SUPPLEMENTAL TESTIMONY OF
DAVID L. SCHREIBER
RANNEY COLLECTOR WATER SUPPLY SYSTEM
SKAGIT NUCLEAR POWER PROJECT
DOCKET NOS. 50-522 & 50-523

A. Introduction

This testimony supplements the testimony submitted by Drs. Marmer, Zussman and myself in this proceeding on February 17, 1978. It addresses the Licensing Board's concerns relative to (1) the applicants' use of pumping test data (set forth in Appendix G to ER) to predict the yield of the proposed Ranney Collector System and (2) the drawdown effects of the Ranney Collectors on nearby Red Cabin and Muddy Creeks. This testimony also evaluates the effects of the applicants' proposed design changes to the System to meet the mitigation requirements prescribed by the Department of Agriculture in its Wild and Scenic Rivers Act determination of April 11, 1978.

B. Projected Yield

The fundamental concepts of the flow of a liquid through a porous media were put forth by H. Darcy in 1856 and were based upon experimental studies. This early work serves as the foundation for modernday theory of groundwater hydraulics. Darcy's Law states that the rate of flow through a porous medium is directly proportional to the cross-sectional area (through which flow takes place) and to the pressure head (or potential energy) difference between the inlet and outlet of the medium, and is inversely proportional to the flow path length between the inlet and outlet.

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The central theme of Mr. Mikels' testimony (testimony of Frederick C. Mikels dated February 22, 1978, Tr. 10, 691) is to demonstrate that Darcy's Law is valid for the Skagit pumping test data and for the predicted collector yields. In order for Darcy's Law to be applicable, the groundwater flow must be in the laminar, and not turbulent, flow regime (a laminar flow regime is evidenced when lines of equal velocity are roughly parallel). Mikels presented a graph from the groundwater textbook by Todd which shows the relationship between the friction factor and Reynolds number for flow in a porous media. Data obtained by several investigators are plotted on the graph. The point at which the data begin to depart from the straight line is approximately the upper limit of the laminar flow regime. This point is approximately a Reynolds number of 10. Darcy's Law is not valid for groundwater flow conditions that exceed this value.

I have reviewed the data from the Skagit pumping tests. The calculated Reynolds number indicates that the flows in the proposed Ranney Collector Water Supply System are within the laminar flow regime; thus, Darcy's Law is valid for this situation. I concur in Mikel's statement that the Reynolds numbers for the proposed Ranney Collectors are lower than those for the pumping tests and are, therefore, further removed from the turbulent flow regimes. Since Darcy's Law is valid for the Skagit situation, it can be used as a basis for estimating water yields from the proposed Ranney Collectors.

It has been common practice for many years in groundwater development for municipal, industrial, and agricultural use to base design flow rates on pumping tests with much lower flow rates. Such extrapolation has proven reliable, as long as Darcy's Law is valid for the particular situation.

I have reviewed the applicant's method, which is based upon Darcy's Law, for estimating the water yield of a Ranney Collector. Data from field pumping tests of a vertical well are used in the method. The method is based upon sound physical principles, and I concur in its use. The Ranney Corporation has utilized this method for nearly 40 years, and their experience (documented as Attachment C to Mikel's testimony) indicates that it is reliable. Furthermore, the method is documented in a reputable professional publication, International Association of Scientific Hydrology Publications (Attachment A to Mikel's Testimony), and has been referenced by Hantush[1/] in a chapter on the Hydraulics of Wells in a major textbook on Hydroscience. The applicant's methodology and selection of coefficients are sufficiently conservative to assure design flow rates, even when such things as interactions between collectors are considered.

I have independently checked the applicant's methodology using the pumping test data provided in Appendix G to the Environmental Report. I calculated estimated yields for the proposed Ranney Collectors that are within a few percent of the applicant's estimates. Therefore, I concur with the applicant's estimates of water yields to be expected from the proposed Ranney Collectors.

1/ Hantush, M.S., Hydraulics of Wells," Chapter 5, Advances in Hydroscience, Edited by V.T. Chow, Volume 1, Academic Press, N.Y., pp. 397-406, 1974.

The applicant's estimates indicate an average combined water yield from the four collectors of 104.3 million gallons per day (MGD) and a minimum combined yield of 80.7 MGD. The minimum collector yield occurs during the winter months when plant water use is also low. The winter plant use at maximum thermal output is estimated to be 49.2 MGD (FES, Table 3.2, p. 3-11). This indicates a safety margin in excess of 60%. Even when comparing the maximum plant water use, 68.4 MGD, which occurs during the summer months, the plant water needs can still be met with the minimum combined collector yield (winter months) with a safety margin of 18%.

