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Robert J. Murdock, P.E.
2964 East 3135 South
Salt Lake City, Utah 84109

December 17, 1992
Phone 487-0258

S.V. Litizzette, Attorney
30 South Main Street
Helper, Utah 84526

Re: Inspection and report of diversion from Fairview Lakes
through the Narrows Tunnel.

Dear Mr. Litizzette,

Enclosed is an original and 4 copies of the report of my investigation of the diversion of water from Fairview Lakes through the Narrows Tunnel. I have also sent a copy to Lyle Bryner. If you have any questions please contact me.

There are some interesting aspects of the water right requirements and the physical situation on the mountain in addition to those that have been mentioned to me that I think have been over looked to the detriment of Carbon County. The water is being measured in the wrong place. It should be measured near Fairview Lakes and at the tunnel, not just near the tunnel. The result is the flow of the spring and other seepage that runs into the canal and tunnel goes to Sanpete County, but the water rights say it should go to Carbon County.

Regarding your comments in your letter dated September 29, 1992; Your point #1 indicates the U.S.G.S. is not tending the gauge station as they should. That is something the River Commissioner should take directly to the U.S.G.S. or the State Engineer for correction. The U.S.G.S. is usually quite diligent in its work to get good records. I do not remember seeing electrical power near the gauge station and it is likely that you are limited to a recorder that must be periodically reset. All gauge stations must be periodically tended any way to look for problems no matter what type of recorder is used. I think there are simpler things that can be done to solve the problems near the tunnel measuring device rather than moving it. Recommendations "e" and "f" in the report cover it.

I believe the problems that relate to your points #2 and #3 are covered in my report.

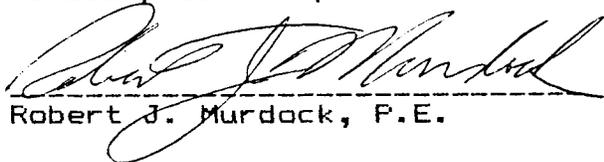
I have enclosed a statement for my time and expenses to date. If you have questions with any of the report or statement or if I can help solve some of these problems please call me.

Sincerely,

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Robert J. Murdock, P.E.

EVALUATION OF THE CONDITION, OPERATION AND
FLOW MEASUREMENTS OF CANAL

from

FAIRVIEW LAKES to NARROWS TUNNEL

Sanpete County, Utah

by

Robert J. Murdock, P.E.

1. GENERAL:

Mr. S.V. Litizzette Attorney for Carbon Water Conservancy District requested that I make a study of the canal that conveys water from Fairview Lakes to the Narrows Tunnel (Fairview Tunnel) at the head of Cottonwood Canyon above Fairview, Sanpete County, Utah. I was asked to evaluate conditions along the canal that would affect the flow and measurement of flow that is diverted through the tunnel to Cottonwood Canyon with respect to the water rights for the diversion.

2. WATER RIGHTS:

The water rights are set forth in Judge Maurice Harding's AMENDED JUDGEMENT dated March 7, 1966 in Civil No. 5357, IN THE DISTRICT COURT OF SANPETE COUNTY STATE OF UTAH, CARBON CANAL COMPANY, et al, Plaintiffs, vs. COTTONWOOD-GOOSEBERRY IRRIGATION COMPANY, et al, Defendants. These rights were slightly modified by change application a-9918 (91-738) with MEMORANDUM DECISION by State Engineer, Dee C. Hansen dated June 26, 1979.

The water rights provide for the Cottonwood-Gooseberry Irrigation Company to collect water from the upper drainage areas of Boulger Creek and Gooseberry Creek, to store it in Fairview Lakes and to make a transmountain diversion of it by a canal, natural channel and tunnel to the Sanpete Valley drainage area. Diversion of a spring above Fairview Lakes for culinary use is also allowed. The section of the original canal from Fairview Lakes to Sanpete Valley drainage that was abandoned when the tunnel was constructed was to be filled in or broken so it no longer collected or conveyed water. The total annual diversion from Fairview Lakes and the spring shall not exceed 3020 acre feet.

The water rights require that the water shall be measured at three locations.

1. The spring flow diverted for culinary use shall be measured with a totalizing meter in the pipeline from the spring. This amount is limited to not more than 67 acre feet during any one calendar year.

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2. The main diversion amount shall be measured in the canal near the outlet of Fairview Lakes before water is released from the canal into a natural channel.

3. The water rediverted from the natural channel through the tunnel shall be measured at or near the tunnel. The amount of water that is diverted through the tunnel shall be controlled to be no more than the amount measured in the canal near the outlet of Fairview Lakes. The decree required that any conveyance losses between the canal and tunnel measuring points shall reduce the amount diverted through the tunnel by the amount of the losses.

