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TO: Colorado Water Conservation Board Members

FROM: Tim Feehan, Deputy Director, Water Resource Management

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AGENDA ITEM: 31 – CWCB's 2015 Project Bill
Modern Method to Determine Probable Maximum Precipitation (PMP) Rainfall for Sizing Spillways

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Background

In 2004, the State Engineer's Office (SEO) began the development of the Extreme Precipitation Tool (EPAT). It was intended as an automated means to utilize "Site Specific Probable Maximum Precipitation" (SSPMP) methods to predict rainfall depths for use in sizing of spillways for dams in Colorado. Though SSPMP methods had been approved and used to reduce the rainfall estimates for spillway design, they proved to be excessively expensive and took up to 18 months to perform. The original intent of EPAT was to reduce the time and cost in analyzing and sizing spillways, thereby increasing the accessibility and use of EPAT to a larger number of dam owners. Reductions in rainfall estimates generally reduce the size and cost of spillways

EPAT was the first such tool of its type in the country and it advanced meteorological methods and Geographic Information System manipulations currently being used. With many new software tools, however, it was not without its flaws. One significant issue was the absence of peer review during the design and testing process. Without a peer review process and a clear understanding of how to use it, EPAT never gained wide-scale acceptance and therefore was not widely used. EPAT was also not accepted for use on FERC regulated dams in Colorado, which further reduced its use.

From 2011-2013, an EPAT evaluation study was conducted to develop a detailed operations and use manual and to conduct a 3rd party peer review. During the evaluation, however, some obvious errors were identified in the data used by the tool, and some non-standard and unaccepted methodologies were found in the meteorological manipulations. In the summer of 2013, based on consultation by SEO with experts in the meteorology field, such as Colorado's State Climatologist, United States Bureau of Reclamation, National Oceanic and Atmospheric Administration, and National Center of Atmospheric Research, it was agreed that EPAT should use more modern techniques of gridded methods, incorporating state of the practice meteorological science and site-specific storm analyses.

Discussion

From the lessons learned from the EPAT evaluation study and from input from local and regional experts, SEO is in the process of developing a new Colorado Statewide Modern Method Spillway Sizing Methods and Tools (Methods and Tools). The new Methods and Tools will be developed under an open process providing for an overall acceptance of the final product by members of the meteorological, dam engineering, and dam regulatory communities working within and outside Colorado.

Over the course of the next three years, SEO will be working with various consultants and experts in the field to develop the Methods and Tools. The end result will be an accepted product that will assist

the SEO, engineering consultants, and meteorologists in sizing spillways for dams throughout Colorado. Using state of the practice meteorological science and site-specific storm analyses will further reduce rainfall estimates for spillway design, resulting in reduced spillway size and cost. The final Methods and Tools developed by the SEO will provide significant cost savings to dam owners and allow for additional storage where achievable. Attached hereto is a summary by the SEO on the proposed Methods and Tools.

The SEO is requesting funding from CWCB in the amount of $1,200,000 over a three year period for the development of the Methods and Tools.

Staff Recommendation

Staff recommends that the Board approve this request for the General Assembly to authorize this project and appropriate $1,200,000 from the Severance Tax Trust Fund Operational Account, to the Department of Natural Resources for allocation to the CWCB for a period of three years to fund the Modern Methods to Determine PMP for Rainfall Spillway Sizing Project.

Need Statement for a Modern Method to Determine Probable Maximum Precipitation (PMP) Rainfall for Sizing Safe Spillways for Dams in Colorado

Need for Modern, Efficient Methods of Determining Extreme Rainfall

1. Due to the unacceptable consequences of failure of high and significant hazard dams, which include expected loss of human life, all practical methods of preventing such failures must be employed to provide to for on-going and future safe storage of water for beneficial uses in Colorado.
2. Overtopping of earth dams by storm flows greater than the capacity of emergency spillways is responsible for about half of all dam failures that have occurred and continue to occur.
3. State (and Federal) regulations require that spillways be constructed at high and significant hazard dams to safely pass the flows resulting from "Probable Maximum Precipitation" (PMP) rain events or some high percentage thereof. These events are also referred to as "extreme precipitation".
4. Current methods of calculating the rainfall from extreme rainfall events are based on technology that has been shown to be outdated in many parts of the country. The data used for spillway sizing in Colorado have been shown to over-estimate the rainfall that is possible, especially with increases in elevation such as in the mountainous areas.
5. Modern meteorological methods can be employed to develop tools to determine extreme rainfall for safe spillway sizing. Modern methods have the potential to reduce the likelihood of over-estimating rainfall and reduce time, money and other finite resources for safe water storage. These approaches are conservative and protective of public health and safety.
6. Surrounding states have begun employing new meteorological approaches in their dam safety programs.

Deficient Spillways

1. There are known deficient spillways on existing High and Significant hazard dams in Colorado.
2. There are dams without current spillway studies. The actual risk these dams present in respect to deficient spillways is therefore unknown.
3. Once modern methods of determining extreme rainfall are developed and adopted, the deficient spillways at High and Significant hazard dams will be targeted for improvement.

New Reservoirs and/or Enlargement/Rehabilitation of Existing Reservoirs

1. Before plans for new dams or dam enlargements or rehabilitation projects can be approved and increases in available water storage realized, determination of an acceptable spillway for safe storage must be made.
2. Current methods of determining extreme rainfall for spillway sizing likely result in over-estimation of required spillway size, resulting in unnecessary cost and expenditure of resources.

Potential Costs and Benefits

1. The average cost for 69 spillway projects performed on Colorado dams between 1995 and 2013 is $1.2 million dollars per spillway with a range from $4000 to $16 million.
2. The cost to construct 69 new spillways in the future will be more than $80 million (69 times 1.2).
3. Reducing the estimated rainfall has the potential to reduce the average cost by 15% or more. A 15% reduction in cost results in a savings of $12 million for those 69 projects.

Cost for Implementation of Modern Spillway Sizing Methods and Tools

1. Based on recent costs for the States of Arizona and Wyoming to develop statewide tools the estimated cost of the process for Colorado is $1.2 million dollars

Schedule for Implementation of Modern Spillway Sizing Methods and Tools

1. Develop scope of work, request for proposals, and conduct procurement, selection and contracting process - 6 Months (Dec 2014)
2. Tool development, including necessary project review meetings to ensure participation and acceptance of final outcomes by local, state and federal stakeholders involved in safe storage of water behind dams in Colorado - 18 months (July 2016)

Opportunities for Increasing Safety of Existing and Future dams

1. The State Engineer's Office (SEO) is responsible for safety of dams in Colorado and has worked toward developing Colorado-specific extreme rainfall prediction methods for over 30 years. As a result there is a backlog of spillway construction projects that will be needed to properly manage the risk of water storage.
2. There is a statewide need for increased storage of water in Colorado in new reservoirs or through enlargements of existing facilities. New efficient methods of determine safe spillway sizing will be integral to those projects succeeding.
3. The State of Colorado provides funding for water projects in part through the Colorado Water Conservation Board Construction Loan Fund. This funding source will be important for the implementation of the Colorado Water Plan. Modern methods for sizing spillways will allow for better use of State funding.