The estimated minimum and average individual collector yields in MGD are as follows:

Collector	Minimum	Average
1	32.3	41.9
2	30.1	39.1
3	8.9	11.1
4	9.4	12.2

Thus, for minimum conditions (49.2 MGD plant water use) and average conditions (57.9 MGD plant water use), neither collector 3 or 4 is needed to supply plant water needs. In addition, it appears that any one of the four collectors could be out for maintenance at any time and not jeopardize full plant operations under most circumstances, since the above plant water use values are based on maximum thermal output. Furthermore, maintenance outages on the Ranney Collectors could be scheduled during the periods of time when the plant is down for fuel loading.

As a final resort, more laterals could be jacked out from the collector caissons or another collector or two could be added to the system within the collector area (see Fig. 5, FES Supplement, p. 4-2), if additional water supply were deemed necessary. Impact on the water resources of such action is expected to be minimal because the collector area contains sufficient additional shoreline.

In the January 24, 1978, Prehearing (Tr. 8411-8413), in the January 27, 1978 letter to the applicant, and in the June 22, 1978 Hearing (Tr. 10,899-10,903), the Board inquired about the possibility of installing and testing one of the proposed Ranney Collectors prior to constructing the remaining collectors. Even though this would allow evaluation of actual data, there would still be uncertainty about the other collectors and their interactions. A test such as proposed would not be proof positive. I do not believe such a test is necessary.

C. Proposed Changes to Ranney Collector System

In a letter dated May 22, 1978, the applicant described changes to the Ranney Well intake system that would meet the mitigation requirements prescribed by the Department of Agriculture (letter dated April 11, 1978 from M. R. Cutler to NRC) pursuant to the Wild & Scenic Rivers Act. To minimize visual effects, the Collector caissons were all moved approximately 50 feet further back from the initially proposed 100 feet from the river's edge. Furthermore, the rooftops of the pump houses were lowered by [illegible]-11 feet

and the wall thickness increased. As a result of moving the Collector caissons, the horizontal lateral design was revised, increasing lateral lengths in the riverward direction and decreasing lateral lengths in the landward direction. The criteria imposed for the changes in lateral design were that the centers of pumpage, computed yields, water quality, and effects on the groundwater table should remain unchanged.

I have reviewed the applicant's proposed design changes, have asked questions concerning the changes, have reviewed responses to the questions (letter dated June 12, 1978 from applicant to NRC), and have reviewed the June 21-22, 1978 Hearing transcripts covering this topic (Tr. 10,675-10,690). It is my professional opinion that the proposed changes in the design of the Ranney Collector intake system will not change significantly the centers of pumpage, computed yields, water quality, and effects on the groundwater table.

D. Drawdown Effects on Nearby Streams

As stated in the earlier written testimony of February 1978 by Schreiber, Zussman, and Marmer concerning drawdown effects of the Ranney Collectors, the influence on Muddy Creek and the East Fork of Red Cabin Creek would be small even assuming the groundwater table is not below the creek beds. Data submitted by the applicant in January 1979 covering the low-flow period from early August 1978 through early November 1978 (item 16) confirm that the ground-water table is isolated from the creek beds. Using the ground-water level measurements in existing wells on November 2, 1978 (see Table 1, item 16),

ground-water table elevation contours were sketched on Figure 1 (item 16). Creek bed elevations (Table 3, item 16) were also noted on Figure 1, along with Skagit River water surface elevations (Figure 1, item 9). As evidenced by this Figure, which now includes groundwater table contours, the creek-bed elevations in Red Cabin and Muddy Creeks are everywhere at least several feet above the ground-water table in the Skagit River floodplain. Therefore, the groundwater table drawdown effects of the Ranney Collectors will have no impact on the surface water flowing in either Red Cabin Creek or Muddy Creek.

The applicant noted in item 16 that there is no surface water connection to the southeast between the eastern headwaters of Etach Creek and the Skagit River (Ranney Collector vicinity) during normal (or lesser) flow conditions. The natural flow of Red Cabin Creek is from north to south with confluence at Etach Creek. Flow then progresses westward through Etach Creek to the Skagit River.

