Nevada Irrigation District

Staff Report

for the Regular Meeting of the Board of Directors, April 13, 2016

TO: **Board of Directors**

FROM: **Gary King, Engineering Manager**
Doug Roderick, Senior Engineer

DATE: **April 5, 2016**

SUBJECT: **Centennial Reservoir Project –**
Phase III Geotechnical Investigation and Conceptual Design

ENGINEERING

RECOMMENDATION:
Award consulting contract to AECOM for Phase III of the Geotechnical Investigation and Conceptual Design, in the amount of $1,303,861, and authorize the General Manager to execute the necessary documents.

BACKGROUND:
AECOM has completed Phase I and Phase II of the preliminary geotechnical investigation for the Centennial Reservoir project. Phase I included a desktop study, site reconnaissance, identification/recommendation of potential dam axis alignments and borrow site(s). The recommended axis alignments (axis #2 and #6) were then used to determine where the preliminary subsurface investigation would focus. Phase II work included subsurface investigation including exploratory drilling, field sampling and laboratory testing. A final report was completed that summarize all Phase I and II information collected. In addition, the report included the feasibility, suitability, constructability and geologic risks for the potential dam axis for the 5 dam types identified.

Based on the investigation work, the two axis alignments identified require further investigation. The five dam types originally analyzed have been narrowed down to two types, the concrete faced rockfill dam (CFRD) and the roller compacted concrete dam (RCC).

AECOM staff will make a presentation of the findings/recommendations from the Phase I and II geotechnical investigation and outline the next steps for Phase III of the geotechnical investigation.

The next round of geotechnical investigation includes seismic refraction surveys, core borings and geophysical testing for both identified axis and in the borrow area. Due to

the remote locations of some of the proposed coring locations, the use of helicopters will be required and is accounted for in the costs. In addition to the geotechnical investigation, the scope of work also includes conceptual design, engineering report, alternatives analysis, construction cost estimation, construction schedule and environmental support.

The conceptual design scope of work includes concept design of dam and appurtenances, stability analysis, PMF and diversion flood routing and design criteria technical memorandum.

The costs of the multiple work items are broken down on the following table.

Geotechnical Investigation	$978,744
Conceptual Design	$108,355
Engineering Report	$33,949
Alternative Analysis	$46,930
Construction Cost Estimation and Schedule	$41,406
Environmental Support/Project Management	$94,477
Total:	$1,303,861

The Board awarded the consulting contract with AECOM for the Phase I and II work on March 25, 2015. The scope of work for this next phase is a continuation of the work already performed. It is staff's recommendation that the Board award a consulting contract with AECOM in the amount of $1,303,861.

Staff will have the final Preliminary Geotechnical Report available for public review on the project website, www.centennialreservoir.org shortly after the board meeting.

BUDGETARY IMPACT:
The contract value of $1,303,861 is currently within the 2016 budget for this project. In the 2016 budget, staff had estimated $1,600,000 for this scope of work. Overall budget for this project in 2016 is $4,500,000.

ATTACHMENTS:
- Section 9 of Preliminary Geotechnical Report – Conclusions and Recommendations

DR

9 Conclusions and Recommendations

The purpose of the Phase II study was to perform a geotechnical investigation to provide an assessment of the site conditions for the proposed dam, and to evaluate the potential dam axis locations and dam types. This final report was prepared as part of the Phase II scope of work and builds upon the draft Phase I report submitted to NID on September 30, 2015. Conceptual designs of the preferred dam types are presented. This report also includes recommendations for further dam foundation and borrow area investigations that are necessary to support the next phase of the project.

All conclusions regarding the foundation excavation and conceptual dam design in this report are preliminary and are subject to change based on the results of further studies described below.

9.1 Preferred Dam Site

Either the site at Axis 2 or Axis 6 is acceptable for either an RCC dam or CFRD. Fatal flaws were not identified at either site. The main geotechnical differences between the two sites are the extent of foundation excavation and treatment that would be required, which in turn would affect construction cost. For the same reservoir water surface elevation 1855 feet, the reservoir capacity would be about 7,000 acre-feet less for a dam at Axis 6 than further downstream at Axis 2. A dam at Axis 6 would need to be about 3 feet higher in order to offer the same reservoir storage capacity as a dam at Axis 2.

