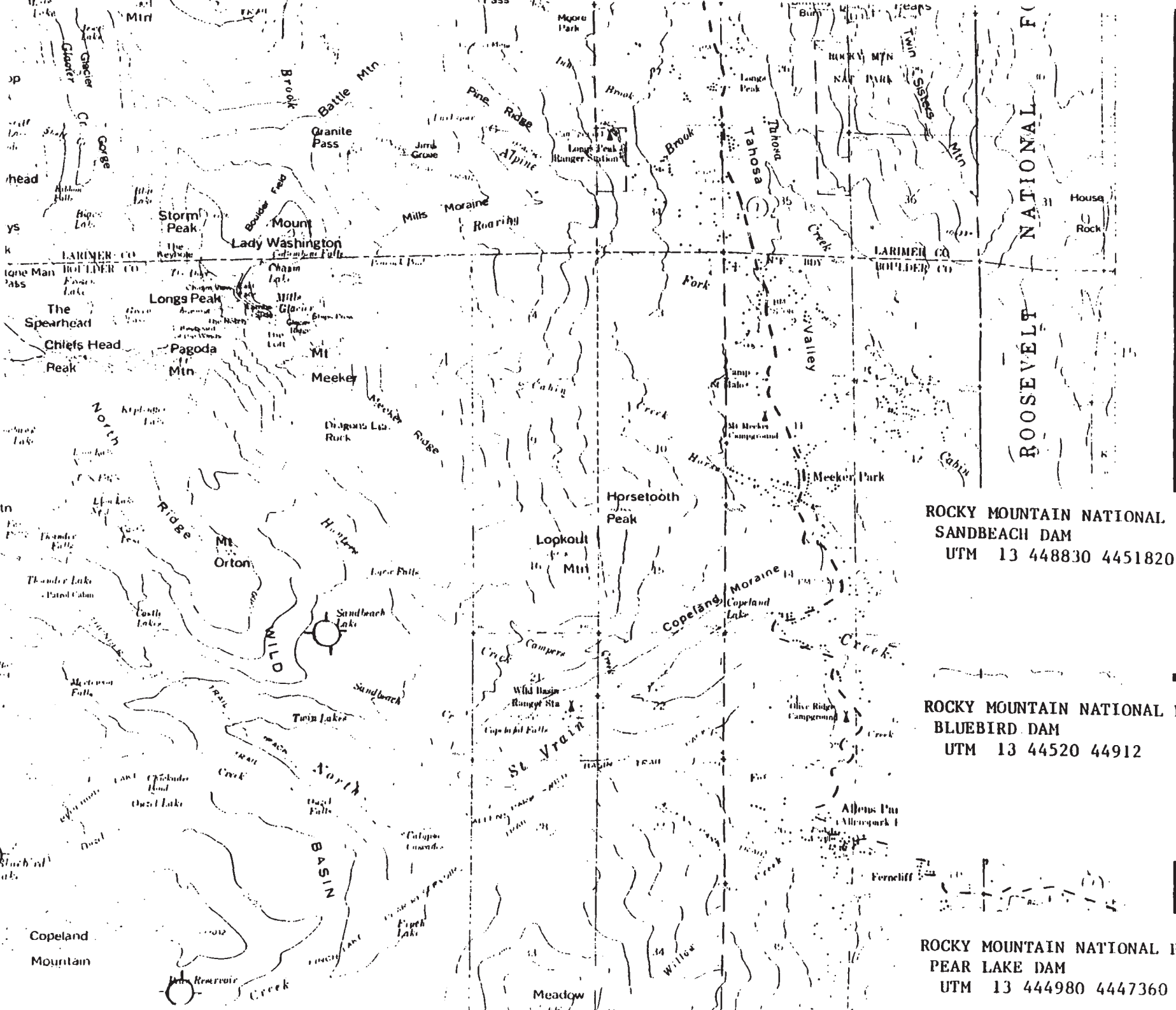
State of Colorado Natural Resource Division. Water file-Arbuckle #4. Denver, Colorado.

Wheeler, H.N. "Letter to District Forester," October 24, 1913.



ROCKY MOUNTAIN NATIONAL PARK QUADRANGLE
SANDBEACH DAM
UTM 13 448830 4451820

ROCKY MOUNTAIN NATIONAL PARK QUADRANGLE
BLUEBIRD DAM
UTM 13 44520 44912

ROCKY MOUNTAIN NATIONAL PARK QUADRANGLE
PEAR LAKE DAM
UTM 13 444980 4447360