The period of the year when diversions are permitted is all year around for the culinary use, and from May 15 through October 15 of each year in the canal and tunnel.

3. HYDROLOGIC CONSIDERATIONS:

The drainage area intercepted by the canals and natural channels between Fairview Lakes and the Narrows Tunnel lies at the top of Gooseberry Creek between elevation 8650 to 9420 feet elevation above mean sea level. Based upon the U.S.G.S. stream gauge on Gooseberry Creek and an estimate of transmountain diversions derived from the Gooseberry drainage, the average annual water yield in upper Gooseberry Creek is about 915 acre-feet per square mile or 1.43 acre-feet per acre.

The primary yield of water from upper Gooseberry Creek is from snow melt. Snow melt in this area mainly occurs between late April through mid June. The water rights allow for the diversion of water through the tunnel to start May 15. Because this water is from storage it is often not released until after snow melt at higher elevations is nearly ended. Since the Cottonwood-Gooseberry Irrigation Company changed from flood irrigation to sprinkle irrigation and can not handle the larger flows, but needs later season water, there has likely been a shift to draw from Fairview Lakes even later in the year than before.

4. PHYSICAL CONDITIONS ALONG THE CONVEYANCE ROUTE:

On September 25, 1992 I made a field inspection of the entire conveyance route from Fairview Lakes to the Narrows Tunnel. I also inspected additional parts of the original canal that are not used at this time. See attached map.

I found the presently used conveyance route is somewhat different than the route anticipated by Harding's decree.

Harding anticipated the use of about 4800 feet of the original canal from Fairview Lakes to a point located North 32 deg. 14 min. West 1421.5 feet from the S

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Section 35, T13S, R5E, SLB&M. At that point the water was to be measured and released from the canal into the natural channel. It was to run in the natural channel to a point of redirection in the SE 1/4, NW 1/4 Section 25, T13S, R5E, SLB&M, from whence it would run in a canal about 2600 feet to the tunnel. I found no evidence there has ever been a measuring device or release to the natural channel near the point described. The natural channel from the point described is very steep and flows from the canal would cause significant erosion.

The route actually followed by the water runs about 2200 feet along the original canal from Fairview Lakes to a point about 1000 feet East and 1250 feet North from the Southwest corner of Section 36, T13S, R5E, SLB&M. At this point the water runs through a parshall flume, the first of two of them along the route.

Just past the parshall flume the canal bank is breached and the water runs from the canal into the natural channel. The water then runs in the natural channel, northerly, under a road, about 4200 feet to a point of redirection to a second canal. It then runs northwesterly about 2400 feet and joins the natural channel it would have been in with Harding's route. It then runs northeasterly in this channel about 2200 feet to a second point of redirection, then 2600 feet in a third canal through the second parshall flume to the tunnel.

The change or use of either conveyance route is not significant if the water is measured and the flows controlled as required by the water rights. The location of measurement and control structures along the canal and the location of tributary inflows to the conveyance route between the Fairview Lakes and the tunnel entrance are critical. The structures and inflow along the conveyance route are described as follows.

The location of the first parshall flume has been described previously. Other significant control and measurement structures are along the third section of canal. The structures are one hundred to two hundred yards apart. The redirection structure is an earth dike 4 to 5 feet high with a rock spillway channel on the east side and the canal on the west side.

Down the canal about 50 yards is a large concrete head gate and turn out that uses long boards for control. It appears to have been recently constructed and is in good condition. It can be used to shut off the canal or make large adjustments to the flow in the canal, but it can not be used to make fine adjustments of the canal flow. However, this is the only control structure that can presently be used to adjust measured flows through the tunnel.

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The next structure is a canal gate turn out with hand wheel and an 18 inch diameter corrugated metal pipe outlet through the canal bank. Soil is blocking the gate from the canal and it has not been operated for at least a few years. It was probably blocked with soil when the concrete head gate was constructed. This gate is the size and type that could make fine adjustments to the canal flow if it were operable. It is located where its adjustments of the flows would be measured and it could be used to finely regulate the diversions through the tunnel.

The next structure is the second parshall flume along the route. The last structure is a 30 inch diameter canal turn out gate with hand wheel and corrugated metal pipe through the canal bank. The 30 inch turn out is located about 500 feet down stream from the parshall flume at a sharp 80 degree bend in the canal about 700 feet up stream from the tunnel portal. The 30 inch canal gate is used to drain the canal and keep water from going through the tunnel. This gate can not be used to adjust measured flow through the tunnel because it is down stream of the parshall flume. Unmeasured water will be conveyed through the tunnel if this gate is closed during the snow melt time of year.