The applicant further notes in item 16 that Etach Creek, east of the confluence with Red Cabin Creek, is closed off from Red Cabin Creek (and the downstream reaches of Etach Creek) and is murky, making it not conducive to spawning. The headwaters of Etach Creek fork in the vicinity of Cockreham Road and Ranney Collector No. 3. The southern fork of the creek has a flow-obstructing log jam at its juncture with the northern fork. In addition, the Cockreham Road culvert over the south fork is blocked by mud

and debris. The existence of the northern fork of Etach Creek could not be ascertained during the observation period or in aerial photographs (item 17 enclosure). The area where this fork of the creek is depicted on Figure 1 (item 16) did not contain any water, nor were there any indications that water had been there.

As noted by the applicant (item 16), and confirmed by aerial photographs (item 17), Manser Slough (East Fork of Red Cabin Creek), just north of Etach Creek, does not flow and has not been in communication with the main fork of Red Cabin Creek for several years. Local residents have been filling in the western end of the slough for several years.

E. Conclusions

The proposed Ranney Collector Water Supply System for the Skagit Plant is sufficient to provide plant water needs under varying conditions with minimal impact on the water resources. This conclusion is based upon my independent assessment of the applicant's methodology (which I believe is conservative) and field pumping test data, upon my review of the pertinent literature, upon the common engineering practice of extrapolating pumping test data to estimate design flow rates, and upon the 40 years of experience by Ranney Corporation in installing such systems throughout the world.

APPENDIX

In preparing this supplemental testimony, I have reviewed the following documents:

1. Letter dated January 9, 1978, from Samuel W. Jensch, Chairman of the Atomic Safety and Licensing Board Panel, to Douglas S. Little, Attorney for applicants;
2. Prehearing Conference Testimony of January 24, 1978 (Tr. 8389-91, 8410-8412);
3. Letter dated January 27, 1978, from Samuel W. Jensch, Chairman of the Atomic Safety and Licensing Board Panel, to F. Theodore Thomsen, Attorney for applicants;
4. Testimony of Frederick C. Mikels, Re: Ranney Collector Water Supply System, dated February 22, 1978;
5. The applicant's Environmental Report, Appendix G;
6. Letter dated April 11, 1978, from M. Rupert Cutler, Assistant Secretary for Conservation, Research, and Education, U. S. Department of Agriculture, to Lee V. Gossick, Executive Director for Operations, U.S. Nuclear Regulatory Commission;
7. Letter dated May 17, 1978, from E. E. Goitein, Project Engineer, Bechtel Power Corporation, to J. R. Fishbaugher, Puget Sound Power & Light Company;

8. Letter dated May 22, 1978, from J. E. Mecca, Manager, Nuclear Licensing & Safety, Puget Sound Power & Light Company, to W. H. Regan, Chief, Environmental Projects Branch No. 2, U. S. Nuclear Regulatory Commission;

9. Letter dated June 12, 1978, from J. E .Mecca, Manager, Nuclear Licensing & Safety, Puget Sound Power & Light Company, to W. H. Regan, Chief, Environmental Projects Branch No. 2, U. S. Nuclear Regulatory Commission;

10. Letter dated June 14, 1978, from F. C. Mikels, President, Ranney Method Western Corporation, to E. E. Goitein, Project Engineer, Bechtel Power Corporation;

11. Response to Intervenor SCANP's Interrogatories and Request for Production, Puget Sound Power & Light Company, June 16, 1978;

12. NRC Hearing Transcript, Skagit Nuclear Power Project, Docket Nos. STN 50-522 and STN 50-523, pp. 10,476-10,718, June 21, 1978;

13. NRC Hearing Trar .ıpt, Skagit Nuclear Power Project, Docket Nos. STN 50-522 and STN 50-523, pp. 10,719-10-978, June 22, 1978;

14. Paper by Jeffrey Haley, "Potential Iron Bacteria Problems in Ranney Collectors for Skagit Nuclear Power Plant," June 22, 1978;

15. Letter dated July 13, 1978, from W. J. Miller, Engineer, Nuclear Licensing and Safety, Puget Sound Power & Light Company, to D. L. Schreiber.

16. Letter dated January 8, 1979, from J. E. Mecca, Manager, Nuclear Licensing & Safety, Puget Sound Power & Light Company, to W. H. Regan, Chief, Environmental Projects Branch No. 2, U. S. Nuclear Regulatory Commission.

17. Letter dated January 3, 1978, from M. V. Stimac, Senior Project Engineer, Puget Sound Power & Light Company, to Paul Leech, Senior Project Manager, Environmental Projects Branch No. 2, U. S. Nuclear Regulatory Commission.