The depth of weathering and fracturing across Axis 2 is somewhat deeper than across Axis 6. The narrow ridge in the right (north) abutment of Axis 2 likely caused increased weathering and fracturing depths. The depth of highly fractured rock in the right abutment of Axis 2 is greater than for Axis 6. The hydraulic conductivities mostly decrease with depth and with decreasing fracture intensity. The exception is for right abutment borings at Axis 2, where the hydraulic conductivities do not show this trend due to the fractured nature of the rock for nearly the full drilled depths in the core borings. It is expected that the foundation grouting requirements in terms of depth and lateral extent of grouting would be similar for both dam sites, although the amount and duration of the grouting effort would probably be greater at Axis 2 due to the relatively higher hydraulic conductivity at depth.

A factor that needs to be considered for Axis 2 is the Bear River Quarry located 1700 feet south of the south end of this axis. The current quarry floor elevation of 1710 feet is lower than the proposed reservoir water surface at elevation 1855 feet. A dam at Axis 2 would likely result in increased seepage into the quarry (some groundwater is already being pumped from the quarry). If the face of this quarry advances towards the dam site, the distance to the reservoir would decrease and the potential seepage could increase. A dam at Axis 2 could require seepage control measures, such as a grout curtain beyond the left end of the dam, to mitigate seepage into the quarry.

Based on the results of the preliminary geotechnical investigation discussed in this report, we conclude that both Axis 2 and Axis 6 appear to be acceptable for dam construction. However, this conclusion is based on limited data on the foundation conditions at the two sites and should be confirmed with further investigations before selecting a preferred site.

9.2 Preferred Dam Type

Based on the investigation results presented in this report, either an RCC dam or CFRD could be constructed for the proposed Centennial Reservoir Project. Both dam types appear likely to be suitable for the site based on the observed foundation conditions. Rock materials suitable for both RCC gravity dam aggregates and a CFRD appear likely to be available within the reservoir area and/or from the nearby quarry in sufficient quantities for these dam types.

Although initial evaluations suggest that a CFRD could be less costly than an RCC dam, further investigation and a formal alternatives analysis are needed to verify this. In addition to further geotechnical investigations,

preliminary engineering studies, conceptual designs, quantity and construction cost estimates, and environmental reviews are needed.

The following are some key considerations that differentiate between an RCC dam and a CFRD:

- An RCC dam would need to be founded on slightly weathered to fresh competent rock. Sliding stability of the foundation must consider the potential presence of weak layers and discontinuities.
- The potential impacts of finding unexpected adverse foundation conditions would be greater for an RCC dam.
- Field quality control requirements would be more intense for an RCC dam than for a CFRD.
- An RCC dam would not require a separate spillway or outlet tunnel.
- Cement and fly ash import would be significantly greater for an RCC dam than for a CFRD.
- An RCC dam would have a smaller excavation footprint area than a CFRD.
- Construction of a CFRD would require a temporary cofferdam for diversion of the Bear River into an outlet/diversion tunnel.
- An RCC dam would likely be constructed more rapidly than a CFRD.
- A CFRD would be less sensitive to adverse weather conditions during construction than an RCC dam. RCC construction can be affected by rainy and hot weather conditions.
- An RCC dam would be more capable of withstanding floods during construction.

9.3 Recommendations for Design Development

Design development to assist in selecting a preferred dam site and dam type should include further geotechnical investigations. A phased investigation approach is recommended focusing on the dam site and rock borrow materials.

The next phase of geotechnical investigation should be sufficient to identify a preferred dam site and dam type, and to support development of the EIR document. The investigations should be performed in the areas of both Axes 2 and 6, and they should cover the potential dam footprint areas upstream and downstream of both of these dam axes. The investigations should include borings along the plinth alignment of a potential CFRD dam type to provide data for excavation and grout curtain design. These investigations should include seismic refraction surveys, core borings, water pressure (packer) testing, and televiewer/caliper logging. Laboratory testing should include strength of the rock foundation materials.

Borrow investigations should be carried out to confirm the nature and depth of the available rock materials. The investigation should assess the amount of overburden that would need to be stripped and wasted. These investigations should include geologic reconnaissance and mapping, seismic refraction surveys, and core borings. Laboratory testing should include strength of the rock materials, abrasion resistance, soundness and bulk specific gravity.

The CFRD and RCC dam alternatives should be evaluated at both Axes 2 and 6. A formal alternatives analysis should be carried out based on the geotechnical investigations discussed above, along with preliminary engineering studies, conceptual layouts and designs, assessment of environmental considerations and constraints, and development of construction cost and schedule estimates.

Based on the results of the above design development studies, sufficient data should be available to confirm the selection of a preferred dam site and dam type for the project.