Both parshall flumes are 5 foot throat width by 2.5 feet deep. The first parshall flume near Fairview Lakes is in fairly good condition, but needs some repair. It is not being used at present, but it should be used to administer the water rights according to Harding's decree. The floor is not level, and the front cross brace is broken allowing the left side to tilt inward. It has a staff gauge and stilling well. It could be repaired and equipped with a recorder. The second parshall flume nearer the tunnel is in good condition, equipped with a continuous recorder and is the point that has been used for diversion measurements.

Other than the repairs needed for the first parshall flume and the blocked 18 inch canal gate, the conveyance system appeared to be in good working condition, but it is not being used properly to administer the water rights. The second parshall flume is not properly located to measure all potential flow to the tunnel. It should either be relocated closer to the tunnel or inflows to the canal between the second parshall flume and the tunnel entrance should be diverted away from the canal or to the canal up stream of the second parshall flume.

At the time of the field inspection I was not aware of the approved culinary diversion and did not review any part of that system.

5. TRIBUTARY INFLOW CONDITIONS:

Watershed conditions along the canal below the first parshall flume are significant with respect to the water rights

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in question. The watershed area totals about 1210 acres tributary to the canals and natural channels of the conveyance route with about 1730 acre-feet of average annual runoff. Approximately 1,062 acres are tributary to the canals and natural channels between the existing locations of the two parshall flumes. In this area are springs that run in the second natural channel and are diverted into the third canal section. During the site visit in late September with no recent storms this flow was estimated to be 0.5 cfs. It ran in the third canal section to the 30 inch canal gate where it was released to the Gooseberry Creek drainage.

About 35 acres are tributary from the west to the canal between the second parshall flume and the 80 degree bend in the canal. The lower part of this area appears to be a wet meadow with several small channels running into the canal. This inflow is not measured and likely runs until later summer. About 113 acres are tributary to the canal in a larger rocky channel that enters the canal from the north at the 80 degree bend. This flow is not measured either and runs during times of snow melt or heavy summer rains.

With measurements and control gates as presently used the flow of the springs and other seepage inflow is lost to the Gooseberry drainage during the entire period of tunnel diversions. These losses likely exceed 100 acre-feet per year. Also flow is able to be measured and diverted through the tunnel without the gate of Fairview Lakes being opened. The potential exists for up to about 500 acre-feet per year of water to be diverted through the tunnel in excess of the water rights depending upon snow melt, seepage and rain fall conditions during the diversion period.

Harding's decree requires that the conveyance losses between Fairview Lakes and the tunnel be subtracted from the amount released from Fairview Lakes thus reducing the amount diverted through the tunnel. The amount of these losses would vary from time to time and be difficult to determine. They are likely small and are likely seepage gains in the natural channels rather than losses most of the time. However, the flow from the springs running in the second natural channel can be measured and should be released from the canal to the Gooseberry drainage. It should not be ignored and simply used to make up for conveyance losses or lack of water yield from Fairview Lakes.

6. CONCLUSIONS:

- a. The diversion of water through the Narrows Tunnel to Sanpete Valley is not being administered in accordance with the water rights involved. Measurements near Fairview Lakes are not being used and excess water is diverted as a result.

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- b. It is estimated that annually between 100 and 500 acre-feet of water is diverted through the Narrows Tunnel in excess of the water rights for the diversion.
 - c. Measurement and control devices exist that need to be repaired and used as part of the proper administration of the water rights.
 - d. The existing second parshall flume is in good condition, equipped with a recorder, the site of an extended record and apparently located at a good point to measure flows in the canal. It is not normally wise to move a stream measuring point or device if reasonable alternatives exist to solve related problems.
 - e. Water that is yielded to the conveyance system between Fairview Lakes and the Narrows Tunnel during times of diversion is delivered to Cottonwood Creek rather than Gooseberry Creek as required by the water rights. The excess measured yield to Cottonwood Creek does not occur during years when the full water right amount of 3020 acre-feet is available from Fairview Lakes.
 - f. The present configuration of the second parshall flume and tributary inflow points can result in an unmeasured yield to Cottonwood Creek not in accordance with the water rights.
 - g. There are three concentrated tributary inflow points to the conveyance system between Fairview Lakes and the Narrows Tunnel. These should each bypass the conveyance system and be released to the Gooseberry Creek drainage below the third canal section.
7. RECOMMENDATIONS:
- a. Repair the first parshall flume (near Fairview Lakes) so its floor is level and its sides are vertical and properly supported. Install a continuous recorder at the parshall flume if the River Commissioner is not able to read the staff gauge frequently enough so there are not large changes between readings.
 - b. Install a small parshall flume with staff gauge in the natural channel below the springs above the confluence with the second canal section.
 - c. Clean out the approach and outfall ditch for the 18 inch canal gate turn out from the canal. Install a small parshall flume in the outfall ditch from the 18 inch canal gate. When water is diverted through the tunnel, the rate of flow out the 18 inch gate should be equal to or greater

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