**MEMORANDUM**

**TO:** **RIVANNA WATER & SEWER AUTHORITY BOARD OF DIRECTORS**

**FROM:** **JENNIFER A. WHITAKER, CHIEF ENGINEER**

**REVIEWED BY:** **THOMAS L. FREDERICK, EXECUTIVE DIRECTOR**

**SUBJECT:** **PRELIMINARY DESIGN FOR THE RAGGED MOUNTAIN DAM**

**DATE:** **MAY 25, 2010**

At the September 2009 Board Meeting, the Board authorized RWSA to execute a contract with Schnabel Engineers for the preliminary design of the New Ragged Mountain Dam. This contract is a re-activation, with a new engineer, of the dam design begun as part of the Community Water Supply Plan. Roller compacted concrete had initially been chosen as the material of choice for the proposed dam. This was primarily because surface appearances (large rock outcrops in numerous locations) made it seem unlikely that there would be enough suitable soil to allow for economical construction of an earthfill dam and that a shallow foundation depth was possible. Schnabel's initial Work Authorizations defining the design effort were written with this expectation.

As design progressed, it was confirmed that hauling large amounts of aggregate, sand, and cement to the site for a RCC dam would be a significant impact to Reservoir Road and to the people who routinely use it, particularly those associated with Camp Holiday Trails. For several months preceding and during construction there would be nearly constant truck traffic both ways along Reservoir Road. Recognition of this fact led to early geotechnical investigations evaluating the possibility of obtaining rock on-site to use in the concrete mix. In the initial geotechnical investigations looking for on-site shallow rock, borings were advanced on several ridges within the proposed reservoir pool just upstream of the dam location, and geophysical explorations using seismic refraction were carried out.

As these investigations proceeded, it was determined that in these ridges close to the dam site there was not sufficient rock near the ground surface to allow for low-cost removal of large quantities of stone. Instead it was discovered that the competent, relatively un-weathered rock was covered by soil materials to a substantial depth, typically around 40 feet. As this result was seen in several locations, it led to questioning the initial assumptions concerning RCC, and a detailed investigation was carried out to determine whether there is sufficient earth material with the appropriate engineering characteristics to allow for cost efficient construction of an earthfill dam. The Authority's Independent Technical Review Team (ITRT) reviewed the preliminary data and concurred that the earth embankment dam merited further investigations.

As the geologic/geotechnical investigations proceeded, a zoned earthfill dam appeared to be more and more feasible. In view of this, Schnabel was authorized to carry out a formal Alternatives

Assessment to evaluate whether an earthfill dam would be preferable to RCC. The Alternatives Assessment is now available and will soon be posted to the RWSA website. In preparing this report Schnabel evaluated estimated costs of the originally conceived RCC dam (with several cost-saving measures advocated by Schnabel). Costs for the earthfill dam at the time of the Alternatives Assessment included a number of conservative assumptions in the estimate of construction cost, since there was not yet a refined design concept to serve as a basis for a more detailed cost estimate. Even with these conservative cost assumptions, it was clear that the earthfill concept would be less expensive than RCC to construct on this site. As it was confirmed that there was merit in the earthfill approach the on-going geological/geotechnical investigations increasingly focused on the soil characteristics (and volumes) in light of their suitability for use in the dam. Schnabel has now completed their Geological/Geotechnical Report, and this will also be posted to the RWSA website.

Since the Alternatives Assessment and Geological/Geotechnical Report indicated that an earthfill dam was preferable to RCC, Schnabel's work efforts were directed to preparation of a Preliminary Design for the earthfill dam. As part of this effort a more detailed design and associated cost estimate has been prepared and is included in the Preliminary Design Report. The estimated construction cost for an earthfill dam on the Ragged Mountain Site is stated as $22,538,470 with a range of probable variance between -10% ($20,213,000) and +20% ($26,951,000). This represents a reduction of approximately $33 million compared to Schnabel's estimate of construction cost for an RCC dam on this site, and is approximately $50 million less than Gannett Fleming's construction cost estimate. As mentioned above, the earthfill option has the added benefit of reduced truck traffic along Reservoir Road. While the dam footprint will be larger, there will be a reduction in the amount of acreage needed for construction, since there is no need for extremely large materials stockpiles or for construction of a concrete batching plant to manufacture RCC.

Within the past month, both Schnabel Engineering and the ITRT have related to RWSA that the current construction market is very favorable to obtain bids less than Schnabel's estimate of construction cost, and both have encouraged RWSA to move as quickly as possible to complete design and bidding if we are interested in taking advantage of that opportunity.

Sketches showing a plan view of the dam site, plan view of grading of the overall construction site, and a typical section view of the zoned earthfill embankment are attached to this report. Schnabel's Preliminary Design for an earthfill dam will soon be posted to the RWSA website. The ITRT has reviewed the preliminary engineering report, offered feedback and review to Schnabel, and has concurred with the earthfill dam design.

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ATTACHED:

Cover Letter to Preliminary Design Report
Executive Summary in Preliminary Design Report
Dam Borrow Area Plan
Dam Sections
Dam Overall Land Disturbance