In addition, I have conducted my own independent analysis of the applicant's pumping test data and evaluations thereof.

As expressed in items 1-3 above, the Board is concerned about the applicant's use of the pumping test data, presented in item 5 above, to predict the yield of the proposed Ranney Collector Water Supply System. The applicant has addressed these concerns in Mr. Mikels' testimony, item 4 above, and in the hearings on June 21-22, 1978, items 12 & 13 above.

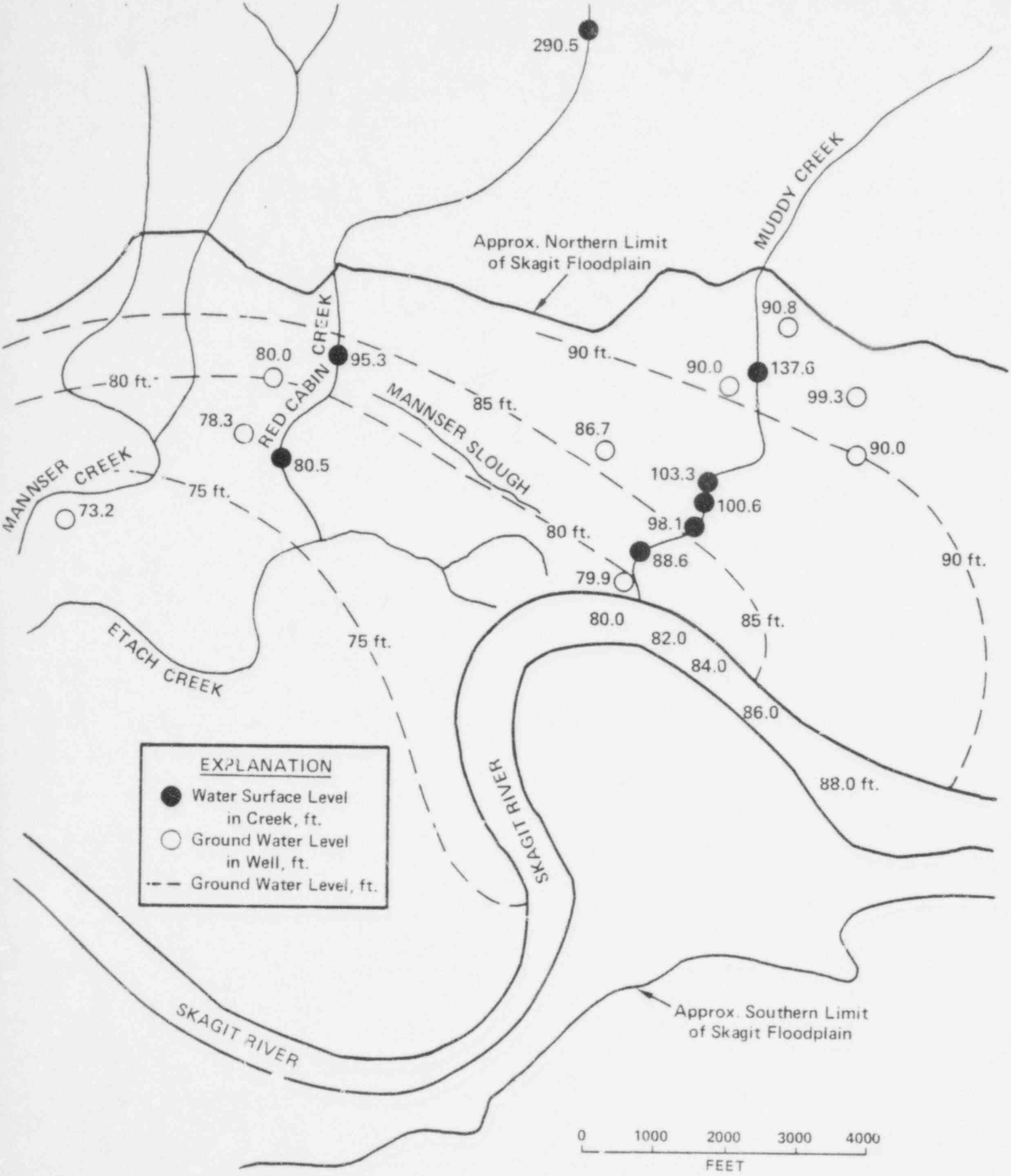

Figure 1 Surface and Groundwater at Skagit Site

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